Natural Shocks and Risk Behavior: Experimental Evidence from Cameroon

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Abstract

Increasing occurrence of devastating natural shocks has stimulated research interest in the economics of natural disasters. Much of this scholarly work concentrates on effects of shocks on poverty, risk and vulnerability, and very little on understanding the effects of natural shocks on risk behavior. Referring to a 24 year-old disaster, we use unique survey data and experiment results from two disaster affected communities in rural Cameroon to test two hypotheses: (1) Natural shocks affect long term risk behavior; and (2) self-relocation into risk-prone areas is an explicit demonstration of risk taking. The results reveal differentiated risk behavior in self-relocated and state-resettled households, with the former taking higher risks compared to resettled households. Experiments strongly support trends observed in the empirical study, but captured cognitive behavior better than the survey. Results support previous evidence on applying experiments in understanding cognitive risk behavior and confirm our hypotheses.

Keywords: shocks, risk behavior, experiment, Cameroon
JEL: C93, D81, Q12, Q28, Q54

1 Introduction

The remarkable global escalation of natural disasters in the later part of the 20th century and the early 21st century has been frequently mentioned in the literature. The period between 1990 and 2005 alone accounted for more than half of all recorded natural disasters, causing global economic losses more than seven fold greater than observed during the 1960s (UNDP, 2008; VAN DEN BERG et al., 2009; ISDR, 2010). Impacts have been different for developed and developing countries. MUNICH RE (2006) for instance reports significant effects of natural disasters on developing country economies, leading to losses above 13% of the gross domestic product (GDP),

compared to less than 3% of GDP in industrialized countries between 1985 and 1999. Africa accounted for over 60% of the total victims (killed and affected) of natural disasters in 2005 (ISDR, 2010). This partly explains the World Bank's global increase in post-disaster construction lending between 1980 and 2000 of over 7.5 billion USD (GILBERT and KREIMER, 1999). Clearly, natural shocks result in income or consumption volatility, with devastating and sometimes irreversible effects especially on the poor (GÜNTHER and HARTTGEN, 2009).

Though the anthropogenic influence and magnitude of climate change and its effects on natural disasters remain largely unknown, trends point towards an increasing occurrence. In the 20th century for example, sea level rose between 10 and 20cm. By 2100, global temperatures are expected to increase in the range of 1.4 to 5.8^{o}C increasing seasonal and inter-annual variability: suitable conditions for increased frequency of extreme events (NICHOLLS and HOOZEMANS, 1999; NICHOLLS, 2002; MECHLER, 2004; TOMPKINS, 2005).

Yet, sustainable economic development depends on the socio-cultural morphology, political stability and decorum. Economic growth and ecosystem stability are thus threatened by future natural disasters. The role of disasters in hampering the smooth evolution of the development process is eminent.

Higher impacts of disasters in developing compared to developed countries are related to a couple of reasons. First, natural hazards in many developing countries occur under deficient structural and institutional conditions. Failing hierarchical and market institutions defect effective management of natural shocks to evade disasters. Second, disaster management through public transfers is beyond the fiscal capacity of most governments (HOLZMANN and JORGENSEN, 2000). Third, most governments are generally deficient in scientific and socioeconomic data needed for effective risk prevention, reduction, mitigation or coping. Fourth, the dynamic responses of informal instruments to hazards active in most African countries have not been well researched (BALGAH and BUCHENRIEDER, 2010 forthcoming). Information asymmetry thus contributes to posing natural hazards as a serious threat to development especially in developing countries (BENSON and CLAY, 2004). As such, early warning systems, disaster monitoring and preparedness as well as knowledge of local processes and shock dynamics are generally deficient in developing countries, particularly in African countries.

Of particular interest to this paper is the long term effect of natural shocks on risk behavior of victims. By inflicting unprecedented losses and promoting risk exposure, natural shocks can implant fear and worry, stimulate demographic changes and even political conflicts within victimized communities. These factors influence short and

long term risk choices (LINDELL and PRATER, 2003; CUTCHIN et al., 2008). Risk choices directly impact livelihoods, income and asset portfolio, result in psychological disequilibrium, and indirectly inhibit the speed of recovery (VAN DEN BERG et al., 2009). Understanding and explaining the effects of natural shocks on risk behavior is therefore critical in the economics of natural disasters. Studies that test the effects of natural shocks on risk behavior of victims are extremely limited; with one contemporary exception (VAN DEN BERG et al., 2009). This paper intends to contribute to this literature.

