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Can we nudge insurance demand by bundling natural disaster risks with other risks?

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Abstract
One question for policymakers is whether demand for natural disaster insurance is impacted by including coverage in a bundled policy alongside other perils, rather than as a separate policy. We examine this question with data collected among homeowners in the Netherlands and the United Kingdom (UK). Our findings show that demand is higher to insure separate risks than to cover all risks together in a bundled insurance policy in the UK, whereas no significant difference is found between demand for bundled vs. single policy insurance in the Netherlands. This difference in preference across the two countries is associated with whether individuals have been flooded, which is more often the case in the UK than the Netherlands. Based on the results we suggest implications for policymaking.

JEL Classification: D9

Keywords
Experience — insurance demand — natural disaster risk — nudge

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Introduction

Climate change and socioeconomic developments are expected to raise the risk of natural disasters in many areas around the world (IPCC, 2014). There is an important role for insurance to limit homeowners' financial losses due to disasters, but studies have shown that many individuals are reluctant to insure these risks at affordable premiums (Browne et al., 2015; Petrolia et al., 2013; Anderson, 1974). One reason for this reluctance may be related to the way in which the risks are cognitively processed by individuals. There is an abundance of research showing that individuals find it challenging to deal with very low probabilities associated with disaster events (Kunreuther et al., 2001; Viscusi, 1998; Barberis, 2013; Angelova et al., 2014; d'Albis et al., 2020; Attanasi et al., 2020), and may ignore disaster risks if the likelihood of occurrence is perceived to be below some threshold of concern (Aerts et al., 2018; Botzen et al., 2015).

A way to deal with this tendency may be to raise the likelihood of experiencing a loss that warrants an insurance claim above this threshold, in order for thought about risks to become rational (Kunreuther and Pauly, 2004). For instance, whereas insurance policies against low-probability events may not be purchased because the likelihood falls below the threshold level of concern, combining the risk with other risky events in a bundled insurance policy may impose a probability that is sufficiently large to overcome the threshold of concern (Schwarcz, 2010).

Many countries adopt bundled insurance policies for natural disaster risks in practice (Surminski, 2018; Atreya et al., 2015; Lamond and Penning-Rowsell, 2014; Hudson et al., 2019). For example, bundling a flood peril with other natural hazards (France, Portugal, Switzerland, and Iceland), fire risk (Belgium and Denmark), as well as general building and household insurance (United States and Spain) is commonplace in a number of developed countries (Seifert-Dähnn, 2018). Nevertheless, there is sparce research on demand for bundled insurance (Landry et al., 2021), therefore very little is known about individuals' preferences for bundled insurance over single policies, and the factors that determine these preferences. Two studies by Landry et al. (2021) and Wang et al. (2012) show that there is demand for bundled insurance in practice, however neither of the two studies compare this demand to demand for single insurances that cover risks separately.

Experimental studies have the advantage that this comparison can be made in a tightly controlled setting that limits the possibility for confounding factors. But the experimental evidence that exists on bundling so far is mixed and comes from examinations that use student subjects primarily (Robinson and Botzen, 2019). Slovic et al. (1977) tested whether 151 subjects, recruited via a student newspaper, prefer to insure against a low-probability/high-impact (LPHI) risk when insurance covers a likely risk of loss as well. In contrast to our study, the risks adopted for their study were general lotteries that did not specify a risk that individuals face in practice, and subjects paid for insurance with hypothetical points rather than monetary amounts. Subjects in their experiment were willing to spend 30 per cent more on insurance that covers

both risks than the sum of their expenditures for two separate policies covering the low- and high-probability risks individually. Furthermore, Schade et al. (2012) conducted a study whereby 254 students were either offered insurance that covers the risk of fire and theft of an inherited painting or sculpture, or individual policies that cover these risks separately. The authors showed similar findings to that of Slovic et al. (1977) although these are not discussed explicitly in their paper. In contrast, Schoemaker and Kunreuther (1979) found, in their sample of 158 students and 68 clients of an insurance agency writing property and casualty insurance, that a larger proportion of individuals are willing to pay less for comprehensive insurance than for individual policies covering general lotteries, than the proportion of individuals who are willing to pay more.

