BENEVOLENCE AND THE VALUE OF STATISTICAL LIFE.

Draft version 3.a
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1999-03-11

Abstract

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1 Introduction

Road traffic accidents are the dominant negative externality in road transport and are used to motivate large road construction programmes. In Sweden approximately half of the benefit of road projects is reduced cost for the society due to increased safety. Road building is today as much about safety as about accessibility.

The values used to evaluate and motivate safety programmes are in many countries based on CVM-studies. These studies estimate the willingness-to-pay for a small risk reduction thanks to some private safety device. The derived value of statistical life (VOSL) is based on purely selfish preferences. However, a generally impression is that we also care about other persons safety. The willingness-to-pay for the safety of relatives, friends and not at least children could be an important component in the evaluation of safety programmes. To employ this kind of non-use values are common, although controversial, in environmental economics. The present paper estimates the magnitude of these values.

To manifest the importance of the traffic safety problem a new official policy to aim at zero-accidents has been launched in Sweden. We take opportunity of this discussion and conduct our CVM-study around a zero-accident programme in one city. The advantage will be a risk reduction that is easier to grasp for the respondents and are relevant for their daily life. The values we estimate are thus VOSL for a totally safe urban road transport system.

Transport safety can be achieved both through public programmes and private provision. Due to the public good characteristic of roads a large part of the safety improvements are due to public road construction and other public programmes. In a perfect world the sum of the private VOSL and the VOSL of relatives and friends would approximately be the same as the VOSL derived from the willingness-to-pay for a public programme. However, we expect individuals to be more negative towards public than private provision of safety. How large this discrepancy may be is finally discussed in the paper.

2 Benevolence in the Cost Benefit Analysis

Consider a proposed public road project that reduces the annual fatality risk for road-users. The project will be pursued if the project shows a positive net-benefit in a cost benefit analysis (CBA). A CBA takes account of several benefits; one is the improved welfare due to increased safety for the road-users themselves (**a**). A second component will be the reduced 'cold-blooded' material accident cost for the society at large (**c**) such as medical cost and lost net-production. These two components are non-controversial and are included as standard practice in CBA models such as COBA in UK and EVA in Sweden.

However, relatives and friends of each road-user would possible perceive an increased welfare and will thus be willing to contribute to the project (**b**). This third component is excluded in conventional CBA routines, which thus underestimate the social benefit of road safety improvements. To deny relatives[1] the right to contribute to their road-users increased safety is to deny consumer sovereignty in public decision-making. This observation is in the same spirit as Mishan (1971) and Viscusi (1988), the latter concludes - *'Consequently, benefits consist of two components: the private valuation consumers attach to their own health, plus the altruistic valuation that other members of the society place on their health'* (p 228). The project should go ahead if it pass the following test where **C** is the project cost including correction for indirect taxation and the excess burden of taxation[2] and **m** the marginal utility of money (Annex 7.1)

a+b+c > mC *(1.)*

The **a-value** can be derived from preferences represented by a traditional *selfish utility function*. However, the existences of a **b-value** presuppose preferences that include *benevolence* in some form. Assume that relatives have no direct utility from the road-users safety, i.e. they are neither depending on his income nor do they expect to inherit him. The most straightforward motive for a positive **b-value,** i.e. a non-use value of safety[3], is to assume that relatives bother only about the safety element in the road-users utility function. Relatives

[1] We will in the following only use the term relatives, which thus implicitly includes friends.

[2] This correction is not trivial. In Swedish official infrastructure planning the project cost is increased with 50% to reflect the additional welfare loss of indirect taxation and excess burden.

[3] The question of non-use value has been discussed mainly in relation to environmental good since Krutilla's essay (1967). Both existence and option values are common, although debated, to include as legitimate values in CBA (See Arrow et al 1993).

want their road-user to put more emphasis on safety then the user do as private decision-maker[4]; relatives are *safety paternalist* (Archibald et.al. (1976) and Jones-Lee (1992)). Alternatively, relatives derive utility from the road-users total utility. They want higher utility in general for the road-user and do not interfere with the road-users trade off between safety and other consumption. Relatives are *pure altruists*[5].

