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No. 2010 | October 2015

Web: www.ifw-kiel.de

Kiel Working Paper No. 2010 | October 2015

Eliciting preferences for public goods in non-monetized communities: Accounting for preference uncertainty

Andreas Pondorfer and Katrin Rehdanz

Abstract:
One major challenge when conducting contingent valuation studies in developing countries is the choice of the appropriate payment vehicle. Since regular cash-income does not exist for the majority of the population and market integration is low, households in rural areas have less experience with monetary exchanges. In these cases labour time may be a more appropriate payment vehicle. A common finding of studies using labour time as the payment vehicle is that households are more often willing to contribute working time as compared to money. However, so far empirical evidence is missing if the labour time elicitation format reduces respondent's uncertainty of contributions.
In this study we analyze and compare uncertainty of people's stated willingness to contribute (WTC) time and money for a local public good in a non-monetized small-scale community in Bougainville, Papua New Guinea. We do so by establishing an open-ended method for eliciting people's WTC, the Range-WTC-method, which elicits the upper and lower bound of a person's WTC. We find that uncertainty is reduced when respondents are asked for labour time contribution instead of monetary contributions. Thus, we provide empirical evidence that, indeed, labour time is the preferred to money in the elicitation of stated WTC in non-monetized communities.

Keywords: Contingent valuation, Non-monetized community, Payment vehicles, Preference uncertainty

JEL classification: D81, Q51, Q56

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***** Financial support from the German Federal Ministry of Education and Research through the project "BIOACID (03F0655H)" is acknowledged. We thank Gianluca Grimalda and Ulrich Schmidt for their helpful comments and suggestions. Furthermore we thank all the research assistants in Bougainville for their valuable support, in particular Eliuda Rigamu and Enoch Magum.

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1. Introduction

A large literature exists that investigates people's preferences for environmental goods and services that are not traded on markets, but only few of them elicit preferences in the context of developing countries. Because of lack of sufficient data for revealed preference studies, these studies mostly rely on stated preference approaches. An issue which is then of major importance is the elicitation of the willingness to pay (WTP) posing many challenges.[1]

One such challenge is the choice of the payment vehicle. Since regular cash-income does not exist for the majority of the population and the exchange of goods and services is augmented trough barter or work exchange, the role of money in the rural developing setting is likely to be different from that of an urban developed setting. It is, therefore, argued that contributions in the form of work time may seem more realistic for rural households in non-monetized communities (see for instance Hardner 1996; Hung et al. 2007; Casiwan-Launio et al. 2011). According to previous findings, comparing labour time and money contributions, acceptance rates for the willingness to contribute (WTC) time are higher than for money (see Gibson (2015) for a recent overview). These studies then conclude that the labour time payment vehicle is a valuable alternative to money in a rural developing setting.[2]

It is plausible to assume that people that are mainly engaged in subsistence activities have fewer difficulties in quantifying their disposable time budget as compared to disposable cash-income. However, to our knowledge, there is no empirical evidence, if respondents are actually more certain about their contribution when using labour time as the payment vehicle. In this study we, therefore, analyze and compare uncertainty of people's stated WTC time and money for a local public good in a non-monetized small-scale community in Bougainville, Papua New Guinea. We do so by establishing an open-ended method for eliciting people's WTC, the Range-WTC-method, which elicits the upper and lower bound of a person's WTC.[3]

The main justification for using Range-WTC instead of classical Point-WTC is the literature on preference uncertainty. Most of the contingent valuation studies that compare WTC time and money in developing countries use the open-ended method and elicit the WTC as a single point (see Swallow and Woudyalew 1994, Hardner 1996, Echessah 1997 Kamuanga et al. 2001, Arbiol et al. 2013, Vandolia et al. 2014).[4] A drawback of estimating the WTC as a single point is that it does not account for the uncertainty of preferences. Preference uncertainty may be caused by

[1] For a detailed discussion of the challenges associated with contingent valuation studies in developing countries, see Whittington (2002).

[2] Usually these studies convert labour time contributions into monetary contributions using information on local wage rates.

[3] There are two widely used methods – numerical certainty scale and polychotmous choice – for estimating preference uncertainty adjusted willingness to pay in contingent valuation (for a review see Akter et al., 2008). However, these methods are mostly applied in the context of dichotomous choices, while we aim to consider preference uncertainty in the context of an open-ended method.

[4] Other studies used closed-ended methods, for example Hung et al. 2007 and O'Garra 2009.

incomplete knowledge about the features of the object under evaluation or simply by the fact that a person is unsure about her own preferences (March 1978; Ariely et al. 2003; Gregory et al. 1993; Jacowitz and Kahnemann 1995). Due to vagueness of preferences, people often have only regions of indifference instead of well-defined indifference curves (Loomes 1988; Butler and Loomes 2007; 2011), a fact that challenges the existence of a single Point-WTP (Dost and Wilken 2012; Hanley et al. 2009; Wang et al. 2007). As a consequence, the classical CV method may impose unrealistic cognitive demands on respondents. It was this point that at an early stage prompted Dubourg et al. (1997) to argue in favour of analysing WTP confidence intervals.

