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Assessing the benefits of organized voluntary emergency services

Concepts and evidence from flood protection in Austria

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Abstract

Purpose – The purpose of this paper is to reveal the benefits of organized voluntary emergency services (OVES) in the case of flood events, since such information is mostly not available, but needed to analyze the total effects of disasters and respective responses. Moreover, the efficient allocation of scarce public resources for emergency and risk management should be based on empirical data.
Design/methodology/approach – Based on a qualitative framework describing the benefits of OVES, the authors develop different tools for monetizing tangible as well as intangible benefits and apply them for case studies in Austria.
Findings – The benefits of volunteer efforts for emergency management cannot be monetized easily, since they are often of intangible character. Nevertheless, we show that the benefits of OVES could be substantial.
Research limitations/implications – As the authors analyze case studies, the results cannot be directly transferred to other regions, but illustrate the empirical dimension of the benefits of OVES. Further research should be undertaken to assess the benefits of avoided losses by OVES using single-object data.
Practical implications – Since many emergency service institutions are involved during/after natural hazards, data availability and exchange should be improved. Objective decisions for investment in emergency services should be based on data of recent hazard events and case studies.
Originality/value – The paper develops a toolbox to evaluate the benefits of OVES and is thus highly valuable for emergency managers, which are responsible for deploying volunteers and non-volunteers in emergency management.

Keywords Benefits, Disasters, Emergency management, Volunteers, Allocation of resources, Rescue organizations
Paper type Research paper

1. Introduction

Voluntary emergency services (VES) form the backbone of disaster management worldwide and in many European countries (Alexander, 2002). UNISDR (2015a, b) highlight the importance and the necessity to strengthen organized, but also non-organized

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volunteers in disaster risk reduction. Their capability to prevent damages gives them globally high-economic relevance (Salamon *et al.*, 2011). In Austria, when a disaster occurs, organized voluntary emergency services (OVES) act as auxiliaries to the responsible governmental authority (Jachs, 2011), especially when a major disaster requires a large, trained, and fast deployable emergency force (4 percent of total population in Austria are engaged in OVES, carrying out 1.3 million hours per week; BMASK, 2013). In general, volunteers in Austria are tightly interwoven in the social fabric and provide essential adaptive capacities in their home communities (Kuhlicke *et al.*, 2011; Pelling and High, 2005). Voluntary fire departments with 256,000 active members are the main institution in hazard control and disaster aid (Federal Fire Brigade Association Austria, 2013).

However, the capacities of VES may become overstressed in the future: increasing individualism, migration from remote regions, and demographic change may threaten the current system relying heavily on decentralized (O)VES (BMASK, 2009). In parallel, the number of disaster operations is likely to increase due to climate change (Intergovernmental Panel on Climate Change, 2013) and socioeconomic developments. Thus, OVES can be considered a contingent liability: If the current system comes under pressure in the future, governments will have to contract paid emergency services instead, which may exceed already scarce public budgets (Pfurtscheller and Schwarze, 2008).

In anticipation of these detrimental developments, local policy makers and disaster managers are well-advised to promote voluntary engagement. Still, voluntary action is often taken for granted or underrated as a complementary effort in disaster management, as its costs and benefits are less tangible than professional emergency services or built structures for hazard control. Quantifying VES' numerous benefits to society may strengthen their standing compared to other disaster management options. Moreover, the results of this study can be used for case study specific cost-benefit-analysis in disaster risk reduction (Shreve and Kelman, 2014).

Thus, the present paper proposes a toolbox for assessing the benefits of OVES, in order to highlight their essential contribution. Note that non-organized (or spontaneously emerging) volunteerism should not be neglected in their effects on risk reduction, however, it is not covered in this analysis, due to poor data availability. Eventually, if OVES are contrasted to other viable policy options, the monetization of the benefits of OVES may support a more efficient resource allocation in disaster management. We describe possible benefits of OVES qualitatively together with applicable evaluation concepts (Section 2). We then apply selected methods empirically to case studies in Austria (Section 3). Section 4 concludes, discusses findings and gives recommendations. Our methodology may easily translate to other countries which also rely on OVES in disaster management.

