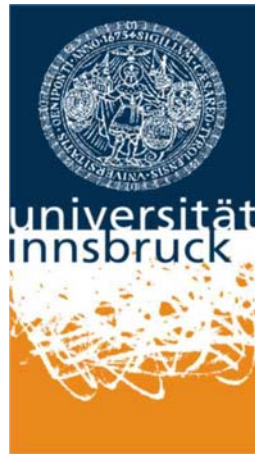University of Innsbruck

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Uncertainty of Governmental Relief and the Crowding out of Insurance

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Abstract

This paper discusses the problem of crowding out of insurance by co-existing governmental relief programs - so-called 'charity hazard' - in a context of different institutional schemes of government relief in Austria and Germany. We test empirically whether an assured partial relief scheme (as in Austria) drives a stronger crowding out of private insurance than a scheme promising full relief which is subject to ad hoc political decision making (as in Germany). Our general finding is that the institutional design of governmental relief programs significantly affects the demand for private natural hazard insurance.

Keywords: Insurance demand, governmental relief, natural hazards

JEL classification: D78, D81, G22, Q54

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1   Introduction

In many European countries we find schemes of ad hoc governmental relief for the recovery of losses from natural hazards in co-existence with market-based natural hazard insurance. Basic rational choice theory tells us that both schemes are substitutes from the standpoint of the recipient so that a crowding out of private insurance can be expected. This effect has been called 'charity hazard' in the literature (Browne & Hoyt 2000). The empirical proof of 'charity hazard' has been difficult though. In several studies of low insurance density, co-existing governmental relief programs are not showing a significant demand decreasing impact. This divergence between theoretical predictions and empirical findings leads us to expect that some important variables for insurance demand and governmental relief so far have been omitted. One missing variable, particularly addressed in this paper, are the institutional features or the 'design' of governmental relief programs. Often these programs do not coincide with the basic promise to help people in need. Rather they are ad hoc, depending on political circumstances such as election years (Garrett & Sobel 2003). In addition, they are incomplete, thus only providing a small share of the actual damage. Uncertain and incomplete governmental relief programs could therefore co-exist with private insurance without a crowding out effect to be observed. This is the guiding hypothesis in this paper. We empirically test the hypothesis that an assured partial relief scheme (as we find in Austria) drives a stronger crowding out of private insurance, or 'charity hazard', than an uncertain scheme of full relief that we find in Germany. Our overall finding is that the design of governmental relief programs significantly impacts private substitute markets if aid from these programs can be relied upon ex ante.

The paper is organized as follows: In the next section we provide a literature review followed by an institutional analysis of the Austrian catastrophe fund and the German ad hoc system of governmental relief in section 3. Our theoretical model is explained

in section 4. Data, estimation method and results are presented in section 5. Section 6 concludes.

2   Survey of Literature

Governmental financial assistance to the victims of natural hazards is a common feature in Europe and the United States (e.g. Stripple 1998, Schwarze & Wagner 2004, Pretten-thaler, Hyll & Vetters 2004, Kunreuther 2006, Michel-Kerjan & Kousky 2010). While clearly needed by victims of mega events (such as the current Haiti earthquake), this type of ad hoc intervention is heavily criticized as a potential cause for crowding out of private demand for natural hazard insurance (Raschky & Weck-Hannemann 2007). The problem of 'charity hazard' (Browne & Hoyt 2000) emerges when individuals underinsure or do not insure at all against certain losses because of expected governmental aid and/or private charity. For simplicity reasons this paper focuses solely on governmental aid as a source for 'charity hazard'. Basically charity hazard is just a special case of the moral hazard problem. Browne & Hoyt (2000) define charity hazard as "[. . .] the tendency of individuals not to insure themselves against possible natural disasters because they believe help will be available, e.g. from friends, family, the municipality, charities or state emergency programs." (p. 293) If individuals rely on external assistance private charity and governmental financial relief can be considered a premium-free insurance against natural disasters. The purchase of costly private insurance cover is therefore expected to be discouraged. The low demand for natural disaster insurance also affects the supply-side of the market, the insurance companies. Some of the providers retreat from the market because it is unprofitable to offer insurance cover against natural hazards. The remaining providers have to increase the premiums in order to cover costs. This leads to an even lower supply at higher prices - a vicious cycle that has been called 'disaster syndrome' (Kunreuther & Pauly 2004, Schwarze & Wagner 2004). In this situation fewer and fewer individuals tend to insure against the risks from natural disasters and rely on governmen-

tal aid in the case of emergency. Factual examples for governmental relief programs are the European Union's solidarity fund, the disaster assistance programs in several states in the USA (e.g. California Disaster Assistance Act) or the Austrian catastrophe fund (Katastrophenfonds).