The present paper contributes to the existing literature in various ways. To our knowledge, we are the first to show that uncertainty decreases when respondents are asked for time contributions instead of money. Thus, we provide empirical evidence that the use of working time as a payment vehicle can produce more reliable welfare estimate than the use of money. Further, we improve techniques of existing contingent valuation studies that compare labour time and monetary payment vehicles. While Wang et al. (2007) have shown that Range-WTP is better than Point-WTP for predicting purchase probabilities of consumer goods, Kniebes et al. (2014) were the first to test in a contingent valuation study if the Range-WTP is consistent with theoretical expectations eliciting WTP for non-market goods. We take a step forward and apply the Range-WTP method among respondents of a non-monetized community in a developing country. In doing so, we account for the uncertainty of respondent's preferences. This setting is an improvement relative to the literature initiated by previous CV-studies, which compare payment vehicles by eliciting the WTC as a single-point.

The remainder of the paper is organized as follows: Section 2 provides an overview of the elicitation approach. Section 3 includes a short description of the study area (3.1), outlines the survey design and sampling strategies (3.2) and the methodology used in the analysis (3.3). Section 4 provides the empirical analysis and results. Section 5 concludes.

2. The elicitation approach

Building upon previous work in marketing science (Wang et al. 2007, Dost and Wilken 2012), we follow first advances of Kniebes et al. (2014) in non-market environmental valuation and establish the open-ended method, the Range-WTP method, for eliciting preferences for non-market goods in non-monetized communities. This measure is designed specifically to reflect the effects of uncertainty in purchase decisions.

Figure 1 illustrates the concept of the Range-WTC. Contrary to point-based WTC measures, the range concept introduces two thresholds: the lower bound (LB) below which respondents would definitely contribute (choice probability of 1) and an upper bound (UB) beyond respondents would no longer contribute (choice probability of 0). In the interval between the LB

and UB, respondents are indecisive about contributing (choice probability between 0 and 1).[5] The difference between these thresholds is the WTC range and is indicative of the degree of uncertainty (Kniebes et al. 2014, Maier et al. 2014, Schlereth et al. 2012; Wang et al. 2007).

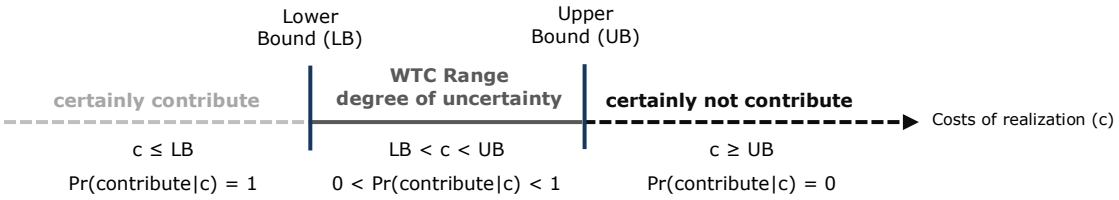

Figure 1: WTP as a range (adapted from Wang et al. 2007, Dost and Wilken 2012 and Kniebes et al. 2014)

In a set-up involving 175 customers, Wang et al. (2007) test the range approach in an experimental elicitation of consumers' reservation prices for chocolate and red wine. They assume linear decreasing purchase probabilities between the lower bound (100%), indifference range (50%) and upper bound (0%). A lottery ensures incentive compatibility, e.g. if the randomly drawn lottery price is lower than the lower bound, then the respondent must buy the good at the drawn lottery price. They conclude that the WTP-range performs better than point-based methods in terms of predictive performance while yielding valuable information about uncertainty in product valuation. In line with Wang et al. (2007), Dost and Wilken (2012) also provide empirical evidence that "traditional" point-based methods measure expected WTP and neglect individual uncertainty, which exists even for daily-use products, such as glasses of caffè latte. They argue that point-based methods produces biased pricing which results in poor estimates of production capacities. Because this effect tends to grow with the variance caused by consumer uncertainty, they particularly recommend range-based methods for new or unfamiliar products, as well as public goods. Related, Kniebes at el. (2014) are the first to test if the Range-WTP is consistent with theoretical expectations eliciting WTP for non-market goods. In their CV study they test theoretical validity and reliability of the two open-ended elicitation formats, the traditional approach of eliciting a single value and the Range-WTP. Using data from two large-scale surveys on the perceptions of solar radiation management, a little-known technique for counteracting climate change, they find evidence that the Range-WTP method clearly outperforms the Point-WTP method.

We follow the approach of Kniebes et al. (2014) and apply the range-based method for eliciting contributions to a hypothetical public good. In doing so, we are interested in comparing the degree of uncertainty between monetary and labour time contributions in a non-monetized economy.

[5] The procedure assumes that contribution probability decreases linearly between the LB and UB.

3. Methodology and data

3.1 The study area

The data for our analysis comes from a survey conducted in coastal villages in the northeastern part of Bougainville Island, Papua New Guinea, in October to November 2014. Bougainville is located in the Pacific Ocean and is exposed to a large number of natural hazards including earthquakes and tsunamis.[6] In combination with low adaptive capacities and economic development opportunities this makes the island state and its many coastal communities particularly vulnerable. So far, protective measures like tsunami evacuations routes have not been implemented. Alerts through warning systems are available via mobile phone but are more or less rejected by the local population perhaps due to lack of knowledge.