2. Evaluation framework and qualitative overview

2.1 Scenario definition

The current benefits (and costs) of OVES can only be determined relative to an alternative reference scenario. The difference between the current system and the alternative reference scenario gives the benefit (or costs) of the current system. Hence, realistic assumptions behind this scenario are crucial. In our analysis we compare the current emergency service system in Austria, which heavily relies on organized volunteerism, with hypothetical reference cases wherein volunteers are substituted by paid, full-time emergency forces, so that the government still supplies basic protection. This leads to several effects: First, since the public sector replaces only a

fraction of current volunteers by paid emergency forces, the lower capacity implies a lower safety level, leading to higher adverse impacts on humans and economic assets. Second, in the reference case emergency services presumably are organized more centrally and therefore the level of spatial coverage of fire brigades is lower, further decreasing the safety level (especially when large-scale events happen simultaneously in remote regions). Third, in the reference case the less tangible benefits of organized volunteerism disappear (e.g. social capital enhancement). All these negative effects would emerge in the alternative reference scenario and thus reflect the benefits of the current system.

The scenario's perspective is limited to volunteering in formal, structured organizations such as fire brigades, because they currently carry the brunt of Austrian VES activities. Beyond OVES, non-organized VES (ranging from neighborly help to emergent citizen initiatives) are highly relevant; unaffiliated volunteers often show crucial agency during and after disasters (Babcicky and Seebauer, 2016; INKA-Forschungsverbund, 2015; UNISDR, 2015b). Unfortunately, data on the extent of non-organized VES is too fragmentary to allow any conclusive analyses. Still, in principle, the concepts presented here similarly apply.

Table I gives a qualitative overview of the benefits and costs of OVES for different actors, comparing the current system to the alternative reference case. Regarding benefits within the tangible dimension there are lower personnel cost and avoided or reduced damages to infrastructures. The intangible benefits are divided into three sub-categories, namely: health, qualification and social effects. Compared to the tangible benefits the monetization of the intangible benefits is much more challenging and is therefore subject of Section 2.2.

The costs of voluntary work can be assessed more easily due to their tangible character: They may be calculated, e.g. by using market values or opportunity cost rates (used by e.g. Salamon *et al.*, 2011) and an analysis of public and institutional budgets (Pfurtscheller and Thieken, 2013). The monetization of the predominantly intangible benefits of OVES, however, is more challenging, since they emerge indirectly (externalities or public goods) and are not clearly visible. Consequently, cost-benefit assessments often neglect the many benefits of OVES. However, sound policy development and efficient resource allocation call for a consistent assessment of costs and benefits of OVES, capturing as many facets as possible (Rose, 2004; Meyer *et al.*, 2013). Hence, we focus on applicable policy-relevant approaches, including valuation techniques for non-market goods by using methods from welfare and environmental economics.

2.2 Concepts to assess and monetize the benefits of OVES

An overview of methods to monetize intangible costs or benefits is given for example in Meyer *et al.* (2013), focussing on the costs of natural hazards (which, if avoided, reflect benefits). Valuation methods for intangibles are divided into indirect (revealed preferences) and direct valuation methods (stated preferences).

Salamon *et al.* (2011) reviews economic approaches for the evaluation of voluntary work. Whereas replacement costs or opportunity costs approaches address the inputs which are necessary to generate a benefit, social benefit approaches focus on the output of volunteerism and thus capture much more of its facets. Expanding on Salamon *et al.* (2011), who provide a first estimate on the global scale based on replacement costs, we aim for a broader view and apply a social benefit approach, focussing on the generated outputs, rather than on inputs. We elaborate this approach for the role of OVES for