It is perfectly rational behavior not to obtain insurance cover against potential losses, when one can expect financial support from the government in the case of natural disasters (Coate 1995). Private insurance cover inflicts costs (search costs and premiums) while the support from the government is available for free. The paradox of the situation is that people often have no actual legal entitlement for any financial relief by the government. This suggests that the sheer existence of governmental relief funds, past personal experience and/or media reports of past catastrophes and governmental aid seems to feed the individuals' belief that the government will provide financial catastrophe assistance as if they were insured. Prettenthaler et al. (2004) further argue that the societal legitimization to rely solely on governmental relief might result from the idea and/or belief that (a) in general individuals cannot be made responsible for natural catastrophes and their effects, (b) the government has to restore social and economic order after an event and (c) the low number of insured properties are not a fault of the victims, but also of the government as it did not assure the proper supply of natural catastrophe insurances and protective measures in general. In addition to this societal beliefs, an institutionalization of governmental aid by politicians and the administration might even further enforce the individuals' anticipation for financial assistance from the government. Such an institutionalization can have various characteristics:

1. The creation of a catastrophe fund that not only provides financial relief for one specific event, but is also a persistent institution that grants financial assistance for disaster losses throughout the year.

2. The governmental aid has some sort of formalization and/or legal foundations such as specific laws. These can be laws that explicitly define the financial sources of the

governmental relief and the way how the financial assistance is distributed among the victims in the case of a natural catastrophe.

3. The governmental relief is administrated by a special bureaucratic entity.

4. Even if there is no particular agency, office or person responsible for governmental relief, the existence of guidelines that inform the individuals about how and where to obtain governmental aid or specific application forms for financial assistance might enforce the belief in relief by the government.

This institutionalization can support the peoples' anticipation of public charity and further impede insurance attempts and thus the diffusion of natural hazard insurances.[1]

Theoretical Background

Governmental assistance after a natural disaster basically reduces the individuals' liability for the financial damages and therefore sets incentives to underinsure or not insure at all. Various authors have developed formal models derived from expected utility theory that analyze these incentive structures and its effects on individual insurance behavior. Lewis & Nickerson (1989) and Kaplow (1991) were among the first translating the idea that people underinsure, because of expected governmental assistance into a formal model. In a related paper Buchanan (1975) showed even earlier that the government is unable to decline financial assistance for the poor and termed this situation Samaritan's Dilemma. Based on this assumption, Coate (1995) created a model in which the amount of public transfers depends on the degree of the potential victim's insurance coverage. Arvan & Nickerson (2000) and Arvan & Nickerson (2006) analyzed the incentive structure in a game between potential victims and a social planner who is responsible for public assistance. Similar to the work by Coate (1995) and Lewis & Nickerson (1989) they argue that it is rational for individuals to underinsure given expected governmental assistance.

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[1]Kunreuther (2006) argued that although studies revealed that individuals do not anticipate governmental assistance, the broad media coverage on disaster assistance following hurricane Katrina could change public views on this subject.

Their explanation for this behavior, however, differs from earlier papers as they endogenized governmental compensation. An individual's purchase of insurance coverage creates negative externalities by reducing the uncovered part not only of the individual's wealth, but also of the uncovered property of all individuals at risk and therefore the fraction eligible for governmental compensation. Underinsurance is a Nash-equilibrium among all potential victims. Charity hazard can thus be explained through such an equilibrium rather than the Samaritan's Dilemma. Kelly & Kleffner (2003) developed a theoretical framework analyzing the demand for insurance and mitigation measures if individuals can expect governmental disaster relief. The numerical simulation shows that governmental aid decreases the amount spent on insurance as well as mitigation measures. Kim & Schlesinger (2005) introduced government guaranteed subsistence levels to a model of insurance market with adverse selection. Governmental assistance can alter the set of separating-equilibrium contracts. Depending on the level of relief, high-risk individuals might fully insure whereby low-risk individuals might have incentives to rely on governmental aid.

Empirical findings

The problem of charity hazard and its effects on individual insurance behavior seem pretty straightforward and convincing at least from a theoretical perspective. However, when it comes to empirical evidence for this issue, only few empirical studies have analyzed the effect of governmental relief on disaster-insurance[2]. A study by Kunreuther, Ginsberg, Miller, Slovic, Borkan & Katz (1978) revealed that the majority of homeowners in hazard prone areas do not anticipate federal financial disaster relief. The empirical results by Browne & Hoyt (2000) oppose the idea of charity hazard. Their findings even suggest a significant positive correlation between the amount of governmental disaster relief and the demand for flood insurance in the USA. They argue that the exposure to

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[2]An empirical study by Botzen, Aerts & van den Bergh (2009) finds that federal post-disaster compensation can crowd out the incentive to mitigate damages via self-protection (e.g. sandbags, water resistant floors).

flood risk might increase both the purchases of flood insurance and the amount of governmental aid received. Asseldonk, Meuwissen & Huirne (2002) measured the demand for a hypothetical public-private crop insurance scheme by interviewing 305 crop producers in the Netherlands with the contingent-valuation method. The producer's belief in potential governmental disaster assistance had a significant negative impact on the likelihood to participate in the insurance program. Brunette, Cabantous, Couture & Stengar (2008) conducted a laboratory experiment where the effect of governmental compensation schemes[3] with a fixed amount of relief on participant's willingness-to-pay for disaster insurance was analyzed. They find a crowding out effect on insurance demand. However, there was no uncertainty related to the amount and likelihood of compensation. The purpose of that experiment to test the effect of 'stylized programs used in the theoretical literature' rather than 'real life governmental assistance programs'.