In this paper we innovate on these studies by relying on a large sample of 597 homeowners, who actually face disaster risk, to assess individual preferences for bundled insurance over insurance that covers risks separately, as well as factors that determine these preferences, an examination that was omitted in the previous studies. The sample issue is important given that students are not the population of interest for the study of natural disaster insurance demand, and systematic differences may exist between students and homeowners regarding concerns about possible damages from natural disasters and cognitive capacities (Belot et al., 2015). That is why we opted for a survey – though non-incentivized – study with a target population (homeowners) and framed hypothetical questions rather than an experimental study – with small real incentives – with a student population and neutral instructions.

The study was conducted in the Netherlands, where homeowners' insurance does not cover flooding, but individuals could purchase a separate policy to cover their flood risk at the time of the study (Robinson et al., 2021), and the United Kingdom (UK), where flood coverage is currently bundled in a homeowners' policy with other perils (Surminski, 2018). This cross-country comparison is also a novel contribution which has practical relevance for policymakers deciding whether to offer voluntary natural disaster coverage as part of a bundled or separate policy. That is, we show whether demand of flood coverage as a bundled vs. single policy is impacted by contextual factors, such as whether bundled coverage is currently offered and flooding experiences, with both factors being more common in the UK than the Netherlands (Robinson et al., 2021).

The Dutch application of bundling flood insurance is of particular interest. Although at the time of the study a pilot flood insurance policy was available, "the Neerlandse", this was withdrawn in 2020 because the risk bearer has withdrawn (van Doorn-Hoekveld et al., 2022). For the time being, it is being debated whether and how flood insurance may be re-introduced in the Netherlands, a country where residents mainly face a low annual likelihood of flooding, but where there is large exposure of assets due to the high concentration of the population and property in flood-prone regions. Therefore, insights into whether Dutch homeowners prefer bundled flood insurance over insurance that covers flood risk separately has important implications for policymakers deciding whether to offer bundled flood coverage in practice, since this decision may impact the future financial resiliency of Dutch residents to flood events.

Method

We sampled 300 homeowners in the Netherlands and 297 homeowners in the UK during February 2019. The data is based on a subsample of the 1187 subjects sampled in Robinson et al. (2021) that examined the influence of opt-in and opt-out default assignment on flood insurance choices. The insurance questions in this study were displayed after the insurance questions of Robinson et al. (2021) and only to those facing the opt-in condition. Note that English language was used in the UK and Dutch in the Netherlands for instructional text and questions included in the study. All monetary amounts in the study were converted based on purchasing power parity (PPP) figures at the time of the study. Further note that descriptive statistics for socioeconomic characteristics and other variables included in our analysis are available in the Supplemental Material.[1]

Following some initial socioeconomic questions, individuals were asked to: "Imagine that you have just moved in to a new home in the Netherlands (United Kingdom) which you purchased for €260,000 (£227,500)." After the introductory text four questions were posed in sequence to elicit demand for insurance. Since individuals typically find it difficult to state their precise willingness-to-pay (WTP) for economic goods in open-ended valuation formats (Loomis, 1990; Bateman et al., 1995), we developed an iterative procedure whereby individuals first stated their demand for insurance in a payment card task (Rowe et al., 1996), and then their maximum WTP in a follow-up question in line with an interval defined based on their answer to the payment card task.[2] Specifically, according to stated yearly likelihoods of risk occurrence (1/1250, 1/2000 and 1/100 for flood, fire and burglary risk, respectively) and estimated damage amounts in the Netherlands (UK) (€80,000 (£70,000), €128,000 (£112,000) and €6400 (£5600), respectively), respondents were asked the maximum amount of money they would be willing to pay per year to insure their home against the flood, fire and burglary risks only, as well as all three risks together.[3]

[1] The Supplemental Material is available at: github.com/prn690/bundling

[2] This is in line with well-established elicitation methods in economic experiments (see Georgantzís and Navarro-Martínez 2010 for WTP for target goods).