	Society and public sector	Firms	Volunteers
Benefits			
Tangible	Salary savings[a] Higher safety level[a]: Avoided damages to public infrastructure and cultural goods Avoided damages to private property and residential homes	Avoided or reduced damages to capital stock and production losses	
Intangible			
Health	Mental and physical health of volunteers: Resulting lower treatment costs Resulting more productive labor force and positive GDP effects[a] Avoided injuries and fatalities of disaster victims	Mental and physical health of employees, who are volunteers (less sick leaves)	Physical and mental strength (e.g. stress resistance)
Qualification		Responsible, stress resistant and execution-driven employees Know-how of employees (technical knowledge, first-aid)	Applying and improving technical and social skills (e.g. leadership, teamwork), experiencing self-efficacy Acquiring professional qualifications and contacts
Social	Social capital enhancement[a] Avoided damages to ecosystems Knowledge transfer to society, strengthening risk reduction capabilities and adaptive capacity	Social coherence in companies Enacting corporate social responsibility	Experience of altruism and solidarity, contributing to the common good Experiencing social belonging and group efficacy Adventure, fun, experiencing personal limits Societal appreciation, gaining social status

(*continued*)

Table I.
Benefits and costs generated by voluntary efforts in emergency services for different actors

Table I.

	Society and public sector	Firms	Volunteers
Costs			
Tangible	Higher costs for geographically distributed equipment and infrastructure Competition with other fields where volunteers are needed (e.g. social care, sports, culture) Costs for coordination between authorities, full-time personnel and volunteers Expenditure for insurance against injury, trauma or death of emergency personnel during training or disaster operations	Costs of special company leaves (lost working hours, lost revenues) Lower productivity due to, e.g. injuries, illnesses of volunteers	Time resources for education, training and emergencies during free and work time
Intangible			
Health			Risk for injury, death, psychic trauma and stress (as more, eventually less experienced people are deployed)

Note: [a]Evaluated in the empirical application, see Section 3

flood protection in Austria with respect to four dimensions of effects: tangible, and intangible in health, qualification, and social arenas.

2.2.1 Tangible effects. Tangible effects are relatively easy to monetize whenever price tags exist. For society and the public sector, the most obvious benefits are costs savings. When comparing the current state with OVES to the reference case with a partial replacement by professionals, the public sector saves costs by paying less wages. Hourly wage rates may measure this benefit directly (see Section 3.1 for the empirical application).

In the alternative scenario, a lower safety level may emerge (see Section 3.2 for an empirical application), confronting the public sector with additional losses, which do not occur in the current system. These avoided losses represent the benefit for the public sector generated by OVES. The concept of avoided losses also applies to the private and economic sector. Values of buildings, interiors, machinery, etc. together with data regarding safety levels or flood risk may be used to calculate avoided damage costs. Alternatively, contingent valuation methods can be used, which is done exemplarily in Section 3.5, by surveying willingness to pay (WTP) of citizens.

In addition to these direct benefits (avoided losses), there are also benefits due to avoided disruption of production and indirect economic effects, leading to further regional and macroeconomic effects. To measure these indirect effects, macroeconomic approaches are needed (e.g. input-output analysis, computable general equilibrium (CGE) models or econometrics).

Tangible effects in terms of salary savings or avoided losses address the core activity of OVES, emergency response operations. Besides, OVES also play an important role in risk reduction, e.g. by disaster control trainings, by informing disaster management plans, or by conveying knowledge on disaster preparedness as risk communicators in their social surroundings (Balas *et al.*, 2015; Tierney, 2014; UNISDR, 2015b). However, monetizing these benefits would require detailed records of risk reduction activities by OVES and follow-up assessments of the actual impact of these.

2.2.2 Intangible effects: health. Health benefits from OVES range between the tangible and intangible dimension. From a public sector perspective, multiple health benefits arise: First, more people are in good physical shape, so treatment costs related to overweight (e.g. diabetes, cardiovascular diseases) are lower (assuming that less than 100 percent of volunteers are replaced in the alternative reference case). Second, due to a possibly higher safety level, less people get injured or traumatized, reducing publicly financed treatments. Third, as membership in voluntary organizations also increases mental health of the volunteers themselves (Cruwys *et al.*, 2013, 2014), public costs for treating mental illnesses are lower. For all of these benefits hypothetical treatment costs may be used for monetization. Furthermore, mental health benefits can then be translated into changes of annual GDP (see Section 3.3).