This short overview on studies indicates that it is difficult to support the theoretical arguments for charity hazard with empirical evidence. First, there are only few empirical studies that have dealt with this subject. Second, the main focus of these studies was on other topics related to natural hazard insurance and incorporated governmental disaster relief only as an additional control variable. Third, the results are contradicting and the majority of studies actually reject the idea of charity hazard. This divergence between theoretical predictions and empirical findings is the starting point of this paper. We believe that some important variables for insurance demand and government relief so far have been neglected. One missing variable, particularly addressed in this paper, is the institutional design of governmental relief programs.

3   Institutional analysis

In Austria and Germany two different forms of institutions for governmental flood relief can be observed. While in Austria the supply of flood insurance is supplemented by a

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[3]the treatments varied between, fixed relief, relief conditional on insurance and subsidized premiums

tax based catastrophe fund, Germany's risk transfer is characterized by a pure market solution with additional governmental ad hoc assistance. The two varying degrees of institutionalization might signal different levels of ex-post security for potential insurance holders and hence impact their demand for insurance respectively (e.g. Coate 1995). The system promising the higher possibility of a governmental bail out is likely to be more prone to the adverse effect of charity hazard by offering an increased incentive for a reduction of insurance demand.

The Austrian catastrophe fund

The Austrian catastrophe fund act including floods and other natural hazards was established in 1966 after severe flood events occurred in 1965 and 1966 in order to provide financial support for victims of natural hazards. To assure the financing of the fund, a markup was levied on the income tax, capital yields tax and corporate income tax which generates fluctuating takings dependent on the economic situation. Until 1996 high amounts of reserves were built due to the absence of severe natural hazard events. In order to allow for the fungibility of these reserves a statue of its own was implemented several times. For this reason a new catastrophe fund act which limits the reserves to a maximum of 29 million Euros was established in 1996. In cases of extreme catastrophes additional means were provided by the government. For example, the government allocated an additional amount of 500 million Euros and 251 million Euros for the flood events in 2002 and 2005, respectively, whereby the relief in 2002 was to some extent financed by delaying a planned tax reduction. [4]

Since the tax based catastrophe fund is in fact a form of enforced solidarity the financing of the catastrophe fund can be interpreted as a quasi compulsory insurance. However, as opposed to insurance contracts the taxpayer does not have any legal rights to a risk transfer in case of damage. For this reason the ex-post transfer is not to be considered as

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[4]Moreover, Austria received 134 million Euro (2002) and 14.8 million Euro (2005) from the European Union's Solidarity Fund.

indemnification payment but rather as relief. Once a flood event occurs, the person concerned has to apply for governmental relief. Since the ultimate authority for all decisions concerning the catastrophe fund rests on the respective Federal States with each state using its own directives, varying levels of governmental relief can be observed for comparable cases across Federal States (Prettenthaler & Vetters 2005). To be more precise, directives for the permission of governmental relief do not exist in Tyrol to this date. The commission calculates for each case individually the level of governmental relief based on the amount of damage, the financial circumstances, the financial burden before the flood event and special burdens within the family. Insurance payments which the household received are sub ducted. The compensation normally ranges between 20% and 30% of the present value; in exceptional cases up to 80% (or even 100%) might be approved. The Federal government carries 60% of this burden whereas the remaining 40% are paid by the Federal State. Therefore, despite the lack of legal entitlement for governmental relief, the Austrian catastrophe fund in its role as a well known persistent institution might induce people to assume to receive relief; however the level of compensation remains insecure.

The German ad-hoc system of governmental relief

In contrast to Austria, governmental disaster assistance is not institutionalized in Germany but rather approved discretionary. Garrett & Sobel (2003) suggest that governmental assistance following a natural hazard event is highly politically motivated. To be more precise, their results show that the rate of disaster declaration and the allocation of disaster relief in the US by the FEMA are driven by presidential and congressional considerations rather than by the need of people concerned. Consequently higher levels of politicians' generosity are to be expected in election years, since the re-election is at stake. Anecdotal evidence from Germany further supports these findings: After severe floods hit communities along the rivers Elbe and Danube in Germany in 2002, chancellor Gerhard Schroeder who was running for re-election not only won the election by promising a governmental emergency assistance amounting to 400 million Euros but also

by visiting flooded areas and speaking to the people concerned. The federal relief was partly financed by a delay of a planned tax cut. The low degree of institutionalization does not affirm people in Germany to expect governmental disaster assistance unless the flood event happens to interact with an election year. However, if that coincidence takes places, the claimant might expect to receive a high level of compensation resulting from the pledge of the politician.

The two forms of governmental relief in Austria and Germany induce different degrees of uncertainty regarding ex post financial assistance. We exploit this difference for a comparative institutional analysis in order to investigate which design of the relief system has a larger crowding out effect on private insurance demand. In other words: Does the Austrian catastrophe fund offering a high probability but a low level of coverage crowd out the demand for flood insurance more than the German ad hoc system with a low probability but high level of coverage?