This paper proceeds as follows. Section 2 briefly reviews the literature on natural shocks and risk behavior, while section 3 presents the problem background and research area. Section 4 discusses the applied methodology and section 5 presents the key results. Section 6 concludes.

2 Natural Shocks and Risk Behavior: A Concise Review of Literature

Natural shocks, that are sudden, unexpected or unpredictable responses from nature, continue to affect the livelihoods of millions of people around the world, with stronger negative impacts in developing countries. Disaster-vulnerable households in developing countries are exposed not only to natural hazards but also to other sources of risks like commodity price fluctuations, poorly functioning input or output markets, sudden changes in price and non-price policies, changing social relationships, unstable governments and armed conflicts. All of these risks cause losses in household welfare (ALWANG and SIEGEL, 1999). Shocks therefore affect household decision-making processes and risk behavior.

Risk behavior to natural shocks is influenced by the degree of institutional, financial and material support received from hierarchical, market and nonprofit institutions (YAMAUCHI et al., 2009). As an illustration, victims who are regularly supported by state and nonprofits might be initially more risk-averse than in the contrary situation. As livelihoods return to normal, households are more likely to invest in high risk, high return ventures. When such support is missing and survival is critical, long term risks are likely to be overridden by private ex-ante actions to the benefit of short term survival, irrespective of current accompanying risk. For example, disaster victims might self-relocate to prohibited risk-prone areas to meet current livelihood needs when public or external assistance is missing or inappropriate.[1] Future risks (with

[1] The term self-relocation is used in this paper to describe a household's decision to return to the disaster area without legal permission. This must be differentiated from the term resettlement, which denotes legal displacement of disaster victims to safer locations. In this paper, relocation will be used to describe illegal movements, while resettlement will denote the officially-supported displacement.

uncertain predictability) are discounted higherthan the need for current survival. When theodicy for example is socially important, religiously-inclined relocating households may "believe that only God [would] save them from any disastrous event [in the far future]" (BANG, 2008: 14).

The theoretical risk literature analyzes risk behavior based on the utility theory of intertemporal decision making, with a clear distinction between economic and psychological approaches. While for example, economists frequently use quantitative data and econometric models based on exponential discounting to assess objective risk behavior (e.g. BAR-SHIRA et al., 1999; COHEN and EINAV, 2007; DOSS et al., 2008), the psychological literature applies hyperbolic discounting to predict actual subjective, cognitive risk behavior (EPSTEIN, 1994; BYRNES et al., 1999). Exponential discounting assumes a linear, constant discount rate, and therefore a straight choice pattern for agents over time. Hyperbolic discount functions rather analyze and describe the actual choices over time, with or without uncertainty (CARDENAS and CARPENTER, 2008).

In both theoretical frameworks, utility, irrespective of how it is construed, is an accepted explanatory construct for explaining risk behavior. But risk behavior, that is risk taking, risk neutrality, or risk aversion is an outcome of agents' weighted appraisal of economic, political, and socio-cognitive interactions (EPSTEIN, 1994; VAN DEN BERG et al., 2009). Household intertemporal decisions are based on differential discounting rates assigned to specific gains at different points in time. These decisions are influenced by factors such as life expectancy, past experiences with, trust in, and received support from formal and informal structures and institutions, current risk exposure and future expectations. Delayed outcomes are discounted higher than current constellations. Consequently, a high hyperbolic discounting rate renders unpredictable outcomes more satisfying, particularly under formal institutional failure (MADDEN et al., 2007; CARDENAS and CARPENTER, 2008). Relating this theory to our hypotheses testing, self-relocation into disaster prone areas might be the understood as the outcome of a more complex (hyperbolic) discounting process. This discounting process by the victims is strongly influenced by the failure of the state and market institutions to provide acceptable shock management mechanisms..