We recruited respondents from small settlements of the Teop society at Tinputz district. Teop people live in villages that vary in size from 50 to 200 people, and are either located along the coast or in the hills. Their subsistence is based on horticulture and pig husbandry, supplemented by fishing, hunting and foraging (Regan and Griffin 2005). Some of the surplus from the subsistence sector is sold on markets. Cocoa and copra are the main commercial crops. These crops are harvested several times a year and sold to intermediaries in one of the larger capitals at the coast. At present, there are hardly any possibilities for engagement in wage labour on Bougainville except for government occupations. Thus, regular cash-income does not exist for the majority of the population.

3.2 Survey design and sampling

The questionnaire was structured as follows: First, respondents were informed about how tsunamis arise and the possible consequences of such an event for coastal communities living in this area. Then, they were made aware of the fact that people's life could be saved by evacuating them in case of emergency.[7] We visualized an example of such an evacuation route (see Figure A1 in the Appendix) and gave details about the necessary tasks associated with its implementation. Then, respondents were asked to imagine a hypothetical situation in which the evacuation route would be constructed in their village. Next, respondents were asked for their willingness to contribute to support the construction of the route in terms of labour time and money. The questions for monetary and labour time contributions were presented in randomized order as to not bias results. We choose the following elicitation format: Respondents were always asked first to state a lower bound (LB) and an upper bound (UB) of their willingness to contribute money and labour time (measured in hours). The lower bound was elicited by asking respondents to state the amount of money (hours) that they would definitely be willing to contribute to support the construction of the evacuation route. The upper bound was elicited by asking respondents to state

[6] http://earthquake.usgs.gov/learn/glossary/?termID=150

[7] The English translation of the information provided to the respondents is presented in Table A1 in the Appendix.

the amount of money (hours) at, or above, which they would definitely not be willing to contribute to support the construction. In addition to the elicitation of the willingness to contribute, we collected socio-economic and demographic characteristics of the respondents.

A total of 195 participants – 102 male and 93 female - voluntarily participated in the interviews across multiple villages. Recruitment was done by drawing a random sample from a residence list. In some cases these lists were already available, in some other cases we asked local village chiefs to prepare one. Each respondent was given the questionnaire in a face-to-face interview which was conducted by local research assistants supervised by the researchers. Before the interviews were conducted, the survey was discussed among focus groups and then pretested with a small sample of randomly selected respondents. Figure 2 displays a map of the area and the villages included in the survey.

3.3 Methodology

To test if the payment vehicle has an effect on preference uncertainty we first present descriptive statistics of the LB and the UB for each payment vehicle separately. Subsequently, we compare LB's and UB's to the average local wage level and the average daily working hours by applying mean comparison tests (t-test). This is done to identify a possible reference point which may be used by respondents to categorize contributions into a certain and uncertain part.

To compare uncertainty between labour time and monetary contributions independent from conversion issues and level of contributions, we had to convert the information obtained from the survey participants. We, therefore, specify uncertainty as the relative deviation of the LB from the UB. We test the statistical difference of uncertainty by applying a mean comparison test (t-test).[8] Finally, to confirm the robustness of the results, we run ordinary least square regressions where we control for socio-economic and regional characteristics of the respondent and the study area. The regression analysis also allows us to investigate factors that determine the uncertainty of contributions.

4. Empirical analysis and results

4.1 Descriptive statistics for the two payment vehicles

Table 1 provides summary statistics of the respondents' age, education level, main activity as well as the household income and the size of the household they are living in. In addition to statistics for the sample as a whole, the table also provides information by gender. It is interesting to note, that there are few differences between men and women regarding education, age and monthly

[8] The results presented in section 4.1 and 4.2 are robust to using Wilcoxon rank-sum test.

income, but significant differences with respect to main activities (χ^2, $p < 0.01$).[9] Women are less engaged in farming and fishing, but more engaged in housekeeping and teaching.

Table 1 about here

Table 2 presents descriptive statistics of the lower bound (LB) and upper bound (UB) of money and labor time contributions, respectively. LB reflects the amount at which or below respondents would contribute for sure to support the construction while UB stands for the amount at or above which respondents reject to support the construction. The difference between UB and LB defines the degree of uncertainty.[10]

Table 2 about here

Focusing on the monetary contributions first, the mean LB of 16.57 Kina corresponds well to the mean local daily wage of 18.42 Kina.[11] A one-sample t-test confirms that the average amount which participants would contribute for sure (LB) is statistically not distinguishable from the local average wage (16.57 vs. 18.42, $p = 0.43$). However, the mean UB of 43.21 Kina is about 2.6 times larger than the LB and statistically different from the local average (43.21 vs. 18.42, $p < 0.01$). Turning to labour time contributions, the mean LB of 4.04 h is about one hour lower than the mean local daily working hours of 4.99 h. The difference is statistically significant (4.04 vs. 4.99, $p < 0.01$). Similar to above, the mean UB of labour time contributions is about 2.2 times larger than the local average and statistically different from the mean of the daily working hours (9.05 vs. 4.99, $p < 0.01$).[12]

Figure 3 combines the mean values for LB and UB with the mean values of local wages and working hours separately for monetary (above) and labour time (below) contributions. The amount of money (hours) which participants would contribute for sure (LB) is at (below) the level of local wages (working hours). The difference between LB and UB indicates the degree of uncertainty. As Figure 3 demonstrates, the mean LBs are very close to local averages for wages and working hours. They seem to represent a reference point for respondent's answers: contributions below this point are more certain compared to contributions above this point. In other words, the size of the contribution is more certain when the costs for supporting the project are equal (lower) than earnings from daily wages (working hours).