[3] Probability 1/1250 reflects the flood probability for homes in the Dutch river delta, based on river-dike safety norms. Average damage caused by flooding for homes facing the 1/1250 probability was calculated in Botzen and van den Bergh (2009; 2012) based on the flood damage model of Wouters (2005). In the price levels at the time the study was conducted, this equals €80,000 (rounded). The 1/2000 and 1/100 likelihoods also reflect realistic yearly rates of house fire and residential burglary, respectively, for certain parts of the Netherlands based on the latest figures available at the time (Montoya et al., 2016; CBS, 2013; 2018). The expected value (probability

Elicitation of willingness-to-pay for combined insurance

Recall that every year there is a **one in 1,250** chance that your new home will be **flooded**. The estimated damage from a flood to your new home is **€80,000** (**£70,000**);

every year there is a **one in 2,000** chance that your new home will catch on **fire**. The estimated damage from a fire to your new home is **€128,000** (**£112,000**);

every year there is a **one in 100** chance that your new home will be **burgled**. The estimated cost of replacing your stolen items at your new home is **€6,400** (**£5,600**).

Of the monetary options displayed below, select the **maximum** you would be **willing to pay** per year to insure the **flood, fire and burglary** risk combined. (A follow-up question will ask for your exact willingness to pay.)

€0 (£0)	€18 (£15.75)	€48 (£42)	€144 (£126)	€480 (£420)	€1,440 (£1,260)	€3,840 (£3,360)	€10,560 (£9,240)
€6 (£5.25)	€24 (£21)	€72 (£63)	€192 (£168)	€720 (£630)	€1,920 (£1,680)	€5,760 (£5,040)	More than €10,560 (£9,240)
€12 (£10.50)	€36 (£31.50)	€96 (£84)	€240 (£210)	€960 (£840)	€2,880 (£2,520)	€7,680 (£6,720)	Don't know

Follow-up task if "More than €10,560 (£9,240)" and "Don't know" are not selected

You indicated that you would be prepared to pay **€(£){amount selected}** to insure the **flood, fire and burglary** risk combined, but not **€(£){next highest payment card value}**.

Within this range, what is the **maximum** amount of money you would be **willing to pay** per year to insure the **flood, fire and burglary** risk combined? (if **€(£){amount selected}** is still the maximum, simply type €(£){amount selected} in the box.)

€(£) ……

Follow-up task if "More than €10,560 (£9,240)" is selected

You indicated that you would be prepared to pay more than **€10,560 (£9,240)** to insure the **flood, fire and burglary** risk combined.

What is the **maximum** amount of money you would be **willing to pay** per year to insure the **flood, fire and burglary** risk combined?

€(£) ……

Figure 1. Elicitation of WTP for insurance against bundled risk

The payment cards included 24 options, i.e. 23 logarithmically spaced amounts from €0 (£0) to "more than €3,520 (£3,080)" for each single policy and to "more than €10,560 (£9,240)" for the combined policy, as well as one "don't know" option. The upper-bound of the payment card was defined based on a pre-test. Figure 1 displays the payment card and follow-up question used for the elicitation of WTP against bundled risk. The Supplemental Material provides an overview of all payment cards and follow-up questions.

To measure individual risk preferences we utilized experimentally validated survey questions developed by Falk et al. (2018). That is, we asked five quantitative interdependent questions where individuals were required to choose between receiving a sure payment and a 50:50 lottery (see Supplemental Material, Figure S1). Respondents were then asked to assess their willingness to take or avoid risks on a scale between 0 "completely unwilling to take risks" and 10 "very willing to take risks" (Dohmen et al., 2011). One combined measure of risk attitude, *risk aversion index*, has been computed according to Falk et al. (2018) based on z-scoring both the quantitative[4] and stated measures at the individual level and applying equal weights.