Integrating economic and psychological approaches can better explain risk behavior. This advantage has been recognized and is increasingly applied by behavioral economists (e.g. BINSWANGER, 1980; CAMERER and HOGARTH, 1999; DONKERS et al., 2001; WIK et al., 2004; DOHMEN et al., 2005; FELLNER and MACIEJOVSKY, 2007; CARDENAS and CARPENTER, 2008; VAN DEN BERG et al., 2009). BINSWANGER (1980) for instance combines standard interviews and experimental gambling to measure risk attitude in rural India. He concludes that interviews are subject to bias and their results are inconsistent with the experimental measures of risk aversion. Similar results have

been reported VAN DEN BERG et al. (2009) for natural hazard-prone Nicaragua and Peru. They conclude that whereas experiments provide reasonable estimates for risk aversion, the hypothetical questions result in an unrealistic distribution of preferences. Comprehensive reviews on empirical applications on risk experiments are provided for example by CAMERER and HOGARTH (1999) and CARDENAS and CARPENTER (2008).

Differential predictive capacities of both approaches are evident. But the power of experiments in predicting risk behavior dominates. FELLNER and MACIEJOVSKY (2007) confirm this in their experiment on risk attitude in asset markets. Using binary lottery choices to illicit market behavior, they show that choices are systematically correlated with risk behavior, with high degree of risk aversion correlated to lower market activity. We follow the example of BINSWANGER (1980) and VAN DEN BERG et al. (2009) by combining strategic risk-related questions in a structured survey and risk experiments. BINSWANGER (1980) is the first and most cited example of risk experiments performed in a developing country while VAN DEN BERG et al. (2009) is the only contemporary empirical application to natural shocks known to the authors. Frequent reference will also be made to FISHER (1930) due to its theoretical relevance for understanding and explaining risk behavior under uncertainty.

As will be illustrated, this combination is methodologically more rewarding for explaining self-relocation of natural disaster victims as a strategic risk behavior under uncertainty. The term self-relocation describes the voluntary movement of people back to their ancestral land with or without legal permission and resettlement captions the initial state-initiated movement from risk-prone areas into save havens.

3 Background of the Problem and the Research Area

Cameroon's geological setting and tectonic history makes her one of the most exposed countries to rapid onset natural shocks in Africa. The frequent geophysical and hydro-meteorological hazards along the Cameroon Volcanic Line (CVL) seriously affect livelihood assets especially of the poor in the country (BANG, 2008).

On August 21st 1986, a natural gas explosion from Lake Nyos in north-west region of Cameroon emitted carbon dioxide and minimal amounts of hydrogen sulphide asphyxiating over 1,700 inhabitants and almost all livestock in three villages (Nyos, Cha, Subum) located within a diameter of over 25 kilometers around the Lake. Later scientific investigations revealed that Lake Nyos contains a huge amount of carbon dioxide (300 million cubic meters) in the deeper layers, with threats of further release in the future. While the scientific community was busy analyzing the cause of this natural shock, a high level conference on the Lake Nyos disaster held in Yaoundé, Cameroon, in March 1987 proposed that surviving victims should be resettled

immediately (SIGVALDSON, 1989). By the end of 1987, the first government-led resettlement had been effected in Buabua and Kimbi villages. Most households moved in the same year. The rest followed in 1988.

The shock-affected villages were declared disaster areas by the government and moving back was legally prohibited. With the objective to reduce risks and enhance safer rehabilitation, the government and foreign partners embarked on a degassing project in 1995. One full-fledged degassing column was installed and primed at Nyos in 2001. Five columns are, however, needed to completely rule out the possibility of another lemnitic eruption (HALBWACHS et al., 2004). Living around Nyos today is safer. The regular presence of military troops around the Lake and the installation of an early warning alarm system indicate current government efforts towards disaster risk reduction.

Important for this discussion is the self-relocation of numerous households back into the disaster zone in the last decade in spite of government restriction. BANG (2008) suggests that a major motive for self-relocation is the deficiency of official post-shock management to jointly address physical, structural and social risk mitigation. This conjecture is supported by a recent assessment report of the Lake Nyos dam that concludes with a possible "breach of the natural dam within the coming ten years, and a high likelihood within five years" (UNEP/OCHA, 2005: 4).