Figure 3 about here

[9] Chi-square tests are used for testing socio-economic differences between men and women.
[10] Note that the number of observations differs slightly between the two payment vehicles due to missing values.
[11] We asked respondents to state how much they would pay others for a full day of work; the average payment per day is 18.42 Kina (S.D. 6.66).
[12] We asked respondents to state how much they work on average during the day; respondents work 4.99 h on average (S.D. 3.27).

4.2 Comparison of the two payment vehicles

To compare the two payment vehicles, monetary and labour time contributions, previous studies have converted labour time contributions into monetary contributions using information on local wage rates (see e.g. Gibson et al. 2015 or Vandolia et al. 2014). As the authors of these studies point out, the results are sensitive to alternative conversion factors. To compare uncertainty of monetary and labour time contributions independent from conversion issues, we define uncertainty as relative deviation of the LB from the UB:

$$uncertainty_{i,j} = \frac{UB_{i,j} - LB_{i,j}}{UB_{i,j}}; \qquad i = 1,2,\dots,N;\ j = l,m \tag{1}$$

with *j* being the payment vehicle (either labor (*l*) or monetary payment vehicle (*m*)) and *i* the respondent). This measure of uncertainty has the advantage that we can take into account the level of contribution of a respondent. A simple example illustrates the advantage: A difference between LB and UB of 10 cannot unambiguously be considered small or big; only a reference to the UB (equivalently, the LB) permits a classification of its size. If the UB is 20, the LB is half of the UB (20 – 10 = 10), so the degree of uncertainty is relatively big (20 – 10) / 20 = 0.5). In contrast, if the UB is 100, the LB amounts to 90, which makes the degree of uncertainty relatively small (0.1).

Before turning to an analysis on the level of the individual level, Figure 4 presents the mean values of the relative deviations for monetary and labour time payment vehicles. Table 3 presents descriptive statistics in more detail. The mean level of uncertainty of labour time contributions is significantly smaller than the mean of monetary contributions (0.48 vs. 0.60, $p < 0.01$). Hence, uncertainty is reduced when people are asked for labour time contributions instead of monetary contributions.[13]

Figure 4 about here

Table 3 about here

To ensure that the differences in the means are not confounded by different background characteristics of respondents or geographical characteristics of individual villages, we specify the following linear regression model:

$$y_{i,j} = a + \gamma D_{i,j} + \beta x_i + \varepsilon_i; \qquad i = 1,2,\dots,N;\ j = l,m \tag{2}$$

where $y_{i,j}$ represents the uncertainty of respondent *i* for payment vehicle *j* as defined in Eq. (1). The dummy variable D takes the value 1 for the labour payment vehicle and 0 for monetary payment vehicle. The parameter γ captures the difference in uncertainty between the two payment

[13] The results are confirmed, when following the approach of earlier studies using the local minimum wage rate to convert labour time contributions into monetary contributions. The mean LBs for the two payment vehicles are statistically not different but the mean UBs are; i.e. uncertainty of monetary contributions is larger than uncertainty of labour time contributions.

vehicles. The vector x_i contains a set of socio-demographic and regional characteristics including among others gender, age, education level, household size, marital status, and daily working hours. β is a vector of parameters to be estimated. The intercept is denoted by a and ε_i is the error term.

Table 4 presents results from a simple ordinary least square regression. The basic specification (1) controls for respondents' gender and the payment vehicle. Specification (2) extends the basic specification by participant's daily working hours. In specification (3) we add further demographic and socio-economic characteristics.[14] All specifications include village fixed effects and controls for interview effects (i.e., question order and enumerator effects).

Table 4 about here

The regression results confirm our earlier results based on descriptive statistics; significant differences in uncertainty exist between labour time and monetary contributions. The coefficient of the labour time dummy is negative and highly significant in all specifications. Thus, when respondents were asked for labour time contribution, is reduced by about 11 percentage points compared to the elicitation using monetary contribution. In none of the specifications has gender an effect on uncertainty. Extending the model to control for further socio-demographic characteristics of respondents, longer working hours significantly reduce uncertainty independent of the payment vehicle; an additional working hour per day reduces uncertainty by 1.3 percentage points. Thus, people who work longer during the day compared to others are less uncertain about their contributions. All other socio-economic and demographic characteristics except for age have no significant impact on uncertainty.[15] Older respondents have significantly higher levels of uncertainty compared to younger ones.