Results

Regarding the difference in WTP for insurance between bundled and individual risks, we find that demand is overall higher to cover the separate risks than to cover all risks together in one combined policy (Figure 2). However, this difference is significant in the UK only (Paired samples T-test p-values = 0.14 and < 0.05 for the Netherlands and UK, respectively).[5]

Furthermore, the proportion of individuals who have a positive risk premium for flood risk (WTP for flood insurance that is higher than the expected value of risk) is 34 per cent (88 of 256 individuals) and 55 per cent (151 of 275) for the Netherlands and UK; whereas, the proportion of individuals who have a positive risk premium for the bundled risk is 38 per cent (102 of 265) and 43 per cent (115 of 266), respectively (Figure 3). Individuals with a positive risk premium are the ones who are expected to purchase actuarially fair priced insurance. McNemar test p-values of the difference in the proportion of individuals who have a positive risk premium for flood risk vs. bundled risk equals 0.21 and < 0.01, respectively. In addition, a minority of those with a negative risk premium for flood risk, i.e. 18 per cent (27 of 148) and 8 per cent (8 of 99), would purchase actuarially fair bundled insurance in the Netherlands and UK.

One theoretical prediction from expected utility theory, the normative theory of rational decision making in economics, is that a preference for comprehensive bundled insurance over covering each component risk separately is positively related to the degree of risk aversion.[6] This is tested by regressing the difference between *bundled insurance demand* and the sum of *fire insurance demand, flood insurance demand and burglary insurance demand*, on the *risk aversion index* and the socioeconomic variables with Ordinary Least Squares (OLS) (Table 1). Individuals who are willing to pay zero are omitted, since these preferences are likely driven by probability neglect rather than preferences towards risk based on expected utility theory.[7]

The regression analysis shows that risk aversion has a significant and positive relationship (*risk aversion index* coefficient p-value < 0.05) with the difference between WTP for bundled insurance and the sum of demand for insurance against three component risks. This means that higher risk aversion (lower risk seeking) either raises WTP for bundled insurance, compared to the sum of WTPs for insurance against the component risks, or lowers WTP for insurance against the component risks, relative to WTP for bundled insurance, in line with our theory prediction.

Furthermore, a preference for bundled insurance, over single policy insurance, is positively related to age (*age* coefficient p-value < 0.01), and lower for male respondents and UK residents (*male* and *UK dummy* coefficient p-values both < 0.1). Compared to Dutch residents, the relatively lower preference of residents from the UK for bundled insurance over single policy coverage could in part be due to flooding experience, which raises demand for single policy flood coverage in the UK, relative to the Netherlands (see Supplemental Material, Table S3). Note that we found no significant influence of flooding experience on demand for bundled insurance in a separate OLS regression analysis (*past flood* coefficient p-value > 0.1). Therefore it seems that there is some dilution of the effect of flooding experience when individuals consider flood coverage that is bundled rather than coverage in isolation. As for gender effect on demand for bundled insurance, this might be related to higher risk aversion of females usually detected in experimental studies (Eckel and Grossman, 2008; Croson and Gneezy, 2009; Charness and Gneezy, 2012).

Discussion and policy implications

This paper adds to the sparse empirical literature on bundled homeowners' insurance. Our findings, on aggregate, show that individuals are prepared to pay more to cover three risks (flooding, fire and burglary) separately than to cover all risks together in one combined policy, in line with Schoemaker and Kunreuther (1979) (see Slovic et al. (1977) and Schade et al.

multiplied by possible outcome) of each risk is held constant (€64 in the Netherlands and £56 in the UK), so the fire and burglary damages are scaled accordingly.