Since resettlement ended, government support has been mostly limited to sporadic dish-outs on yearly commemorative events (ETAKA, 2007) or during political campaigns. Increased illegal relocation towards the risk source can be attributed to state failure. As part of a comprehensive socioeconomic analysis of surviving Lake Nyos disaster victims, we attempt to explain this natural experiment by comparing risk attitudes for self-relocated and state-resettled households in Subum (self-relocation) and Buabua (state-resettlement) villages, respectively. Subum is located some 8 km from the source of risk, Lake Nyos, and another 8 km from Buabua. Buabua lies 5 km diagonally on the safe side of the Lake.

4 Methodology

Unique primary socioeconomic data were collected using a structured survey and risk experiments. Because the literacy rate in the research villages (37%) was far below the national average of 68% (UNICEF, 2010), we decided to keep the risk aversion game simple. Hypothetical questions on risk behavior were included in the structured survey, and the risk experiments were scheduled on agreed dates, about two months after the initial survey.

A census of all self-relocated and state-resettled households was done during the survey. Data was collected from 100% of all former disaster-affected returnee households to Subum in the disaster zone and from over 85% of all households in the resettlement village. A total of 106 (38 self-relocated and 68 state-resettled) households were surveyed. Only members from these households participated in the experiments.

The key experiment involved making a choice between two lottery games. Game A was a lottery with a 50% chance of winning any amount, up to a maximum of about three times the local daily wage. Game B foresaw a constant but smaller win. We opted for experimental games with no real pay-offs for a number of reasons. First, our objective was to understand and explain a naturally occurring experiment: self-relocation into disaster-prone areas. Financial gains could distort true risk behavior. Secondly, immediate financial gain is not the sole factor influencing risk behavior for surviving disaster victims. In this particular case study of a 24 year old natural shock, the critical coping phase is long expired. It is safe to assume that current poverty and future livelihood sustainability are more important for decision-making. Relocating or not is the outcome of complex processes of hyperbolic discounting influenced by both economic and psychological variables. Risk behavior is thus contingent on past shock experience, current exposure and discounted future risks. The interesting dynamics in our case study should not be contaminated with real pay-offs. Thirdly including real pay-offs would have warranted the inclusion of time-variant variables, further complicating the experiments, "reminding non-student participants of the exams that [probably] caused them to leave school as soon as possible" (CARDENAS and CARPENTER, 2008: 329). Past experiences (e.g. CARPENTER et al., 2005) have shown that numeracy correlates highly with participant behavior especially when the experiments are complex. We opted not to apply a highly numeric game.

At the start of the game, visualization was used to illustrate and explain the game to participants. Players were asked to choose between two games: the risk taking game (A) with a 50-50 chance of winning or loosing, but with the possibility in case of luck to win up to 5,000 FCFA (10 USD), about three times the local daily wage; and the risk aversion game (B) with a constant but smaller win. Participants were encouraged to play the game seriously as if it was in a real life situation.

A total of five iterations were played and players made their choice whether to play Game A or B at the beginning of each iteration. Possible wins for Game A were randomly drawn from a bundle of lots prepared a priori by the researchers with 50% wins and 50% losses. The minimum win was equivalent to the hypothetical ticket cost of a game ticket: 25 FCFA (5 USD cents) while a loss was a zero. Only players who had chosen the risk taking Game A were allowed to draw a lot, and only one lot could

be drawn per game. At the end of each game, the wins were completely recorded for all participants before the next game was played. Illiterate players were helped by other players and the researchers in the recording process. Jubilant or nonjubilant winners announced their wins after each game, but this was not obligatory. The pay-off of the constant win Game B was set at three times the hypothetical cost of a ticket (25 FCFA or 5 USD cents) for the fist game and increased to four times in the second game, six times in the third game, eight times in the fourth game and nine times in the fifth game. Please note that with Game B, losses are not possible, however, those who take the risk and play Game A can win more than a risk-averse player in all five game iterations if they get lucky once.

Each player had one sheet of paper with recording tables for the five game repetitions. It is assumed that as constant payments for Game B increase, Game A will look less attractive to a more risk-averse player who may switch from Game A to B. The pay-off from Game B at which a player switches reveals the player's certainty equivalent to the gamble represented by Game A (VAN DEN BERG et al., 2009). At the same time, as people win in the risky Game A, more gamblers may switch to try their luck. Risk takers with hidden, cognitive risk aversion traits may switch to the constant win Game B after loosing in the first risky Game A. Thus, of particular interest for analysis will be the switching dynamics, especially after the first game cycle. The highest winners were promised a special (undisclosed) gift from the researchers.[2] All players were compensated by a sumptuous lunch. We assumed a priori that self-relocated households are higher risk takers than resettled counterparts, thus playing more often Game A. This should be reflected in the survey questions, but above all in the experiments. This assumption is based on the hypothesis that self-relocation is an explicit demonstration of risk taking.