Pure altruistic relatives may consequently perceive a *reduced* welfare due to their taxpayers lost consumption. Assume that road-users are the sole contributors to the funding of the road, for example through an earmarked fuel excise duty. They will hence face a reduced consumption of **C** in exchange for the project. Define **g** as the reduced welfare of relatives when the user's income is reduced with 1 unit. Relatives will thus suffer a reduced welfare due to their benevolence towards the road-user/taxpayer of **gC** even if they are not affected *per se* by the reduced consumption. The proper CBA test will take the following form:

$$\mathbf{a(1+b/a)+c > C\mathtt{m}(1+g/\mathtt{m})} \qquad (2.)$$

With a *pure altruistic* utility function *relative's valuation ratio for safety* (**b/a**) will be identical with *relative's valuation ratio for money* (**g/m**) (see Annex 7.1). The CBA test collapse to (almost) a simple selfish CBA test only including **a** and **c**. This result has influenced the prevailing practice since Bergstrom (1982) picked it up[6]. Milgrom (1993) forcefully argued that '*there is a potential Pareto improvement if and only if the project passes the benefit-cost test with the altruistic value excluded'* (p421).

The precondition for this strong conclusion is that relatives are *pure altruists***.** In all other cases, including additional intermediate forms as paternalism with respect to both safety and general consumption, benevolence will influence the result of a CBA-test[7] but not always in a way that makes safety more important[8].

3 Purpose of the study

Relative's valuation of road-user safety may be of utterly importance in the evaluation of safety projects. Only a few studies have addressed this issue; Needleman (1976), Jones-Lee (1985) and lately Schwab and Christe (1995).

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4 This also mean that road users behaviour generates an externality towards relatives. However, it seems reasonable to assume that this imperfection is solved in a non-market transaction (Coase) without a need for governmental interventions.

5 All forms of preferences including benevolence may be seen as altruistic, i.e. also the safety paternalistic form. Hence the term pure altruism. In addition to the altruism discussed above which is selfish in the sense that individuals is assumed to maximise their own utility, albeit including others welfare, we may define genuine altruism as actions motivated solely by the utility of others („,„,).

6 The argument can be found already in Hochman and Rogers (1969). Olof Johansson suggested this reference to me.

7 It should be noted that in a world with both users (beneficiaries) and non-users (general public) the outcome of a CBA test would not be insensitive to the distribution of the taxburden (see McConnell (1995)).

8 If people get some 'warm-glow' effect from the act of contributing to the utility of others, i.e. *impure altruism* (Andreoni 1990/1989), and if this effect only occurs during an interview situation with the aim to estimate the **b-value**, values should not be included (see Khaneman and Knetsch (1992) and Hanemann (1994) for an introduction to this discussion).

Viscusi (1988) focus on the WTP for safety of all individuals in the society independent of their relationship.

First, we will examine the **b-value** in relation to the respondents' relatives and friends. Secondly, parents WTP for children safety will be examined. These values will be compared with a selfish **a-value** derived within the study with the same approach as used for the **b-values** and the result is expressed as a *relative's valuation ratio* and *valuation ratio for children*.

Thirdly, we will examine the difference between safety as a *private good*, *a household good* or a *public good*. With a positive **b-value** we expect the public good, which give safety to many persons, to be valued higher than the private or household good. We also expect the household good, which gives safety to all members in the household, to be valued higher than the private good. In the simplest case we assume the WTP for the public good to be of the same magnitude as the summary of the WTP for household's and relative's safety. Fourthly, we will pilot a test to identify if the preferences are of the safety paternalistic or the pure altruistic type.

4 Empirical study and result

We use a model of the simple single-period type where the individual at the beginning of the period faces two possible future states, having an accident with fatal or serious injuries as outcome or not having an accident. We ignore life insurance and bequest motives and employ a household view on the utility function. A household's preferences are represented by the well-behaved[9] utility function (3).

$$U^i = U^i\{x^i, z^i, S^i, z^j, x^j,\} \qquad i \neq j \tag{3.}$$

where $\mathbf{x^i}$ is a vector of consumption goods other than safety equipment, $\mathbf{z^i}$ is the annual risk of fatal or serious injury accidents for household members and $\mathbf{S^i}$ is a vector of household characteristics. The remaining two components reflect the household's benevolence towards other households; $\mathbf{z^j}$ is a vector of other households' annual risk and $\mathbf{x^j}$ is a matrix of other households' consumption goods, excluding safety equipment (see Jones-Lee 1992).