4 Charity hazard and the optimal insurance demand

We commence our examination with a theoretical analysis of the effect of uncertainty in governmental relief on insurance demand. The basic model of optimal insurance demand which is based on the contributions of Mossin (1968) and Smith (1968) assumes a competitive insurance market with fair premiums, a symmetric distribution of information as well as risk averse and rational individuals.

In this model it is assumed that an individual has an initial wealth of W_0 and is confronted with two states of wealth: a situation with no disaster event $W_1 = W_0$ and a situation with an occurrence of a disaster loss L, so that $W_2 = W_0 - L$. Disaster losses happen with a probability of π. There exists an insurance market which offers coverage $I = \alpha \cdot L$ at fair premiums P, where α defines the degree of insurance coverage, which can range from $\alpha = 0$ for no insurance coverage to $\alpha = 1$ for full insurance coverage. Premiums are called fair as they reflect expected payments $P = \pi \cdot I$. With the opportunity to purchase

insurance coverage, wealth in the no-loss situation becomes $W_1 = W_o - P$ and wealth in the loss situation $W_2 = W_0 - P - L_{net}$ where L_{net} defines the difference between disaster loss and insurance coverage. The expected utility for any $\alpha \geq 0$ is given by

$$EU_{ins} = \pi u(W_0) + (1 - \pi)u(W_0 - P).$$

As shown by Mossin (1968) $\alpha = 1$ is always the optimal choice for risk averse, rational individuals as long as premiums are fair. Risk averse, rational individuals always try to eliminate their risk and to equalize their wealth in both states by shifting wealth from state 1 to state 2. If premiums are fair, individuals are maximizing their expected utility by totally eliminating their risk.

4.1 Guaranteed but partial public compensation

In line with Kim & Schlesinger (2005), let us assume that government provides partial relief S for losses caused by natural disasters, which are guaranteed and well known by all individuals. The amount of relief S is given by

$$
\begin{aligned}
S &= S_{set} - W_2 \quad &&\text{for } W_2 \leq S_{set} \text{ and} \\
S &= 0 \quad &&\text{for } W_2 > S_{set} .
\end{aligned}
$$

S_{set} is the social standard of wealth in case a disaster occurs and is influenced by political considerations. S_{set} guarantees that no one has to live below this level of social welfare. If disaster losses decrease individual wealth below this social welfare standard, public compensation S will guarantee wealth amounting to S_{set}. Public compensation S will only be paid to households when personal wealth in state 2 is lower than the social welfare standard ($W_2 \leq S_{set}$). Typically social standard can range between zero and a full recovery of initial wealth. Therefore S_{set} can be written as $S_{set} = \sigma W_0$, where σ can range between 0 and 1. If $\sigma = 0$ governmental relief will be zero. If $\sigma = 1$ than S_{set} is equal to W_0 so that the government will recover each personal initial wealth.

As it is the case in Austria public reliefs are guaranteed but do not recover people's initial wealth completely, so that $0 < \sigma < 1$. A guaranteed full public coverage of disaster losses would completely crowd out private insurance demand as it would be rational for any individual to consume coverage for free rather than to pay premiums for it.[5] However, the question of our concern is: What impact does a guaranteed partial public coverage have on private insurance? Does partial public coverage also eliminate incentives for private insurance or does there exist a level of σ without any crowding out effect on private insurance?

The choice either to insure or to rely on public relief depends on the corresponding benefits. There is a critical level of S_{set}^* where expected utility in a situation with public partial relief equals expected utility with insurance coverage. As mentioned above, if individuals decide to insure the optimal choice is full coverage with $\alpha = 1$. If they decide to rely on public relief, it's rational not to insure ($\alpha = 0$).[6] Therefore the critical level of S_{set}^* is determined by

$$EU_{ins} = EU_{pub}$$

$$u(W_0 - \pi L) = \pi u(S_{set}^*) + (1 - \pi)u(W_0).$$

The equation solved for S_{set}^* is

$$S_{set}^* = u^{-1}\frac{u(W_0 - \pi L) - (1 - \pi)u(W_0)}{\pi}.$$

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[5]Expected utility for full insurance coverage becomes $EU_{ins} = \pi u(W_0) + (1 - \pi)u(W_0 - P)$ whereas expected utility for costless and full public coverage is $EU_{pub} = u(W_0)$. It is obvious that $EU_{pub} > EU_{ins}$ regardless of the degree of personal risk aversion. This means that there is no reason for rational individuals to purchase any insurance coverage.

[6]A rational decision can only be a choice between full insurance coverage or no insurance coverage and public compensation. If individuals decide to rely on public coverage their wealth in state 2 will be determined by S_{set}. Any partial insurance coverage that would lead to a wealth W_2 below social standard S_{set} would not be rational as social standard S_{set} could be reached for free. Any partial insurance coverage that would lead to wealth W_2 higher than social standard S_{set} wouldn't be rational either as full private insurance coverage with $\alpha = 1$ would be the optimal choice for risk averse, rational individuals anyway.