5 Results

In section 5.1, socioeconomic characteristics of the surveyed households are presented, before proceeding to the experimental results for the two household types in section 5.2.

5.1 Socioeconomic Characteristics of Households

About 80% of all households in the research region are survivors or descendants of survivors of the tragic 1986 Lake Nyos gas disaster. As mentioned before, the literacy rate is far below the natural average. However, a significantly higher literacy rate

[2] The number one winner received exercise books and pens for his children.

(54%) is observed in the resettlement as compared to relocation (34%). This suggests that self-relocated households take refuge under subsistence agriculture, given the difficulties of accessing the labor market. Our explorative statistics confirms this conjecture: 85% of household heads in the resettlement are employed in agriculture, compared to almost 95% in the relocation. 94% of resettled households live in government-constructed houses, while returned households constructed their houses themselves. This clearly indicates state social responsibility. Directly contradicts BANG'S (2008) conjecture on strongly deficient government intervention in the social aspects of disaster management. However, we found out that 94% of all houses in the state-resettlement village (Buabua) are either seriously dilapidated or needing major repairs, even if 100% of the houses were permanent structures. Comparatively, only 35% of houses in the relocating area were in such bad shape. Thus, having invested in the own house construction seems, not surprisingly, to provide the motivation for regular maintenance. To further illustrate, almost 88% of all permanent houses in the resettlement constructed with solid walls and plastered with cement in 1987 have remained with dusty floors, although household heads confirm house ownership. Government support seems to have induced dependency amongst resettled former disaster victims. We therefore expect these households to be adamant to relocation, considering the expected household investment that accompanies self-relocation. State-resettled households should be more risk-averse, or in the best scenario show mixed risk attitudes based on their experience from the natural shock of 1986.

Table 1, which presents the variance of means for self-relocated and state-resettled households, complements the socioeconomic characteristics described above. An analysis of wealth variables such as per capita expenditure on clothing and footwear, per capita household assets and net cash balance in the household at the time of interview reveal that relocated households are significantly wealthier than stationary households. While contradicting the finding of BINSWANGER (1980) in rural India and the scholarly work of FISHER (1930), our results support the conclusions of VAN DEN BERG et al. (2009) from Peru. Wealth is inversely related with risk aversion. Relocated households, by moving back into the hazard zone take higher risks than victims who remain in the resettlement. Interestingly, relocated households also witnessed significantly higher losses in the 1986 disaster, compared to the matching households in the resettlement village. For example the number of human lives lost per capita to the 1986 disaster by returned households is about 300% higher than for the resettled households. The significantly higher values of livestock loss reported by returned households indicate risk taking abilities prior to the disaster.

Important socioeconomic variables worth discussing are the land size and agricultural expenses per capita, considering that the major capital asset for rural households in developing countries after labor is land (ELLIS, 1993; 2000). BINSWANGER (1980) for

example found that 69% of physical wealth for rural Indian households was held in the form of land. Because household labor is mostly used in subsistence agriculture, risk-taking households are more likely to move into areas where land is abundant and fertile, and minimal financial capital investments can yield higher returns. This logically explains the higher per capita number of plots and higher agricultural expenses for returned compared to resettled households. Because agricultural investment itself is a risky business, returnees by investing more in agriculture are higher risk takers than nonreturnees.