Besides benefits for the public sector there are also health benefits for protected households and the volunteers themselves. Mirroring the public benefits, protected households benefit in terms of avoided injuries, fatalities and mental trauma, whereas volunteers benefit from mental and physical health. For the monetization of these benefits at the individual level the disability adjusted life years method may be applied (WHO, 2015) together with a value for one life year lost (LYL; e.g. Steininger *et al.* (2015) use €63,000 per LYL).

2.2.3 Intangible effects: qualification. Qualification effects of voluntary workers materialize as benefits mostly at the firm level. Likewise as health effects, this facet of benefits lies between the tangible and intangible dimensions. First, firms benefit via the

technical skills a worker obtains from his engagement in, e.g. the fire brigade. Costs for training courses may be an appropriate surrogate for monetization. Second, but harder to monetize, volunteers contribute manifold soft-skills, for example sense of responsibility, leadership and management abilities, team building abilities, etc. These soft-skills translate into higher productivity, meaning that the labor force is able to create more value added. Methods to measure this benefit could be CGE-modeling, econometrics or stated preferences approaches (e.g. employers' WTP for employees with a volunteer background or with similar soft-skills).

2.2.4 Intangible effects: social. The social effects of voluntary engagement are highly intangible and difficult to monetize. At the public and societal level, voluntary work leads to avoided or reduced social and cultural damages. Revealed and stated preferences methods may assess social benefits (see Meyer *et al.*, 2013 for a review). Revealed preferences measure market values indirectly by looking at actual behavior of individuals on the market where implicit trade happens (e.g. the travel cost method or hedonic pricing). Stated preferences measure the value directly by asking about a WTP (or accept) for, e.g. environmental changes. Further stated preferences methods are choice experiments or correlating the degree of public goods with life satisfaction. All of the mentioned empirical methods require high efforts in data collection (Markantonis *et al.*, 2011); still, Section 3.5 provides estimates of WTP for OVES in Austrian rural households.

Volunteerism also fosters participation, trust, social cohesion and solidarity within a society. All these aspects can be summarized as "social capital" (e.g. Adler and Kwon, 2002). Like any other capital, "social capital" yields numerous benefits. Several studies connect social capital and economic growth (Whiteley, 2000; Knack and Keefer, 1997; Iyer *et al.*, 2005; Neira *et al.*, 2009; Temple and Johnson, 1998), resulting in elasticity coefficients telling by how much GDP changes, when social capital changes (see Section 3.4 for an empirical application on OVES).

As an individual benefit, volunteers gain public recognition. In contrast to the alternative reference case with professionals who "just" get paid for doing their jobs, volunteers may improve their public status through civic engagement. Surrogate markets that convey similar social status, e.g. the membership fee of a golf club, may be used for monetization.

3. Empirical application

3.1 Tangible effects: salary savings

Salary savings of OVES could be assessed in a very general way combining hypothetical and empirical data, but also more accurately using numbers on past hazard events. We present both approaches exemplarily. First, salary savings due to voluntary work can be determined by the following formula, which is based on working hours:

$$\text{salary savings} = \frac{\emptyset vt}{h/w} \times V \times r \times \emptyset wage$$

where $\emptyset vt$ is average weekly voluntary working time in hours, h/w is working time per week in a full-time job, V is the number of volunteers is the regarded region, r is the assumed rate of replacement of volunteers by full-time workers in the reference scenario and $\emptyset wage$ is the average gross wage rate of full-time workers per year.

Table II summarizes the necessary data for voluntary fire brigades in Austria and gives results for different scenarios of replacement ($r = 100$, 50 and 20 percent).