Apparently a crowding out effect of private insurance depends on the level of public relief coverage offered by the government. If $S_{set} > S_{set}^*$, people do not insure anymore and private insurance is totaly crowded out. Whereas if $S_{set} < S_{set}^*$ people insure completely against disaster losses and don't rely on public compensation.

4.2 Guaranteed but random public compensation

As it is the case in Germany there is no established relief fund for disaster losses or any other reliable public transfer system for disaster risks. But as Germany is - by constitution - a welfare state, the state is expected to be an insurer of last resort. This means that there will be public relief after a disaster as far as it is legitimized by social welfare concerns. However, the level of public compensation is unknown ex ante and varies over time.

Assume that people cannot rely on a guaranteed level of public compensation S_{set}. Let therefore S_{set} be a random variable $\check{S}_{set}$. People build their expectations on the level of public relief $E(u(\check{S}_{set}))$. Compared to the situation before, when S_{set} was guaranteed and the level of compensation was fixed and well known, the level now is insecure and will therefore reduce utility for risk averse individuals. If the expected value of the random compensation level $E(\check{S}_{set})$ is equal to the expected value of fixed compensation level $E(S_{set})$, the following inequation must hold for risk averse individuals:

$$u(E(S_{set})) = u(E(\check{S}_{set})) > E(u(\check{S}_{set})).$$

In line with the definition for risk averse behavior this equation expresses risk averse individuals benefit more from any secure level of S_{set} than from an insecure level $\check{S}_{set}$ provided that the expected value in both cases is the same. For instance, people have a lower utility in case of an insecure compensation level with an expected value equal to S_{set}^*, $E(\check{S}_{set}) = S_{set}^*$, so that $u(S_{set}^*) > E(u(\check{S}_{set}))$. In this case people are not indifferent between insurance and public compensation and will therefore buy insurance. No crowding out takes place at any insecure level of public compensation that on average is S_{set}^*. Hence,

people are indifferent between insurance and public compensation if the average level of random compensation $E(\check{S}_{set})$ is higher than S_{set}^{*}. Furthermore it follows, that a higher variance of $\check{S}_{set}$, or in other words, a more insecure $\check{S}_{set}$ leads to smaller crowding out of insurance demand and therefore to a smaller charity hazard effect.

The theoretical considerations implicate two results: First, in any design of governmental relief program there will be a critical level of public compensation. Beyond this critical level public compensation will significantly impact private substitute markets negativly. Second, this critical level decreases for a governmental relief program with secure and reliable compensations in comparison to a relief scheme with insecure and variable public compensations. That is to say in a reliable relief design less public compensation will lead to a crowding out of private insurance demand than in an unrelaible one. As public relief in Austria could be considered as reliable and secure, it is reasonable to assume that crowding out of private insurance demand is more probable than in Germany where public compensation is less secure and unreliable. Hence under ceteris paribus conditions the charity hazard effect should yield a lower insurance demand in Austria than in Germany.[7]

5 Empirical analysis

5.1 Data

Our analysis on charity hazard is based on data collected in 2006 in the Austrian region of Tyrol and the German region Upper-Bavaria. A randomized sample was drawn from among the population in municipalities affected by the 2005 floods. Telephone-interviews were conducted to ask individuals about their personal experience with the 2005 flood, their WTP and general interest in disaster insurance. The survey in Tyrol contained 218 households, 72 of which were affected by the heavy rain event of 2005. The 147 households which suffered no damage in 2005 form a control group in the following analysis. The

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[7]If we take into account the literature about ambiguity we can find even more support for the theoretical findings above. Einhorn & Hogarth (1986) and Hogarth & Kunreuther (1989) showed that individuals are ambiguity averse (e.g. individuals have higher WTP for insurance in ambiguous situations).

results from Upper Bavaria are based on a survey conducted in the context of the MEDIS project in collaboration with the German Institute for Economic Research (DIW) Berlin and the German Research Centre for Geosciences Potsdam (GFZ). In this case the survey contained 305 households, all of which were affected. Although the surveys in Austria and Germany were conducted by two different survey companies, the wording of the key questions were identical. In fact, the survey in Tyrol was designed much as an international comparative questionnaire to the MEDIS (MEDIS 2008) project's survey.

Dependent variable:

The dependent variable is the respondent's answer to the following open-ended valuation question: "How much are you willing to pay for a full insurance coverage against natural hazards?". This type of question of course bares the risk of strategic answering from the respondent. The hypothetical private good at question (e.g. NATCAT insurance for the respondent's property) is basically an (imperfect) substitute for an existing publicly provided good (e.g. governmental disaster relief). In addition, protest responses[8] as a result of dissension regarding some aspects of the study (e.g. the interviewee perceives unfairness to pay for insurance after he has suffered severe losses from a recent flood) or the refusal to provide an answer due to some other circumstances (e.g. the traumatic experiences from the flood event cause an answer refusal) can threat the validity of the contingent valuation studies. We deleted all observations that refused to give an answer to the WTP-question, including those where the "don't know"-option was chosen.