We have chosen to study *total safety* and *aggregated causalities* (fatalities and severe injuries). Consequently, the magnitude of the risk reduction will be larger than in traditional approaches (see e.g. Jones-Lee 1989). This approach is chosen because we believe that the 'total safety good' is more understandable than small reductions in risk-levels (i.e. "a 10% reduction in the risk 8/100.000"). The 'zero-accident programme' is today discussed in Sweden and in the municipality of Örebro. When the responses are compared to traditional approaches on values of statistical life we have arguments in favour for both a lower and a higher value. *First,* the budget constraint will be stronger than in questions about small reductions in only fatality risk and *secondly,* due to the 'diminishing returns on safety improvements' the responses should result in

[9] See e.g. Varian …..

lower values compared to traditional studies based on marginal risk changes. *Thirdly*, the good 'total safety' can be viewed as a different good with higher value compared to a safe good but nevertheless with a very small risk[10]. We can expect a *'certainty bonus' of approximately 100%*[11] (Viscusi 1998).

If the WTP for relative's safety improvements is positive the respondents express *non-selfish* preference, i.e. **b>0**. Given that the respondent has accepted a bid for relative's safety they are given the opportunity to buy a voucher to their relative which he may use for free consumption or to acquire the safety improvement. If a respondent accepts to buy the voucher he shows *pure altruistic* preferences[12]. If he doesn't, he shows *safety paternalistic* preferences. In addition to these private goods the preferences is examined in a public good framework. With *selfish preferences* the WTP for a safety improvement will be the same with a public good as with a private good. With *safety paternalistic* or *pure altruistic* preferences the WTP for the public good will, in a simple case, be above the WTP for the private good.

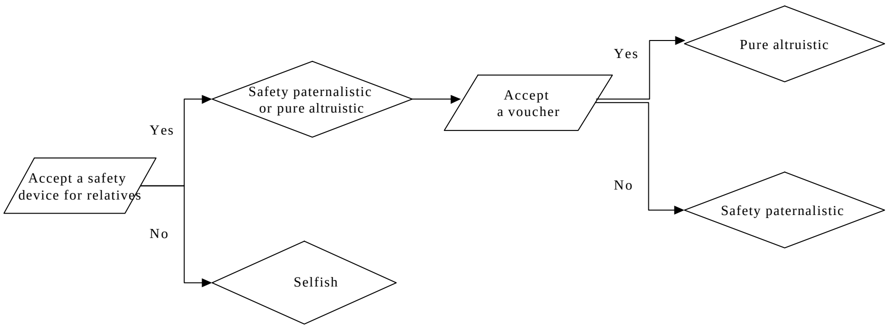

Figure 1 The chosen questionnaire principle

4.1 Sample

A mail survey was conducted in the city of Örebro, Sweden, in June 1998[13]. Örebro is the 8th largest city in Sweden with approximately 120.000 inhabitants situated 197 km west of Stockholm. The economy is dominated by the service sector (78% of employees) with a number of large public employers.

The sample consisted of 1950 individuals between 18 and 76 years old living in Örebro. The sample was split in five equal subsamples that received one of the

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10 Individuals may also have a willingness to pay a certain premium for a reduction in risk to zero. The bases for this can be explained with a perceived probability function where the individual overestimates small risks. When the actual risk approaches zero the perceived risk will approach a risk above zero. However, with sufficient information the individual will perceive the risk to be zero and a jump will occur in the perceived risk function. People are thus willing to pay a certainty premium for the assurance that the risk is zero (See Viscusi 1998 pp6).

11 The result in Viscusi (1998) implies a certainty premium of over 100%. With a starting risk of 15/10,000 and an actual risk reduction of 5/10,000 the WTP is $ 1.04 (per bottle insecticide). With the starting risk 10/10,000 and the same risk reduction the WTP is $ 0.34. For the starting risk 5/10,000 and a zero target risk, the WTP is 2,41$. The two first responses demonstrate the expected diminish willingness to pay while the last demonstrates the certainty bonus.

12 Another possibility is benevolence for both safety and consumption with stronger concern over consumption.

13 With a first reminder in August and a second in October

questions. One of the subsamples consisted of households with at least one child younger than 18 years old and they received a question on child safety; the addresses to these households were in the mother's name.

For one subsample the safety improvement is achieved through a *public* programme financed with earmarked charges while it for the other four groups are a *private* safety device, which is possible to hire on an annual basis. Both the public and the private good reduce fatality and severe injury probabilities in traffic within the municipality from the current level to total safety for the whole population respectively for the person using the device.