Table 1. Variance of means of selected socioeconomic characteristics of resettled and relocating households

Variable	Household Type	Mean	Std. Dev.	Significance level
Per capita expenditures on clothing and footwear (FCFA)	State-resettled	15140	8250	***
	Self-relocated	24165	12160	
Per capita household assets (FCFA)	State-resettled	44290	1.17258E5	NS
	Self-relocated	52110	1.05079E5	
Number of plots owned per capita	State-resettled	0.4	0.4	***
	Self-relocated	1.2	1.3	
Per capita net cash balance at the time of interview (FCFA)	State-resettled	8515	11640	*
	Self-relocated	19785	54050	
Total number of human lives lost to the lake Nyos disaster	State-resettled	8	12	***
	Self-relocated	25	26	
Value of livestock assets lost to Nyos disaster per capita (FCFA)	State-resettled	28850	51190	***
	Self-relocated	37175	6.65353E5	
Per capita annual agricultural expenses (FCFA)	State-resettled	5725	5175	**
	Self-relocated	15055	35190	
Number of rooms per capita	State-resettled	0.7	0.5	*
	Self-relocated	1	1	
Household size	State-resettled	9	4.9	***
	Self-relocated	5	4.5	

Notes: Mean currency values have been rounded to the next whole currency number
*** indicates 1% significance level; ** 5%; * 10%, and NS means not significant statistically significant
N= 106 (Resettled: 68; Relocated: 38)

Source: own survey data

The significantly higher household size for nonreturnees justifies their high risk aversion behavior. Because self-relocation is the outcome of decision making at household level, such decisions are logically more difficult to arrive at in larger households. Also, relocation into a risk-prone environment places more people at risk for larger households. Crucially, relocation entails investments in the recipient village (for example in constructing a new house). Because nonreturnees are poorer, risk-averse behavior is a rational behavior. Additionally their losses to the 1986 disaster might be quantitatively small, but proportionately large in terms of percentage of total assets owned, compared to the returning households with higher losses. It would be somewhat illusionary to imagine that these resettled, risk-averse households would want to witness such an event again. Thus, the suggestion of VAN DEN BERG et al. (2009) from their Nicaraguan example that past experience has a significant effect on risk aversion is evident in our case study. However, contrary to their findings, it is rather the wealthier and highest hit households who are risk takers.

5.2 Descriptive Statistics on Risk Behavior Based on Survey Questionnaire

In this section, descriptive statistics from the hypothetical risk questions included in the questionnaire will be discussed. Table 2 presents the results of current household willingness to return to the disaster region under present conditions of uncertainty. Over 64% of households in the resettlement village confirmed their risk aversion behavior, by clearly refuting to return to the disaster zone under uncertainty. All returned households confirmed their self-relocation decision under uncertainty. This was expected as they already live in this risk-prone region. When the question was posed on the willingness to relocate under less risky conditions (table 3), the dynamics amongst resettled disaster victims changed significantly. About 70% would be willing to relocate under safer conditions, while almost 30% are not willing to relocate, even if the conditions were improved.

Table 2. Household willingness to relocate to disaster area under risky conditions

Village type	Household is willing to return under present (risky) conditions …				
	No (%)	Not decided (%)	Yes (%)	P	Likelihood ratio
State-resettled	64.1	1.6	34.3	0.000	0.000
Self-relocated	0	0	100.0		

Source: own survey data

The willingness to return to the former disaster zone was motivated mainly by the rich livelihoods resources in the recipient village Subum (80% of all responses) and cultural motives (17%). Those who were not ready to relocate at all valued better livelihood facilities (such as clean drinking water and acceptable housing) in the resettlement village Buabua (55%) and access to supportive resources from nature, government and non-governmental organizations (19%). The remainder (26%) did not want to return because they felt that the ancestral land is cursed (by the massive deaths in 1986), or because relocation will refresh the horrors of the 1986 natural shock. This psychological behavior is an outcome of the natural shock, and supports our hypothesis that natural shocks affect risk behavior. It also supports the view in the psychological literature that emotion-related processes guide cognitive, psychodynamic behavior (EPSTEIN, 1994). The natural shock of 1986 left behind fear and anger. These psychological variables have culminated in risk-averse choices for fearful resettled households, and risk-seeking by optimistic, angry, returnees (LERNER and KELTNER, 2001).