To test the robustness of specification (3) we run regressions where we include additional factors that may influence uncertainty. More specifically, we would expect those that are more risk averse, those that live closer to the coast, and those that are afraid of a tsunami event in the future to be less uncertainty. Table 5 shows the results of the robustness analysis. We find sizeable effects for the new control variables. In particular, we find that that people in coastal villages (column 1), with higher levels of risk aversion (columns 2) and those with apprehension of a tsunami event (column 3) are significantly more certain about their contributions. These findings are as expected. However, the main finding remains: the coefficient of the payment vehicle dummy is significant, negative and of similar size compared to previous regression models. Thus, respondents are significantly less uncertain when they were asked for labour time contributions. The results for the other control variables are unchanged.

Table 5 about here

[14] Due to missing observations for some socio-demographic characteristics the sample for specification (3) reduces from 386 to 363. For comparison, we estimate all specifications with this reduced sample.

[15] We have also varied the specification of income and education, but the coefficients were never significant and more importantly, did not effect of our main variable of interest, the payment vehicle.

5. Conclusion

In the context of rural households in developing countries, previous studies suggested the use of labour time as an alternative payment vehicle to money for the elicitation of WTC (see Hardner 1996; Hung et al. 2007; Casiwan-Launio et al. 2011). The aim of this paper is to address the issue of uncertainty in the comparison of people's stated WTC time and money for a local public good in a non-monetized small-scale community.

Using the Range-WTC method in a contingent valuation study, we find strong evidence that the degree of uncertainty is reduced in stated WTC when respondents were asked for working time contributions instead of money. To avoid conversion issues we define uncertainty as the relative deviation of the amount at which or below respondents would contribute for sure from the amount at or above which respondents would not contribute.

We also analyzed factors determining the degree of uncertainty. In line with expectations, people who have a greater workload during the day (e.g., working close to the daily maximum), are less uncertain about their contributions. This effect holds for both payment vehicles. It can be argued that people who work relatively more have less additional time to allocate and are, therefore, more certain about their contribution. Similar, people with a higher work load are more likely to earn cash-income. These people might be, therefore, more certain about the value of money.[16]

Furthermore, we find evidence that people use the local wage (working time) level as a reference point for dividing contributions into a certain and uncertain part. For both payment vehicles, contributions that lie below the local wage rates can be perceived as relatively certain while uncertainty is increasing with the distance to the local wage (working time) level. Our results provide, therefore, also valuable information to decision makers in non-monetized communities using cost-benefit analyses as one basis for decisions on environmental projects.

However, it is deterred to future research to generalize our findings to other cultural settings and to other public goods. Another promising direction is to address the issue of uncertainty in the comparison of people's revealed and stated WTC time and money for a local public good. By applying the Range-WTC, one can then analyze the size of hypothetical bias that originates from uncertainty in both payment vehicles.

[16] In our sample, working hours is significantly and positively correlated with monthly income ($\rho = 0.14$, $p < 0.01$).

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Table 1: Descriptive statistics

	All subjects	**Men**	**Women**
	mean (s.d.)	mean (s.d.)	mean (s.d.)
Age (years)	38.43	39.41	37.39
	(12.49)	(13.33)	(11.53)
Household size	5.94	6.27	5.59
	(3.09)	(3.59)	(2.41)
	percent	percent	percent
Education			
Less educated (below 8 years)	48.20%	46.10%	50.50%
More educated (above 8 years)	51.80%	53.90%	49.50%
Main activity			
Farmer	60.50%	69.60%	50.50%
Fisher	8.70%	11.80%	5.40%
Housekeeping	20.00%	7.80%	33.30%
Wage Labour	2.60%	2.90%	2.20%
Pupil/Student	3.60%	3.90%	3.20%
Teacher	2.10%	0.00%	4.30%
Other	2.50%	4.00%	1.10%
Monthly income			
Category 1 (0 to 30 Kina)	16.00%	15.70%	16.30%
Category 2 (31 to 200 Kina)	66.00%	63.70%	68.50%
Category 3 (above 200 Kina)	18.00%	20.60%	15.20%
Observations	195	102	93

Table 2: Descriptive statistics of contributions by payment vehicle

	monetary contribution (Kina)		**labour time contribution (Hours)**	
	lower bound (LB)	upper bound (UB)	lower bound (LB)	upper bound (UB)
Mean	16.57	43.21	4.05	9.03
S.D.	32.34	47.26	4.05	9.65
Observations	195	195	191	191

Note: 1 Kina = 0.37 US-Dollar

Table 3: Descriptive statistics of relative uncertainty by payment vehicle

	monetary payment vehicle	**labour time payment vehicle**
Mean	0.60	0.48
S.D.	0.23	0.20
Observations	195	191