Independent variables:

The questionnaire further provides information about property owner's disaster damage to both housing and furniture during the 2005 flood events. The interviewees were also asked to reveal their perception of flood risks for their property. In addition, the respondent's

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[8]For a detailed discussion of the problem of protest responses in contingent valuation studies see Jorgensen, Syme, Bishop & Nancarrow (1999).

should indicate if they consider flood relief a governmental task or not. A number of socio-economic characteristics (e.g. income, household size, sex) were also collected as additional control variables. After removing all observations that had missing values for the dependent or the explanatory variables the final dataset consists of 223 observations. Each questionnaire also included information on the country where the interview was taken. Table 1 provides the summary statistics.

[TABLE 1 ABOUT HERE]

5.2 Estimation method

In order to identify the determinants of the individual WTP for NATCAT insurance we regress the reported WTP on a number of explanatory variables. A closer look at the distribution of the dependent variable, reveals that a considerable fraction of respondents have a zero WTP while the rest have a positive WTP. Econometric analysis of data with such distributional features requires the application of alternatives to standard estimation methods. Ordinary-least-squares (OLS)-estimator does not account for the censored character of the sample and the resulting parameter estimates are both biased and inconsistent (Maddala 1983). In the case of a censored dependent variable Amemiya (1984) suggests two types of Tobit models (Type 1 and 2). The Type 1 model is the standard Tobit approach with left-censoring at zero. Type 2 models are a family of two-part models, encompassing a standard two-part model and a sample-selection model. Type 2 models would be the preferable if the WTP-question in our questionnaire was set-up as a pair of questions. For example: The first question is "Would you be willing to buy NATCAT-insurance?". If this question is answered with "yes" then the follow-up question would be the actual WTP question "What is your maximum WTP for a NATCAT-insurance policy?". However, our questionnaire included only one open-ended question for the WTP. The dependent variable is clearly censored at zero because of the design of the payment question. Zero values in our sample can consist of: First, true zeros, for people that live in

areas that are not exposed to natural hazards. Second, protest respondents that answer zero for strategic purposes (e.g. sending a signal to policy-makers that they prefer the publicly provided federal relief to the private good "NATCAT insurance"). Third, protest respondents that actually have a negative WTP and want in fact send an even stronger strategic signal but are limited to the boundaries of the payment vehicle. Therefore, the Type 1 Tobit model is the natural choice for our purposes. Although the standard Tobit model assumes a normal distribution, WTP data is often better modeled as log-normal. The log-normal model for equation (...) can be formulated as followed:

$$y_i^* = \exp\left(\mathbf{x}_i'\boldsymbol{\beta} + \epsilon_i\right) \tag{1}$$

Where $\mathbf{x}$ is a vector of exogenous regressors, $\boldsymbol{\beta}$, a vector of parameters to be estimated and ϵ is the error term with $(\epsilon_i \sim \text{iid}\ (0, \sigma_\epsilon^2))$. Instead of the latent variable y^*, y_i is observed which is related to y_i^* as followed:

$$y_i = \begin{cases} y_i^* & if \quad \ln\left(y_i^*\right) > 0, \\ 0 & if \quad \ln\left(y_i^*\right) \leq 0 \end{cases} \tag{2}$$

The notion $y_i = 0$ if $y_i^* \leq 0$ shows that some of the WTP values are not truly observed if $y_i^* \leq 0$. In the log-normal model, the expected value of y is then given by

$$E(y_i|\mathbf{x}) = \exp\left(\mathbf{x}_i'\boldsymbol{\beta} + \frac{\sigma^2}{2}\right)\left\{1 - \Phi\left(\frac{0 - \mathbf{x}_i'\boldsymbol{\beta} - \sigma^2}{\sigma}\right)\right\} \tag{3}$$

Although Tobit estimates deliver consistent and unbiased results in the case of censored data, the method is based on two distributional assumptions for the error term: normality and homoskedasticity. Non-normality is a particular problem and causes the Tobit estimates to be inconsistent. To diagnose the validity of this assumption we apply an parametric bootstrap version (Drukker 2002) of the conditional moment test proposed by Skeels & Vella (1999).

If the test rejects the null of normality we have to apply an alternative to the Tobit model. Powell (1986) proposed a symmetrically censored least squares (SCLS) estimator that is consistent for an non-normal and heteroskedastic error. This estimator has already been applied to analyze the determinants of WTP by Kwak, Lee & Russell (1997). The SCLS estimator overcomes the non-normality by 'artificially' restoring the symmetry of the error term via a symmetric trimming process. The initial censoring causes the dependent variable to be asymmetrically distributed since the lower tail is censored at 0 while the upper tail is 'piled up' at a censoring point g, with g equal to the natural log of the maximum WTP in our sample (Chay & Powell 2001). The basic idea is to restore symmetry by recensoring the uncensored observations in the upper tail of the distribution. The error term of the censored regression model has the form $\epsilon_i^* = \max\{\epsilon_i - \mathbf{x}_i'\boldsymbol{\beta}\}$. The symmetric censoring process has the following decision rule:

$$
\epsilon_i^* = \begin{cases} \min\{\epsilon_i^*, \mathbf{x}_i'\boldsymbol{\beta}\} & if \quad \mathbf{x}_i'\boldsymbol{\beta} > 0, \\ . & \text{otherwise} \end{cases}
\tag{4}
$$

In a similar fashion the dependent variable, y_i will be replaced with $\min\{y_i, 2\mathbf{x}_i'\boldsymbol{\beta}\}$. See appendix for a more detailed explanation of the SCLS estimator.