The mailing and recording of responses was carried out by the Swedish National Road and Transport Research Institute (VTI). The response rate (complete) was 55% excluding the 2% unknown addresses. The group of non-respondents consisted of 8%, which returned the questionnaire empty and 37% that did not respond at all. The average bid level among the non-respondents were slightly above (SEK 6542) the average in the actual sample (SEK 6399) due to high average bid level in questionnaire Q3 and Q4. However, in Q5 the bid level among the non-respondent is lower than in the sample. Among the complete responses the average bid (SEK 6158) was below the average in the sample. Women have a higher representation among the non-respondent (62%) compared to the actual sample (60%) and to the complete responses (59%). (Annex 7.2).

Table 1 Sample size and responses

Subsample	Sample size	Unknown	Non-response	Completed
Q1	390	9	159	222 (58%)
Q2	390	12	162	216 (57%)
Q3	390	9	179	202 (53%)
Q4	390	10	185	195 (51%)
Q5	390	4	170	206 (54%)
Total	1950	44	855	1040 (55%)

The gender representation among the complete responses was similar to the Swedish population (49% excluding Q5 compared to 50.4%). The average annual income per consumption unit (SEK 85,300) was below the Swedish average (SEK 96,100 (1995) (SCB 1997)). Three of the respondents have allocated more than 25% of the households' disposable income to the safety device[14]. All of them had very low income; a mother hiring a children device for the second highest bid; a person accepting the highest bid for a relative's device and one demanding more then ten extra devices for relatives. The two persons responding to questions about relatives had relatives with accident experience. Nevertheless, these three were taken out of the material on the ground that the accepted bid(s) constituted an un-proportional large part of the household's annual disposable income. The models were tested also including these observations without significant changes in the result (?).

[14] Response 963, 1468 in Q3 and 1844 in Q5.

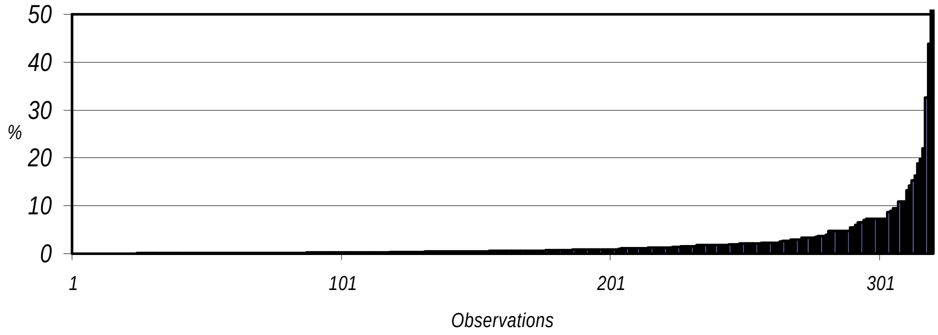

Figure 2 Total accepted bid cost as percentage of household net-income.

4.2 Questionnaire

Each of the subsamples got the same information about the survey and the same relevant background questions. They were informed about the number of fatalities and severe injuries in the Örebro traffic during 1996 and 1997 as well as the average over the years 1993 to 1997. Together with the information of the population the annual risk was presented (20/100,000).

"I Örebro kommun bor ca 120.000 invånare. I en grupp om 10.000 örebroare kommer alltså ungefär 2 personer att dödas eller skadas svårt i stadstrafiken årligen om inte säkerheten förbättras."

They were also informed about the distribution of the fatalities and severe injuries between modes of transport in a pie-chart (bicycle 66%, car 21%, pedestrian 10%, moped 2% and MC 1%) as well as the actual location of the last year's accidents on a town map.

Finally they were informed about the national transport policy which aims at reducing the number of fatalities and severe injuries in road traffic to zero in the future. This should not come as a surprise to the inhabitants of Örebro as the municipality have prepared a *'zero-accident programme'* which have been presented in the local press.

The payment vehicle for the public good was an annual fee earmarked for a traffic safety fund within the municipality. It was highlighted that all other individuals within the municipally also had to pay the fee.

"… förutsatt att du, tillsammans med alla andra örebroare, måste vara med och betala en särskild kommunal avgift till en trafiksäkerhetsfond för detta"
Q1 - "Skulle du vara beredda att betala 200 kronor per år i en avgift till en särskild trafiksäkerhetsfond i kommunen för att detta trafiksäkerhetsprogram ska genomföras i Örebro tätort?"