Table 4: Regression results

	(1)	**(2)**	**(3)**
Payment vehicle (1=labour time, 0=money)	-0.110***	-0.110***	-0.109***
	(-0.021)	(-0.021)	(-0.021)
Gender (0=male, 1=female)	0.001	0.002	-0.005
	(-0.022)	(-0.021)	(-0.026)
Daily working hours		-0.013***	-0.014***
		(-0.003)	(-0.003)
Income (category 1 (low) to category 3 (high))			0.008
			(-0.018)
Education (1=more educated, 0= less educated)			-0.034
			(-0.023)
Age			0.002**
			(-0.001)
Constant	0.709***	0.808***	0.799***
	(-0.093)	(-0.095)	(-0.113)
Village fixed effects	Yes	Yes	Yes
Interview effects	Yes	Yes	Yes
Additional socio-economic controls	No	No	Yes
N	364	364	364
R-sq	0.21	0.24	0.26

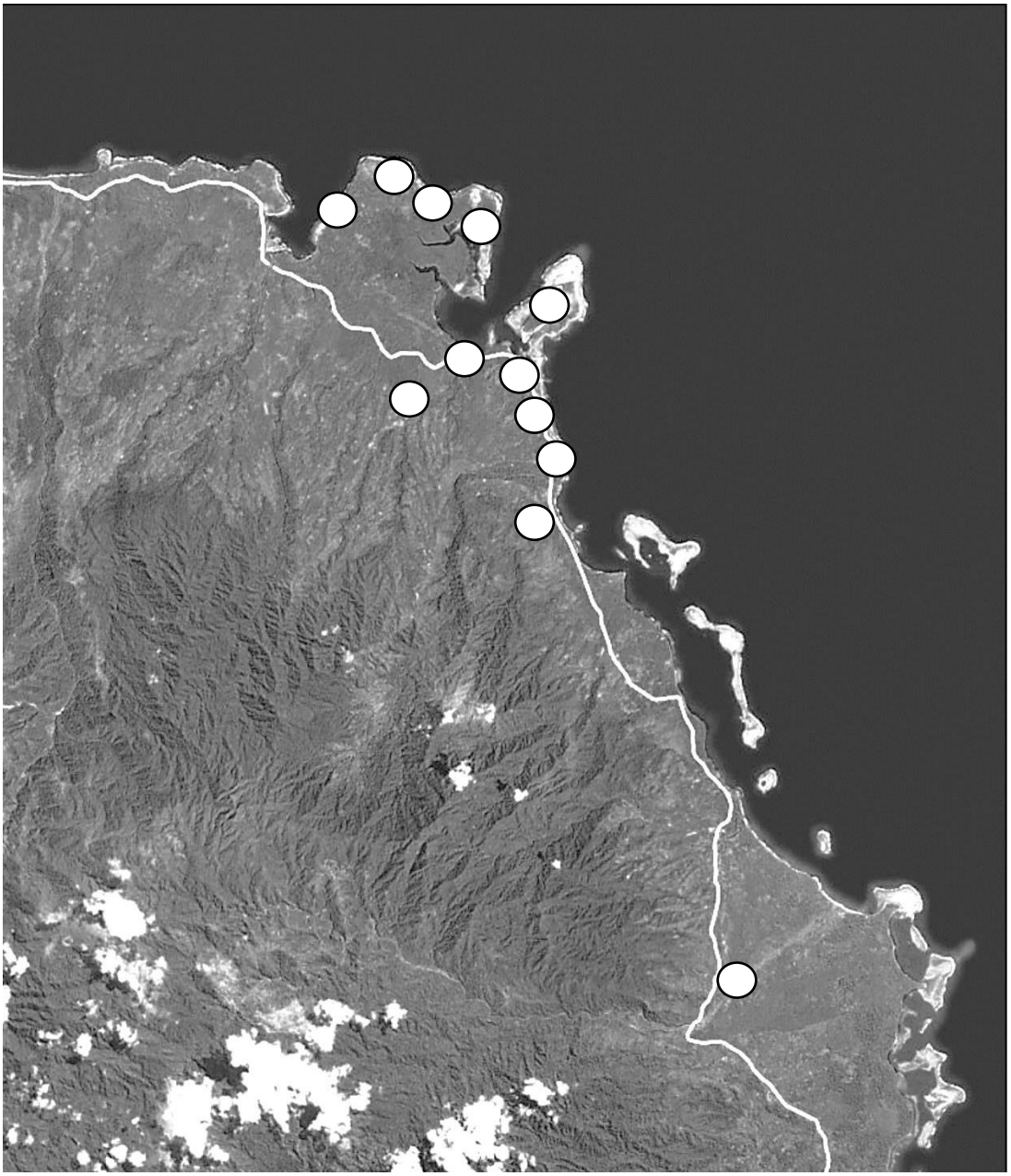
Dependent variable: Uncertainty (relative deviation of LB from UB)
Interview effects: question order and enumerator effects.
Additional socio-economic controls: marital status, main activity, household size, and household head.
OLS-regression, robust standard errors in parentheses
[a]Note that observations do not sum up to 386 (195+191) because of missing values. We only include respondents where we have full information on socio-economic and demographic characteristics.
* statistical significance at the 10 % level
** statistical significance at the 5 % level
*** statistical significance at the 1 % level