5.3   Results

Table 2 presents the results of our Tobit-estimates. Model 1 is the baseline regression, indicating that higher income, a larger household and the individual assessment of the flood exposure have a signifcant positive effect on the WTP for NATCAT insurance. This is in line with previous findings in the literature (e.g. Browne & Hoyt 2000, Kunreuther et al. 1978, Michel-Kerjan & Kousky 2010). The amount of experienced flood damage, sex and the control dummy for the August 2005 flood do not appear to have a strong significant effect on the WTP. Importantly, the average WTP of interviewees in Austria is lower than in Germany. Model 2 introduces the governmental task dummy. The dummy is negative and highly significant, therefore confirming the general predictions of

the charity hazard model. In the next step, we look at the effect of individual experience with governmental relief payments on the WTP (Model 3). The coefficient is positive and significant at the 10 %-level. The coefficient of the governmental task variable stays positive and significant and it's size decreases only slightly. Model 4 adds an interaction term between the governmental task variable and the country-dummy to the specification. The purpose is to test the key propositions of our theoretical model regarding the effect of different degrees of certainty of public relief. The interaction term between governmental task and Austria is our empirical proxy for governmnetal relief in an instituional environment, where compensation is guaranteed but partial. The reference group contains the observations where compensation is random (e.g. Germany). The estimated coefficient of the interaction term has a negative sign and is significant at least at the 10%-level. These results indicate that, *ceteris paribus*, the crowding out effect is larger in an institutional environment where the probability of governmental relief is higher (e.g. Austria).

[TABLE 2 ABOUT HERE]

The conditional moment tests, however, clearly reject the null of normality for all 4 specifications. The failure of the normality assumption yield our Tobit estimates to be inconsistent. We therefore repeat the regressions using the SCLS estimator (Table 3). All results are robust and the sign of the coefficients stay the same. An increase in the significance of both the governmental task variable as well as the interaction term is a sign for the strong support of our theoretical model.

[TABLE 3 ABOUT HERE]

6 Conclusion

Can governmental disaster relief programs co-exist with market-based private insurance against natural hazards? Basic rational choice theory tells us that both schemes are substitutes from the standpoint of recipients so that a crowding out of natural hazard

insurance will occur, which has also been termed 'charity hazard'. A closer look reveals that the crowding out effect on private insurance depends on the level of public relief coverage and the certainty with which it is offered by the government. The lower the level of disaster relief and the more uncertain it is, the lesser is the danger of crowding out of private insurance.

There are many ways of creating recipient expectations on the level of govermental relief and its certainty. One way is to restrict the coverage within governmental programs to a pre-defined level, say a rate of 50-percent of actual damages or an amount fixed below average damages. Another way is to subject aid to the discretionarity of public officials and politicians on an ad hoc basis. Neither approach is convincing on a normative political-economic basis, yet both can explain why we find co-exsiting schemes of private natural hazard insurance and government relief programmes in practice in many European countries and throughout the world. It can also explain why co-existing governmental relief programs are not showing the expected signifcant demand decreasing effect in the several empirical studies. One missing variable in these studies are the institutional features or the 'design' of governmental relief programs as they are addressed in this paper. Based on a comparative willingness-to-pay study for natural hazard insurance in Germany and Austria we are able to show that an assured partial relief scheme (as in Austria) drives a stronger crowding out of private insurance than an uncertain scheme of full relief (as in Germany). Overall we find that the design of governmental relief programs significantly impacts private substitute markets.

There is a strong call for public-private-partnership programs of risk transfer in a 'new era of catastrophes' (Kunreuther & Michel-Kerjan 2009). There has been a considerable increase in the economic and insured damages caused by natural hazards over the past thirty years (MunichRe GeoRisk 2007). This trend is likely driven by human-impacted climate change as well as a growing accumulation of wealth in hazard-prone areas (Intergovernmental Panel on Climate Change (IPCC) 2007). Strenghening the role of private insurers and incentivising strategies for the mitigation of risk are important

challenges in the face of these developments. To avoid disincentives to mitigate (moral hazard) and disincentives to insure (charity hazard) we need institutional designs that allow for a combined public and private involvement. This challenge is far from being resolved, despite important world-wide efforts to develop 'systemic' approaches for natural hazard risk transfer under (e.g. the Munich Climate Insurance Initiative). Our paper is a first step to study the interplay of private insurance and public relief programs in a framework of existing institutions of natural hazard risk transfer. It needs to be complemented by studies which address this issue from a normative legal and economic perspective as outlined (e.g. Faure 2006, Nell & Richter 2005). Other lines of future research would be to compare these findings from natural hazard insurance to general social insurance programs where private and public institutions also co-exist.