Assuming $r = 50$ percent, additional salaries to be paid are about € + 550 million per year (equivalent to doubling the current national spending for fire brigades, which is about + 0.2 percent additional expenditure measured in percentage of GDP), reflecting the benefit of VES (€2,300 per volunteer p.a.).

Few case studies were carried out in the aftermath of high-impact disasters, in order to cover the costs of the event and of deployed OVES workers (Pfurtscheller and Thieken, 2013). Our second example on salary savings refers to voluntary and professional emergency services during the 2005 flood in the province of Vorarlberg (Austria). This event triggered about €180 million direct losses. Using the replacement cost approach with alternative wage rates, total personnel costs were approximately €2.8 million (see Table III) for that single event. In service hours, 42 percent of the total effort were carried out by volunteers. In costs, this share lies at 62 percent covered by volunteers representing benefits from salary savings of about €1.7 million.

	Measuring unit	Variable	Description
5.20	h	*Øvt*	Average voluntary working time (Public Opinion, 2012)
40	h	*h/w*	Full-time equivalent (40h per week)
243,490	Volunteers	*V*	Active volunteers in Austrian fire brigades in 2012 (Federal Fire Brigade Association Austria, 2013)
34,568	€	*Øwage*	Average entry wage of professional fire fighters p.a. (gross including employer's contribution) (AMS, 2015)
+1,094	M €/year		Additional necessary salaries paid to professionals to replace volunteers ($r = 100\%$)
+547	M €/year		Additional necessary salaries paid to professionals to replace volunteers ($r = 50\%$)
+219	M €/year		Additional necessary salaries paid to professionals to replace volunteers ($r = 20\%$)

Table II. Cost savings in terms of hypothetical additional necessary salaries due to voluntarily worked hours in fire brigades in Austria

Emergency organization	Service hours[a]	Alternative charge rate in €/hour	Costs if they had to be paid in €	Percent of costs for volunteers	Percent of total costs
Voluntary					
Fire Brigades	60,000	20[b]	1,200,000	71	44
Austrian Red Cross	1,500	21[c]	31,500	2	1
Mountain Rescue Service	5,700	55[d]	313,500	18	11
Water Rescue Service	2,900	55[e]	159,500	9	6
Sum voluntary	*70,100*	–	*1,704,500*	*100*	*62*
Professional					
Police	8,000	29.06[f]	232,480		8
Federal Armed Forces	88,000	9.40[g]	827,200		30
Total sum	*166,100*	–	*2,764,180*		*100*

Notes: Data sources and explanations: [a]Federal Government of Vorarlberg (2005); [b]pay scale of the Fire Brigade of the Federal State of Tyrol, 2010, this includes personnel costs and expenses for material, vehicles; [c]pay scale for a Red Cross emergency medical assistant, 2012; [d]pay scale of the Austrian Mountain Rescue Service, 2011; [e]as no charge rate of the Water Rescue Service was available the charge rate of the Mountain Rescue Service was used; [f]pers. comm. Lieutenant-Colonel M. Dummer, 2013; [g]this charge rate is only for recruits, pers. comm. Colonel D. Heiß, 2013

Table III. Service hours and charge rates of emergency organizations for the 2005 flood event in the Federal State of Vorarlberg, Austria

3.2 Tangible effects: higher safety level and better efficacy

Since in the alternative reference scenario fire brigades are assumed to be organized centrally and equipped with less staff, shortages of personnel, vehicles and equipment may emerge, when several large-scale events happen simultaneously in the same area. So, one option for assessing benefits of OVES is to focus on the number of large-scale events with spatially distributed impacts which can be handled less effectively (or not at all) by fire brigades in the alternative reference scenario. We therefore exemplarily analyze operational data of fire brigades in the province of Styria (Austria) from 2010 to 2013. Focussing on large-scale flood events (> 300 service hours per event), 43 such events (~11 per year) were scattered over Styria's ten districts. In 24 out of these 43 cases, more than one event happened on the same day in the same district. More precisely, in five cases two events happened simultaneously, in two cases three events and in two cases four events took place at the same time and location. Fire brigades facing such pressure have basically two options: Either focussing on one event, neglecting all other parallel events. Or, split up resources to handle more events at the same time[1]. In any case higher damages due to a reduced efficacy result. If focussing on one event only, within these four years 15 large-scale flood events would not have been handled by fire brigades (~four per year). Multiplying this number by the damage (in €) incurred in an average large-scale event if no emergency services were deployed yields hypothetical costs, which reflect the benefit of the current voluntary system. Unfortunately for the province of Styria not enough data are available to continue the analysis at this point, however this procedure might serve to estimate the benefit of an extensive workforce in case of parallel large-scale events.