Table 5: Regression results

	(1)	(2)	(3)
Payment vehicle (1=labour time, 0=money)	-0.108***	-0.110***	-0.108***
	(-0.021)	(-0.02)	(-0.021)
Gender (0=male, 1=female)	-0.015	0.000	0.008
	(-0.026)	(-0.026)	(-0.026)
Daily working hours	-0.013***	-0.013***	-0.013***
	(-0.004)	(-0.003)	(-0.003)
Income (category 1 (low) to category 3 (high))	0.008	-0.002	0.000
	(-0.017)	(-0.018)	(-0.019)
Education (1=more educated, 0= less educated)	-0.026	-0.03	-0.03
	(-0.023)	(-0.023)	(-0.024)
Age	0.003**	0.002**	0.002*
	(-0.001)	(-0.001)	(-0.001)
Coast (1=coastal village/island, 0=hinterland)	-0.091**		
	(-0.040)		
Risk aversion (1=risk averse, 0=risk seeking)		-0.065***	
		(-0.024)	
Apprehension (1= very afraid, 0 = otherwise)			-0.107***
			(-0.031)
Constant	0.943***	0.729***	0.531**
	(-0.126)	(-0.110)	(-0.249)
Village fixed effects	No	Yes	Yes
Interview effects	Yes	Yes	Yes
Additional socio-economic controls	Yes	Yes	Yes
N[a]	364	364	355
R-sq	0.20	0.27	0.29

Dependent variable: Uncertainty (relative deviation of LB from UB)
Interview effects: question order and enumerator effects.
Additional socio-economic controls: marital status, main activity, household size, and household head.
OLS-regression, robust standard errors in parentheses
[a] Note that observations in specification 3 do not sum up to 364 due to missing values in the Apprehension variable, see also Table 4.
* statistical significance at the 10 % level
** statistical significance at the 5 % level
*** statistical significance at the 1 % level

Figure 2: Map of the study area (northeastern part of Bougainville island)



the white circles represent villages where the survey was implemented

Figure 3: Mean values of LB and UB by payment vehicle

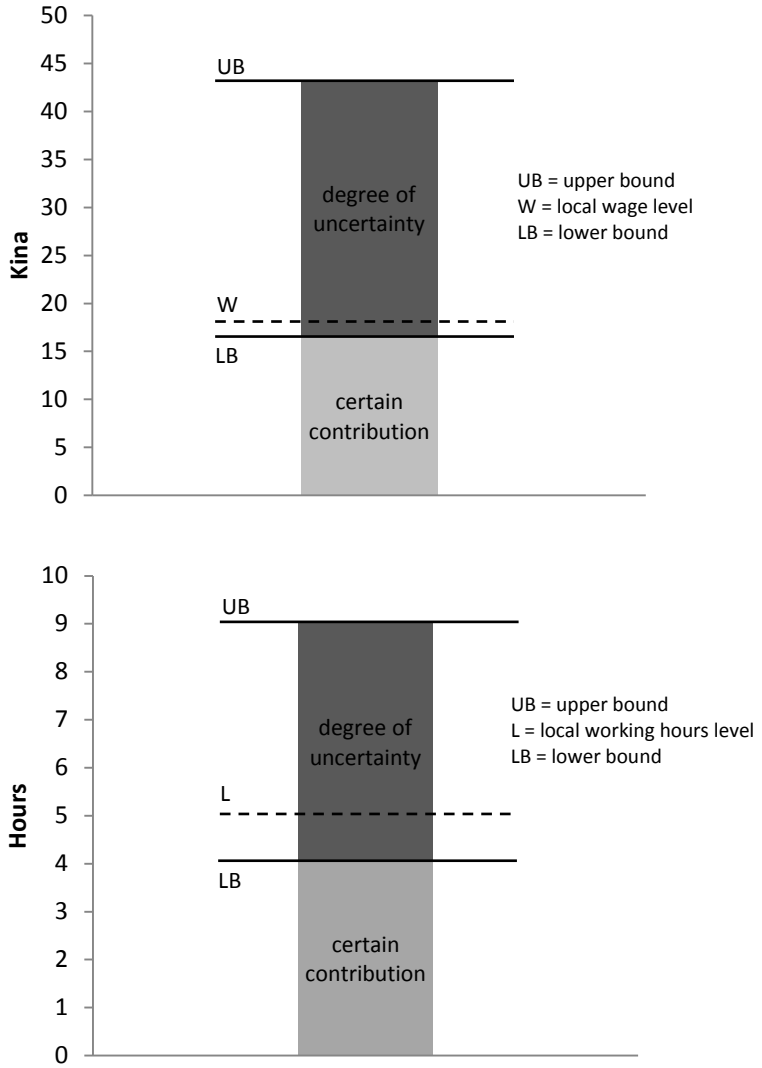
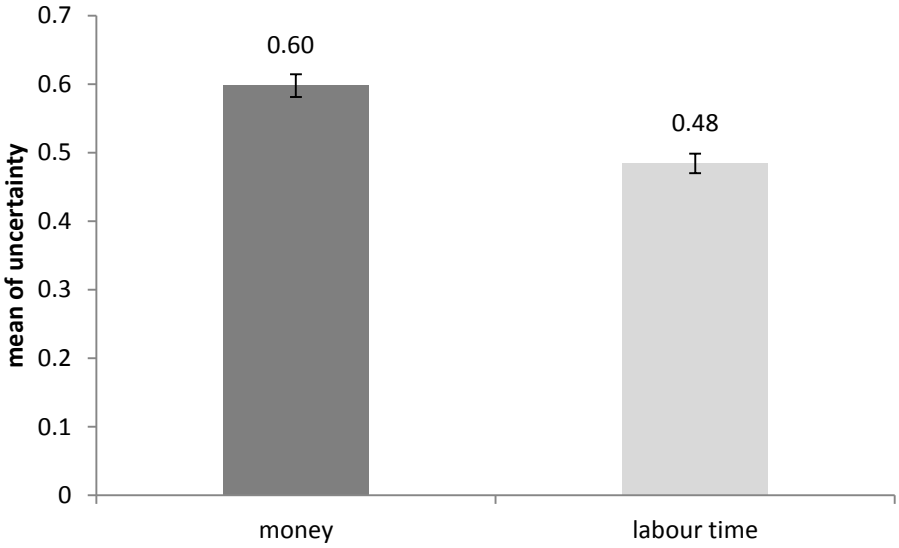