The private good was an unspecified safety device reducing the risk to zero for the user of the device. The safety device could be rented on an annual basis. In Q2 it was possible to rent only a private device. In Q5 the safety device was to be used by one of the respondents children younger than 18 years old and living at 'home'.

Q2. "Tänk dig att man får fram en trafiksäkerhetsutrustning vilken minskar risken för dödsfall och svåra skador till noll för de som har denna utrustning vid färd inom en stad, t.ex. Örebro tätort. Denna utrustning skall kunna användas av såväl gångtrafikanter, cyklister, som bilister.

Utrustningen kan hyras ett år i taget och minskar alltså risken till noll inom tätorten enbart för personen som hyr utrustningen; den kan inte användas av andra.

Kom ihåg att kostnaderna skulle behöva betalas från hushållets årliga inkomster.

- Skulle du hyra utrustningen till dig själv för <u>200 kronor per år</u>?"

In Q3 a device for the whole household and one or more for relatives were possible to rent. This type of question proved to be successful in the pre-test where also questions about moving to new areas and house prices were tested. In addition, if willing to rent the device for relatives, they were asked if they were prepared to buy a voucher for free consumption to their relatives. In Q4 the household question of Q3 was dropped and the subgroup was only asked about their willingness to pay for relatives safety and wealth in the same way as in Q3. Otherwise, the wording of the questionnaire was the same as in the 'private' questionnaire (Q2).

Q3a -Skulle du hyra en uppsättning sådana utrustningar åt alla personer i hushållet för totalt <u>400 kronor per år?</u>

Q3b & Q4b: Tänk dig att du också kan hyra <u>en</u> liknande utrustning till någon utanför hushållet (t.ex. en släkting eller vän). Utrustningen kan användas där personen bor. Personen har inte fått och kommer inte att få erbjudande om att hyra utrustningen själv. Du måste betala hyran själv och kan alltså inte kräva personen på ersättning.
- Skulle du hyra en liknande utrustning till någon <u>utanför hushållet</u> (släkting eller vän) för <u>zzzz kronor per år och person</u>?

Q3c &Q4c: Tänk dig att du fick möjlighet att hyra ytterligare utrustningar till samma hyra per utrustning (<u>200 kronor per år och person)</u>. Skulle du hyra ytterligare utrustningar? (0;1;2-10;>10).

Q3d &Q4d: Om du svarade Ja på fråga 2. om att hyra en utrustning till <u>en</u> person <u>utanför hushållet</u> (släkting eller vän) för 200 kronor per år ber vi dig ta ställning till följande; - Du kan istället för säkerhetsutrustningen köpa en värdecheck för 200 kronor åt personen; han/hon kan välja att hyra en säkerhetsutrustning under ett år eller använda den till något helt annat som han/hon finner bäst.
-Skulle du köpa en värdecheck till någon <u>utanför hushållet</u> (släkting eller vän) för <u>zzzz kronor per år och person</u>?

The risk level was based on objective (average) risk rather than subjective risk but questions on risk exposure and risk perception were asked. The average of the estimated objective risks in the sample (19.6/100,000 - see Annex 7.3) is close to the objective average risk in the city (20/100,000).

The bid design was based on prior knowledge about the WTP for car safety devices reducing the fatality or the severe injury risk (Persson Cedervall) and assumption on the *certainty bonus*. It was assumed that all WTP-values were *non-negative*, which is plausible if the good to be valued does not affect any other attributes than increased safety. The following bids were used in four of the five questions (SEK); 200, 1000; 2000; 5000; 10,000 and 20,000. In the question about total household safety (Q3a) the double bid level was used.

4.3 Results

The acceptance probability for the lowest bid and for the highest bid is presented in Table 2. Of the individuals that accepted a bid to hire a device for relatives 36% wanted only to rent this single device, 26% wanted to rent one more, 25% asked for between two and ten more devices while 6% were prepared to rent over 10 more devices for their relatives.

The question on the willingness to accept a bid for a voucher to relatives free consumption (Q3d and Q4d) were made conditional on a yes response to hire the safety device for relatives (Q3b and Q4b). Approximately 14% respectively 17% accepted to buy a voucher to their relatives instead of hiring the safety device.

Table 2 Acceptance probability for lowest and highest bid.