3.3 Intangible effects: macroeconomic mental health benefits

According to Cruwys *et al.* (2014, 2013), membership in social groups is protective against depression and curative if depression already exists. In particular "social identification" coming from group membership is a strong predictor of depressive symptoms. Being a volunteer at the fire brigade also creates this "social identification," and therefore yields a benefit in terms of mental health. To monetize this benefit, we calculate the hypothetical economic loss in percent of annual GDP which would emerge if there were no volunteers working for Austria's fire brigades, but exclusively full-time workers, applying the following formula:

$$\text{Mental health benefit} = \frac{GDP \times l}{\emptyset ltp \times pop} \times V \times u$$

where GDP is absolute annual GDP, l is the average annual GDP loss due to mental illnesses, $\emptyset ltp$ is the average life time prevalence of anxiety and depression, pop is the total population, V is the number of volunteers and u the a person's probability of getting mentally ill when there is no more group membership.

With 3.5 percent annual GDP loss due to mental illnesses, predominantly anxiety and depression (OECD, 2014), the average loss per mentally ill person in Austria was about €14,000 in 2013. Knowing that about 256,000 people volunteer in Austria's fire brigades, this gives the number of people with no (or less) group membership in the alternative scenario. Assuming $u = 9$ percent (which reflects current $\emptyset ltp$), this results in annual losses of 315 million[2] (Table IV summarizes).

	Measuring unit	Variable	Description
9	%	*Øltp*	Average life time prevalence of anxiety and depression (Statistics Austria, 2007)
8,477,230	People	*pop*	Total population of Austria in 2013
243,490	People	*V*	People with no more group membership in alternative scenario w/o volunteers (i.e. current active volunteers in Austrian fire brigades)
313,067	M €	*GDP*	GDP of Austria, 2013 (Statistics Austria, 2015)
3.5	%	*l*	Average annual GDP loss due to mental illnesses[a] in EU (OECD, 2014)
35	M €		Annual mental health benefit ($u = 1\%$)
175	M €		Annual mental health benefit ($u = 5\%$)
315	M €		Annual mental health benefit ($u = \text{Øltp} = 9\%$)

Note: [a]Predominantly anxiety and depression (OECD, 2014)

Table IV. Cost savings in terms of hypothetical GDP reduction due to mental health effects

3.4 Intangible effects: social capital benefits

Several studies analyze the effect of changes in social capital on a country's economic growth (Whiteley, 2000; Knack and Keefer, 1997; Iyer *et al.*, 2005; Neira *et al.*, 2009). Applying different social capital indices, the elasticity coefficients in the literature range between 0.002 percent and 0.630 percent (meaning that a 1 percent increase in the social capital index implies an increase between + 0.002 percent and + 0.630 percent of GDP growth).

The following formula allows to evaluate the benefit of social capital generated from volunteerism in terms of additional GDP:

$$\text{Social capital benefit} = \frac{V_F - V_{tot}}{pop} \times e \times GDP$$

where V_F is the number of volunteers working for fire brigades, V_{tot} is the total number of all voluntarily working people, *pop* is total population, *e* is the elasticity coefficient and *GDP* is annual gross domestic product. The fraction in the formula gives the change of the share of voluntary workers of total population, when there are no more volunteers working for fire brigades. This share is equivalent to the widely used "Petris Social Capital Index (PSCI)" (cf. Scheffler *et al.*, 2007).