Table 3. Willingness to relocate if disaster area was rendered less risky

Village type	Household would return under less risky conditions …			
	No (%)	Yes (%)	P	Likelihood ratio
State-resettlement	29.8	70.2	0.000	0.000
Self-relocation	0	100.0		

Source: own survey data

Table 4 presents the results of the hypothetical questions on the willingness to pay for a lottery ticket with different winning possibilities. Before posing this question, the respondents were asked a preceding question to assess their current involvement in gambling games. While no one had been involved in a gambling game for the past year in the resettlement, four out of the 38 households (10.5%) reported some involvement. This difference was found to be statistically significant at the 10% level. Stronger and clearer tendencies, howeve,r emerged when households were asked about their willingness to pay for a lottery ticket with the possibility of winning about 100 USD; 2,000 USD and 4,000 USD, respectively.

Table 4. Hypothetical willingness to pay for lottery tickets

Possible win	Payment categories	Resettled (%)	Relocated	P	Likelihood ratio
Up to 100 USD (50,000 FCFA)	0 FCFA	83.8	41.7	.002	.001
	> 0 FCFA	16.2	58.3		
Up to 2000 USD (1,000,000 FCFA)	0 FCFA	83.8	41.7	.001	.000
	> 0 FCFA	16.2	58.3		
Up to 4,000 USD (2,000,000 FCFA)	0 FCFA	83.8	41.7	.003	.002
	> 0 FCFA	16.2	58.3		

Note: 1 USD is exchanged for approximately 500 FCFA
Source: own survey data

At all levels, slightly above 16% of all resettled households compared to about 58% of self-relocated households were willing to risk money in gambling. While these results confirm the risk-averse nature of nonreturnees as previously examined, it provides additional evidence that wealthier households are more likely to take risks. This contradicts FISHER'S (1930) reversed hypothesis, and BINSWANGER'S (1980) conclusion on the neutrality of wealth to risk-averse behavior in rural India. It however supports the findings of VAN DEN BERG et al. (2009) and FELLNER and MACIEJOVSKY (2007) of an inverse relation between wealth and risk aversion.

5.3 Results from Risk Experiments

As mentioned earlier, the risk experiment was restrictive, and players had only two choices: take a risk (Game A) or be risk-averse (Game B). This is appropriate for the phenomenon we set out to understand and explain with the risk experiment. Table 5 presents the results of the first two games which for our analysis will be sufficient. The first choice approximates the player's absolute risk behavior, while the choice in the second game that can be influenced by the results of the first game cycle and reflects partial risk behavior. For example, whether risk takers win or loose in the first game might partially influence risk averse players to switch games (known as the reference group effect), irrespective of their initial choices. As shown in table 5, there was an almost 50-50 choice split amongst players from the resettlement in the first game cycle for Games A and B, while a significantly higher percentage of returnees (over 94%) opted for the risky Game A. This percentage remained constant for relocated players in the second game iteration, despite wins and losses. This is because coincidentally, an identical number of players (four from each side) switched from Game A to B and vice

versa. On the contrary, wins from the first risky choice game in the first iteration moved the number of players opting for the risky game during the second iteration up from less than 50% to almost 70% in the resettlement sample. Table 6 presents these results.

The results in tables 5 and 6 demonstrate stronger cognitive risk aversion behavior amongst the players in the resettlement. Although more people opted for the risk choice in the second game, it is interpreted as a demonstration of risk aversion under influence, because their decision was to a large extent contingent on the wins of the risk takers in the first game.

Table 5. Choice of first two games in the risk experiment

Game number	Choice	State-resettled (%)	Self-relocated (%)	P	Likelihood ratio
1	Risk averse	48.8	5.7	.001	.003
	Risky	51.2	94.3		
2	Risk averse	30.2	5.7	.000	.000
	Risky	69.8	94.3		

Source: own survey data

Table 6. Switching dynamics of players after the first experimental game

Village type	Switches		X^2	Likelihood
	Number of persons	% of all players		
State-resettlement	12/43	27.9	.008	.007
Self-relocation	8/53	7.5		

Source: own survey data

In line with other findings (e.g. BINSWANGER, 1980; VAN DEN BERG et al., 2009), the experimental results demonstrate a more realistic distribution of risk preference compared to the hypothetical survey questions, although patterns from the hypothetical questions were maintained in the survey. However, our results suggest complementarity of hypothetical questions and choice experiments in understanding risk behavior under uncertainty as a consequence of natural shocks, rather than the substitutability of the former with the latter as suggested for example by VAN DEN BERG et al. (2009).