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Table 1: Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
WTP	223	44.772	61.643	0	500
Income	223	2044.318	795.981	500	3000
Damage Flood	223	17711.200	51522.410	0	420000
Perception of flood risk	223	3.800	1.941	1	6
Female	223	0.541	0.499	0	1
Austria	223	0.291	0.455	0	1
Government Task	223	0.218	0.414	0	1

Table 2: Determinants of WTP for NATCAT-insurance - Tobit

	Model 1	Model 2	Model 3	Model 4
ln(Income)	0.660**	0.737***	0.743***	0.762***
	(0.286)	(0.275)	(0.273)	(0.270)
Household size	0.383**	0.318*	0.323*	0.337**
	(0.173)	(0.166)	(0.167)	(0.163)
ln(Damage)	0.041	0.033	0.018	0.015
	(0.031)	(0.029)	(0.031)	(0.031)
Female	0.104	0.008	−0.018	0.002
	(0.239)	(0.224)	(0.220)	(0.219)
Perception of	0.201***	0.170**	0.172***	0.172***
Flood Risk	(0.070)	(0.066)	(0.065)	(0.065)
Flood August	−0.143	−0.205	−0.315	−0.386
	(0.251)	(0.239)	(0.256)	(0.255)
Austria	−0.969**	−0.936**	−0.955***	−0.703*
	(0.373)	(0.360)	(0.354)	(0.366)
Government Task		−1.429***	−1.397***	−0.990***
		(0.324)	(0.321)	(0.372)
Relief			0.495*	0.594**
Experience			(0.297)	(0.291)
Austria ×				−1.246*
Government Task				(0.728)
Constant	−3.722*	−3.607*	−3.606*	−3.809*
	(2.227)	(2.117)	(2.105)	(2.082)
F-Stat	0.000	0.000	0.000	0.000
R^{2a}	0.229	0.311	0.317	0.330
CM-Test^b	88.826***	27.416***	28.153***	40.542***
N	223	223	223	223

Notes: Coefficients reported. Dependent variable is Ln(WTP). [a]Cox-Snell R^2. [b] Conditional moment test for non-normality based on Skeels & Vella (1999). The null is that the underlying disturbances are normally distributed. The test statistics developed by Drukker (2002) is applied. ***, **, * indicate significance at the 1, 5 and 10%, respectively.

Table 3: Determinants of WTP for NATCAT-insurance - SCLS

	Model 1	Model 2	Model 3	Model 4
ln(Income)	0.746***	0.498**	0.483**	0.651***
	(0.216)	(0.202)	(0.192)	(0.219)
Household size	0.346**	0.323**	0.330**	0.352***
	(0.147)	(0.146)	(0.139)	(0.135)
ln(Damage)	0.035	−0.015	0.042*	−0.019
	(0.025)	(0.021)	(0.025)	(0.024)
Female	0.189	0.031	0.103	−0.160
	(0.190)	(0.174)	(0.191)	(0.192)
Perception of	0.160***	0.154***	0.051	0.186***
Flood Risk	(0.055)	(0.055)	(0.060)	(0.057)
Flood August	−0.402*	−0.339*	−0.358	−0.338
	(0.218)	(0.178)	(0.217)	(0.214)
Austria	−0.738***	−0.620**	−0.798***	−0.494*
	(0.256)	(0.255)	(0.302)	(0.283)
Government Task		−1.264***	−1.174***	−0.645**
		(0.219)	(0.215)	(0.273)
Relief			0.663**	0.370
Experience			(0.291)	(0.303)
Austria ×				−1.640***
Government Task				(0.494)
Constant	−4.008**	−1.403	−1.485	−2.752
	(1.597)	(1.454)	(1.407)	(1.698)
N	223	223	223	223

Notes: Coefficients reported. Dependent variable is ln(WTP). Bootstrapped standard errors in parenthesis (No. of bootstrap replications: 200). ***, **, * indicate significance at the 1, 5 and 10%, respectively.

A Appendix

Description of Variables

Variable	Exp. Sign	Description
Income	+	Respondent's net income.
Household size	+	Number of people in the respondent's household
Damage Flood in tsd.	+/-	Damage to respondent's property caused by the 2005 floods
Flood August in tsd.	+/-	Dummy=1 if respondent was affect by the flood in August 2005, 0 if respondent was affected by other flood event in 2005
Perception of flood risk	+	Respondent's assessment of flood exposure; 1=low, 6=high.
Relief Experience	+/-	Dummy=1 if respondent received some federal flood relief; 0 otherwise.
Austria	-	Dummy=1 if interview was conducted in Austria; 0 Germany.
Government Task	-	Dummy=1 if respondent considers flood relief a governmental task; 0 otherwise.

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Paul A. Raschky, Reimund Schwarze, Manijeh Schwindt and Ferdinand Zahn

Uncertainty of Governmental Relief and the Crowding out of Insurance

Abstract

This paper discusses the problem of crowding out of insurance by co-existing governmental relief programs - so-called 'charity hazard' - in a context of different institutional schemes of government relief in Austria and Germany. We test empirically whether an assured partial relief scheme (as in Austria) drives a stronger crowding out of private insurance than a scheme promising full relief which is subject to ad hoc political decision making (as in Germany). Our general finding is that the institutional design of governmental relief programs significantly affects the demand for private natural hazard insurance.