In Austria the PSCI lies at 0.438. Assuming that in the alternative reference case there are no more volunteers working for fire brigades, this index drops by −0.029 points to 0.409. By monetizing this drop using *e*, the difference in annual GDP between a system with and without volunteers in fire brigades yields the benefit of OVES. Taking the PSCI as a proxy for the social capital indices used in the previously stated studies, together with the different elasticity coefficients (*e*) and GDP, the benefit ranges between €19 million and €5.89 billion. Taking an average of the benefits in Table V, the annual economic benefit would be €1.895 billion per year (about €7,000 per volunteer).

3.5 Intangible effects: benefits for private households

Asking beneficiaries about their WTP to maintain a certain service may give an estimate of its market price. We surveyed households in two small rural Austrian municipalities, Kössen (Province of Tyrol) and St Andrä/Wördern (Province of Lower Austria) shortly after these regions were affected by riverine flooding in 2013. Questionnaires were distributed as an inlay to municipal newspapers, which allowed us to reach virtually all residents in the surveyed areas. A response rate of 6 percent yielded a sample of 296 households. This sample fairly well reflects the

socio-demographic structure of the respective communities. However, the low-response rate suggests to caution against an eventual self-selection bias of respondents who hold strong views on OVES and flood risk management.

Households state that they currently contribute on average €97 per year to OVES, through donations or when visiting fund-raising events, above and beyond their indirect contribution as tax-payers (see Table VI). If OVES in their community were in financial difficulties, the respondents would be willing to pay additionally an average €180 per year in order to maintain current operational capacities.

However, households are not uniform in their WTP for OVES. WTP is higher in Kössen than in St Andrä/Wördern, both regarding the current and an additional contribution (see Table VI). This may be connected to higher overall economic losses and a higher number of affected households during the flood event in Kössen. Households which sustained damage during the flood event and thus presumably leveraged help from voluntary workers report higher current contribution, but similar additional WTP. Previous flood experience however neither influences current nor additional WTP in a statistically significant way.

Extrapolating the mean values from the survey to a population of 1.50 million Austrian households in rural regions[3] in 2013, current contributions amount to €146 million per year, reflecting how households value their benefits from OVES. Note that this value covers more than just response and recovery related to flooding, as OVES also protect from other hazards (e.g. fire, oil spills) or act as auxiliary force to various community services.

Taking current and future contributions together and again projecting to the Austrian rural population, households' WTP is €416 million to maintain OVES in their community. This amount nearly covers the costs for replacing 50 percent of the volunteer workforce by paid professionals (see Table II), making partial transfer from a volunteer to a professional emergency service viable. Still, it seems prudent to consider these results as the upper limit of WTP, as households gave hypothetical preferences and self-selection may have skewed the sample toward over-representing proponents of OVES.

4. Conclusions, discussion and recommendations for emergency managers

This paper outlined the different benefits (and, to some extent, costs) of OVES in disaster management and their possible economic value. We show that tangible benefits such as volunteer service hours are easy to monetize, while quantifying intangible benefits is subject to high uncertainties regarding assumptions. However, this paper underscores that the potential benefits of OVES should not be ignored but used in decision making by policy makers, as they may be very high. The benefits of non-organized volunteers in risk reduction are not part of

Table V.
Elasticity coefficients for the impact of changes of social capital on economic growth

Elasticity coefficient (%)	Change in GDP p.a. in %	Change in GDP p.a. in million €	Source
+0.630	1.826	5,891	Whiteley (2000)
+0.082	0.238	767	Knack and Keefer (1997)
+0.270	0.783	2,525	Knack and Keefer (1997)
+0.029	0.084	271	Iyer *et al.* (2005)
+0.002	0.006	19	Neira *et al.* (2009)