6 Discussions and Policy Implications

The rapid upsurge of natural shocks is increasingly creating both economic and psychological impacts on victims worldwide. These impacts are higher in developing countries where budget and institutional constraints lead to state failure, and the absence or dysfunctioning of risk markets. In the meantime, victims adapt (informal) strategies to cope with the aftermaths of the covariate as well as idiosyncratic shocks. Using unlawful self-relocation into the disaster zone in the lake Nyos region of Cameroon is such an example. We analyzed this behavior by combining survey and experimental data to test the hypotheses that (1) natural shocks affect risk behavior and, (2) self-relocation is an explicit demonstration of risk taking. We used hypothetical questions on household involvement in gambling games, the willingness to pay for lottery tickets, and the decision to return to the disaster zone under risky and less risky conditions to assess the effects of the 24 year old shock on current risk behavior.

Our results show that the natural shock has differentiated effects on risk behavior, with self-relocated households demonstrating higher risk taking abilities at all levels than their counterparts in the resettlement. While anger stimulates optimistic, relocating household, to hyperbolically attribute higher discount rates to the future than the present, fear cordons pessimistic resettled household to be more risk-averse. These trends are similar in both hypothetical questions and the risk experiments. However, in line with previous findings, experiments tended to detect subjective, cognitive risk preferences better than survey questions. However, because trends were the same, we suggest complementarity rather than substitutability as suggested by some behavioral economists. A key finding from the differentiated socioeconomic analysis was that wealth is positively correlated with risk taking. This contradicts inter-alia the inverse relationship suggested by BINSWANGER (1980) from his Indian case study, or FISHER'S (1930) theory of interest that predicted higher risk taking amongst poorer than richer households.

It was also found that the failure of state and market institutions for risk management, and delay in enforcement of contracts has led to impatience. One generation has past since the disaster stroke, and victims have been kept permanently on call. The marginal preference for current over deferred enjoyment leads to a high valuation of the present and an undervaluation of the future. Delayed hierarchical interventions are transforming impatience into forceful relocation into the disaster prone areas. But the impatience is clearly differentiated. While highest-hit households are the first to return, less hit, risk-averse households prefer to enjoy the remnants of the social amenities such as drinking water and dilapidating houses provided by the state as its contribution to reducing social vulnerability. However, once the risk is significantly reduced, more

households (and definitely not all) will be willing to officially relocate into the former disaster villages.

Our results suggest a number of implications for policy. First relocation is a contemplated state policy to be (hopefully) implemented in the next two years (LOH, 2010). We suggest that participatory policy implementation should be carried out, to allow victims to make the choice of relocating or not. If the commonly state-driven trickle down approach is implemented, then failures similar to those of the late 1980s are likely to result. People might relocate for the sake of benefiting from the policy, and later eye sores (such as the dilapidating houses) will be the outcome. Our case study has revealed that self-relocated households were highest hit by the 1986 disaster. Although relocation is illegal, it is an explicit demonstration of risk taking and an implicit outcome hyperbolic discounting strongly influenced by state and market failure. Thus rather than punishing early returnees by excluding them from benefiting from an official relocation program, they should, by virtue of the value of loss from the disaster, and their demonstrated risk-taking abilities be the first targets of policy.

Secondly, relocation will continue to occur with or without legal authorization. As the population in the resettlement increases, resources will become scarcer, and memories of the disaster will disappear in the new generation. Under such conditions, more people are likely to relocate into their formal ancestral land. It is therefore of interest for policy makers to continue with the efforts underway on physical risk reduction, but at the same time to increase efforts in the social domain.

Thirdly, in the absence of state and market institutions, informal institutions have emerged with differentiated potentials to support victims manage risks and shocks. If policy has to succeed, it must identify and include potential, vibrant local institutions such as local risk management institutions within a comprehensive policy package. This may require further research to identify local institutions and their potentials for inclusion in a long term risk management strategy.

Meanwhile economists and psychologists researching on natural shocks need to continuously test and validate the dual model of risk behavior proposed in this paper, rather than substituting one for the other as frequently suggested and implemented at the moment. As a suggestion, policy makers in Cameroon for example should extend this model to other resettlement and affected villages to better understand risk behavior prior to policy implementation. Otherwise, the policy objective of satisfactory relocation may remain illusive, and devolving meager state resources may produce less than optimal results.

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