Figure 4: Mean values of relative deviation of LB from UB by payment vehicles



Appendix

Table A1: Information Text

[*Read out the following text slowly and make sure that respondent understands everything*]

As you may know from own experience, earthquakes of different power occur frequently on Bougainville. For example, earlier this year there were several strong earthquakes within a few days that destroyed houses and other parts of villages in several areas of Bougainville.

For people like you living near the coast, earthquakes entail the additional threat of a tsunami. Earthquakes that occur in the open sea close to the coast can cause big waves (tsunami). If these waves arrive at the coast, they can cause devastating floods. Depending on the power and location of the earthquake, these floods can then destroy everything close to the coastline including beaches, trees, streets, houses and even whole villages. Further, a tsunami can put people's life in danger if they are not evacuated before the waves reach the coast.

Tsunamis cannot be prevented. However, in case of emergency people's lives can be saved by evacuating them. In order that people know where to go if a tsunami occurs, an evacuation route for your community could be built **[show picture of tsunami evacuation route]**. This evacuation route would enable people to reach a safe place (e.g. higher ground away from the coastline) in a short time. Signs will be needed along the evacuation route to direct people in case of emergency. They also help people to find the right way even if they are in a hurry. Further, to make evacuation possible for children, old people and disabled people, railings will need to be built at places that cannot be easily passed, for example bridges over streams or handrails along steep slopes.

In your community members could be saved from future events by implementing such an evacuation route. Constructing the evacuation route would include the following tasks:

- **Purchasing materials** for bridges and handrails (e.g. timber and ropes);
- **Purchasing weatherproof signs** that indicate the evacuation route;
- **Constructing the evacuation route.** This includes physical tasks like cutting bushes, constructing handrails and bridges, placing the signs along the route.
- **Cleaning up the route after construction.** This includes physical tasks like collecting and putting away groove, waste and other construction materials.
- **Providing food and water** for community members and other people who work on the construction

The construction of this route can be done by community members and other people. However, before any decision about planning or constructing of this route is made, we want to know what people in your community think about such a project. In the following we would like to know what you think about this evacuation route and if you would personally contribute to its construction.

[*Go on to the next page and start with questions B.02 to B.06*]

Table A2: Willingness to contribute elicitation

Please **assume** that the evacuation route will be constructed in the near future.

B.03	B.04
Would you be willing to contribute **money** to the construction of the evacuation route? 1 Yes → B.04 2 No → B.05	In the following we are asking for **two different things**: 1) **How much Kina would you for sure contribute** to support the construction of the evacuation route? (*Write down amount of Kina*) _____**Kina** 2) **At or above which amount of Kina would you for sure not support** the construction of the evacuation route? (*Write down amount of Kina*) _____**Kina** Naturally, **the amount of money** that you announce **in the first question** – the money you would give for sure – **is smaller than the amount of money in the second question** which represents a kind of **upper limit at which** you would **not support** the construction of the evacuation route (money you would not spend since it would be too much). Please be as realistic as possible. Remember that you have daily and monthly expenses for food (e.g., rice, tea, sugar) and other consumables (e.g., clothes, benzin, seeds). → *go on with B.05*

B.05	B.06
Instead of money, you could also contribute part of your time. Would you be willing to contribute **part of your time** to the construction of the evacuation route? 1 Yes → B.04 2 No → C.01	In the following we are asking for **two different things**: 1) **How many hours would you for sure contribute** to support the construction of the evacuation route? (*Write down number of hours*) _____**Hours** 2) **At or above which amount of hours would you for sure not support** the construction of the evacuation route? (*Write down number of hours*) _____**Hours** Naturally, **the number of hours** that you announce **in the first question** – time you would spend for sure – **is smaller than the number of hours in the second question** (time you would not spend since it is too much). Please be as realistic as possible. Remember that you have demands on your time for example subsistence activities (including planting, fishing, housekeeping, etc) and social activities (like family affairs, meeting friends, community meetings, religious services etc.).

Figure A1: Picture of a tsunami evacuation route. This picture was shown to respondents during the interview