Table VI.
Willingness to pay for VES by private households

Group	Current contribution						Additional contribution					
	M	SD	MED	*t*	df	*p*	*M*	SD	MED	*t*	df	*p*
All	97	162	50	–	–	–	180	268	100	–	–	–
Kössen	127	226	100	2.81	294	< 0.01	245	330	100	3.65	286	> 0.01
St Andrä/Wördern	74	83	50				131	197	100			
Damage	121	210	100	2.41	294	< 0.05	191	293	100	0.63	286	> 0.05
No damage	76	106	50				171	246	100			
Flood experience	122	241	75	1.77	279	> 0.05	148	244	100	−1.34	271	> 0.05
No flood experience	85	109	50				194	274	100			

Notes: M, mean; SD, standard deviation; MED, median

this analysis; most quantification methods presented here, may also be transferred to that field.

Calculating the benefits of OVES for Austria yields a range of estimates (Table VII summarizes). Based on hourly wage rates, OVES amount to salary savings between €0.22 and €1.09 billion p.a. (depending on the replacement scenario). Other monetized benefits are macroeconomic gains due to mental health (between €0.04 and €0.32 billion per year), social capital effects (ranging between €0.02 and €5.89 billion p.a., with an average of €1.895 billion) as well as valuation by protected households (€0.15 to €0.42 billion p.a.). Nevertheless, these results should be treated with caution, since we rely on case study data and exemplary approaches. In addition to these calculated benefits, OVES reduce or avoid substantial costs from physical impacts of natural hazards on property and economic assets.

While the monetization results reported here provide empirical yardsticks for the actual dimension of the benefits of OVES in Austria, we strongly advise against using these numbers directly in accounting or budget making. Further studies are necessary to validate our results, respectively to evaluate how the different categories of benefits may overlap in order to provide a sound basis for decision making.

Our analysis is restricted by fragmentary data on emergency efforts and damages relating to OVES. Currently, there is no joint effort of Austrian institutions to collect and share such data in the aftermath of natural hazard events. A comprehensive database on recent hazard events would go a long way for facilitating evidence-based decisions for investment in OVES. Long-term strategic resource allocation in disaster risk management, especially when preparing for possible future high-impact events triggered by climate change, needs much more detailed data than currently available.

Volunteerism in disaster management faces adverse societal developments such as growing individualism, urbanization, rural migration or an aging population (Balas *et al.*, 2015). Fostering societal appreciation for citizen engagement might counteract these developments. Communicating the multiple benefits of VES to the public might make their contribution to society more transparent and provides evidence-based data for decision makers. Contrasting the costs and benefits of OVES to other options in disaster risk management might underline OVES' significance and cost-effectiveness. To support this argument, more research should be undertaken to assess the benefits of avoided losses by organized and non-organized VES using single-object data.

Table VII.
Summary of monetized benefits of voluntary emergency services

	Benefit in bn €	Explanatory text
Salary savings	0.22-1.09	Depending on the replacement rate ($r = 20\text{-}100\%$) by which volunteers are replaced by paid full-time workers
Macroeconomic mental health benefits	0.04-0.32	Depending on person's probability of getting mentally ill when there is no group membership ($u = 1\text{-}9\%$)
Social capital benefits	0.02-5.89	Depending on operationalization of social capital and the used elasticity coefficient ($e = 0.002\text{-}0.63$)
Benefits for private households	0.15 (0.42)	Depending whether voluntary emergency services require additional support or not

Notes

1. When large-scale events emerge, auxiliary fire brigades from neighboring areas may be requested, however also these forces may be insufficient or may be already deployed in other regions.
2. These numbers can be adjusted to the fraction of volunteers which are replaced by full-time professionals, since also these full-time workers will develop social identification to a certain degree. However, the effect may be stronger for volunteers, as a professional's motivation to be a member of the group may be more strongly driven by financial reasons.
3. Rural refers to "thinly populated areas," according to the DEGURBA classification of Eurostat. We extrapolate only to rural regions, because they entirely depend on volunteers for coping with disasters. Contrastingly, several Austrian cities maintain professionalized, paid emergency forces.

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