[4] As for the quantitative measure of risk preferences, a staircase method *à la* Falk et al. (2018) was used, which is in line with the bisection process in Abdellaoui et al. (2011).

[5] Supplemental Material, Table S2 displays the means and standard deviations of all the WTP values for the Netherlands and the UK.

[6] See Supplemental Material, Section 1 for the derivation of this prediction.

[7] That is, probability neglect is difficult to explain by risk preferences under expected utility theory because it is assumed that probabilities are processed linearly. Extreme curvature of the utility function, which is empirically implausible (Wakker, 2010), would explain probability neglect here. Our measure of risk aversion is also not likely to pick up probability neglect because it is based on a 50:50 lottery.

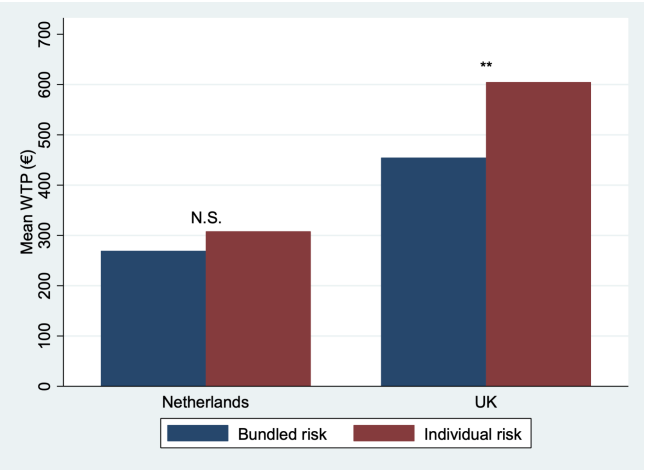

Figure 2. Average WTP for insurance against bundled and individual risks for the Netherlands and UK

Notes: ** indicates a significant difference at the 5% level according to a Paired samples T-test. N.S. indicates no significant difference.

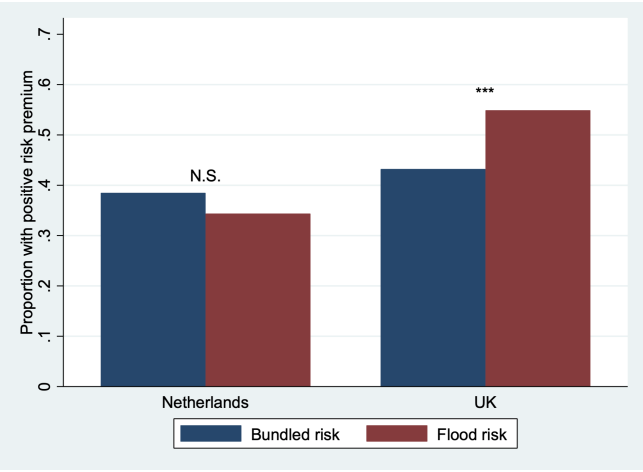

Figure 3. Proportion of individuals who have a positive risk premium for bundled risk and flood risk for the Netherlands and UK

Notes: *** indicates a significant difference at the 1% level according to McNemar's test. N.S. indicates no significant difference.

Table 1. Regression analysis of expected utility theory hypothesis

	Coefficient	Standard error
Risk aversion index	77.92**	32.27
UK dummy	-94.30*	49.56
Age	5.12***	1.82
Male	-91.46*	51.27
Higher education	-31.53	49.92
Constant	-242.40**	109.058
Observations	424	
R-squared	0.07	

Note: ***Significant at 1%; **Significant at 5%; *Significant at 10%.

(2012) for counter evidence). In a related study, Tannenbaum et al. (2015) investigated whether healthcare providers are more or less likely to choose treatment options that are packed or listed as part of a group. Providers were less likely to choose certain aggressive treatment options when they were grouped compared to when the same options were listed individually. Apparently, unpacking items may increase their saliency, which encourages providers to examine the benefits of options in greater detail, which in turn raises their likelihood of being chosen. Some individuals in our study perhaps considered the benefits of insurance purchase more intently when the risks were listed separately.

Despite the aggregate finding, individuals preferred bundled insurance to covering each component risk separately under higher levels of risk aversion, which is a finding consistent with expected utility theory. There is a larger variance of potential loss outcomes when one evaluates several risks at once, because multiple risks can occur together, and risk aversion implies aversion to high variance.

Our results suggest several implications for policymakers. For instance, since a significantly lower proportion of UK residents have a positive risk premium for bundled insurance, compared to separate flood insurance, this implies that less individuals would purchase flood insurance offered on a voluntary basis as a bundled policy than as a single policy with actuarially fair premiums. Yet, it is important to mention that the actual take-up rates of flood insurance (that is bundled with other perils) in the UK is very high (95 per cent) because it is generally included as standard in homeowners' insurance, meaning that customers receive it automatically along with their standard cover, and basic flood insurance is required for homeowners who want to obtain a mortgage (Surminski, 2018; HM Government, 2016).

In the Netherlands, where there is ongoing debate about whether and how flood insurance may be introduced, insurers could expect no major difference in flood insurance penetration rates if voluntary coverage is offered as a bundled policy than as a single policy marketed at actuarially fair rates. That is, our findings show that there is overall an insignificant effect of bundling on flood insurance demand in the Netherlands, both in terms of WTP and purchase of actuarially fair insurance.

Moreover, policymakers and/or insurers may consider marketing flood coverage as a separate policy in high risk areas where flood damages are a frequent occurrence. The reason is that, compared to Dutch residents, individuals who reside in the UK have a lower preference for bundled insurance that includes flood coverage over single policy insurance, a finding that is partly driven by observed differences in the data of

residents between the two countries, i.e. whether individuals have been flooded in the past.

It appears that an individual may draw on their flooding experiences, which have been shown to influence insurance demand in a number of field studies on flood preparedness (Robinson and Botzen, 2019), to a larger extent when flood risk is assessed in isolation, compared to a situation where flood risk is considered alongside a range of other risky outcomes. These other risks may compete for the attention of the individual, who may then focus on one or a subset of the constituent risks, or apply importance weights to each risk when deciding whether to purchase insurance. The latter would also diminish the impact of experience with one of the component risks, which may have been disregarded or applied a low weight in the decision making process. These speculations are in line with a simple lexicographic decision heuristic (Bettman, 1979) and more in general with coherent heuristic-based frameworks in economic decision making (Mousavi, 2018). They are also in line with weighted additive mechanisms of choice behavior (Scheibehenne et al., 2007), as well as our results which show that flooding experience raises demand for single policy flood coverage, whereas there is no significant influence of flooding experience on demand for bundled insurance.

Conclusion

There has been very little research conducted to date on whether individuals prefer natural disaster insurance offered separately, or bundled alongside other perils, despite the prevalence of such bundled insurance in several countries. In this paper we sampled 597 homeowners in the Netherlands and the UK to assess demand for bundled insurance and insurance that covers the component risks separately. We also examine factors that may influence whether individuals prefer bundled over single policy insurance, such as risk preferences, natural disaster experience and socioeconomic variables. Our findings reveal that, compared to Dutch residents, individuals who reside in the UK have a lower preference for bundled insurance that includes flood coverage over single policy insurance. This effect appears to be partly driven by observed differences of residents between the two countries, i.e. whether individuals have been flooded in the past. We suggest several implications for policy on the basis of our results. An insignificant effect of bundling flood coverage on flood insurance uptake in the Netherlands means potential policymakers may expect the impact of bundling on flood insurance penetration rates to be relatively minor. Whereas, offering voluntary flood coverage as a bundled policy, in areas where flood damages are common, may negatively affect penetration rates, compared to offering flood coverage as a separate policy.

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