Question	Lowest bid (200SEK)	Highest bid (20,000SEK)
Q1 - Public programme	**47%**	**11%**
Q2 – Private device	**76%**	**15%**
Q3a - Household device	**67%** [a]	**7%** [a]
Q5 - Children device	**86%**	**21%**
Q3b – Relatives device With Hh-device	**41%**	**0% (3%)**[b]
Q4b – Relatives device	**61%**	**0% (12%)**[b]

a) double bid level is used in Q3a on the household device. b) second highest bid (10,000 SEK)

The acceptance probability (Π) when the probability of fatal or severe injure change from $\mathbf{z^o}$ to **0** is assumed to follow a logistic model:

$$\Pi = 1/\,[1+e^{-\Delta v}] \qquad (4.)$$

The probability of accepting to pay at least the price **p** for the product or program is dependent on the change in the utility level (**Dv**) following from the safety improvement when the person pays **p** for this improvement. Both *bivariate* and *multivariate models* are estimated. In the *bivariate* model the changed utility is written as $\mathbf{Dv} = \mathbf{y_0} + \mathbf{b_1 p}$. In the *multivariate* model the following linear[15] approximation in utility is used; $\mathbf{Dv} = \mathbf{y_0} + \mathbf{b_1 p} + \mathbf{b_2 E} + \mathbf{b_3 P} + \mathbf{b_4 S}$, where **E** is a measure of risk exposure, **P** is measure of risk perception and **S** other socio-economic variables (see Annex 7.4 for a full table of variables). The parameters β are to be estimated. In addition to these logit models a *non-parametric* bivariate model is estimated (Kriström 1990) and presented together with the bivariate logit model in Annex 7.5.

[15] Hultcrantz, Li and Lindberg (1996) shows that a second order approximation will in addition to the model above include a number of interaction elements between the attributes. All of the exposure measure can be expressed either as household variables or private variables. It is a strong correlation between these two alternatives.

A priori we expect the acceptance probability to increase with increased risk exposure (**E**) and higher risk perception (**P**). The latter proposition is not obvious in surveys based on marginal risk changes as a perceived risk above the actual is linked to a perceived *risk change* below the actual (Viscusi 1998). However, in estimate on total safety this apparent perversity will not occur. We also expect the acceptance probability to increase with income. The correlation between the variables is presented in Annex 7.4.

The models were estimated using the binary choice logic regression in LIMDEP7.0 with maximum likelihood methods. The goodness of fit is expressed as the percentage of correctly predicted responses and the likelihood ratio index (LRI). (See Greene 1993 pp651-653).

Table 3 Result from logit model - public good, private device, household device and children device

	Public good (Q1)	Private device (Q2)	Household devices (Q3)	Children device (Q5)
Constant	0.0653 (0.083)	1.367 (1.644)	-0.697 (-0.934)	-1.373 (-1.176)
BID	-0.000417 (-4.283)	-0.000203 (-3.624)	-0.000105 (-4.347)	-0.000152 (-4.959)
ACC EXPERIENCE	-0.472 (-0.847)	0.00679 (0.013)	0.920 (1.845)	0.636 (1.411)
SUBJ RISK BELOW	-0.824 (-1.513)	-0.585 (-1.067)	-0.491 (-0.940)	-0.603 (–1.319)
SUBj RISK ABOVE	-1.635 (-1.429)	0.450 (0.675)	-0.313 (-0.316)	2.211 (2.419)
SEX	-1.083 (-2.502)	-0.782 (-1.865)	0.298 (0.806)	-0.286 (–0.384)
AGE	0.0163 (1.136)	-0.0223 (-1.686)	0.00129 (0.107)	0.0183 (0.699)
INCOME	$0.302 \cdot 10^{-6}$ (0.013)	$0.112 \cdot 10^{-4}$ (0.486)	$0.304 \cdot 10^{-4}$ (1.694)	$0.869 \cdot 10^{-4}$ (3484)
LRI	0.30	0.14	0.18	0.21
Correct prediction	0.826	0.739	0.750	0.724

(t-value in parenthesis)

The bid is highly significant with an expected negative sign in all four regressions in Table 3.

None of the exposure measures (annual risk, cardistance, cartrips, bustrips or cycle/walking distances for the respondent himself or the whole household) were successful. In general their level of significance and their signs are inconclusive. Table 3 reports models where the exposure measures are excluded. However, household bus-trips significantly increased the acceptance probability of the public good (Q1). The household device model (Q3) implied a decreasing willingness to accept the bid with increased private risk exposure, especially cycling and walking.

The perceived risk measure ‘wearing a luminous tag’ had no significant impact and was excluded in all models. Accident experience of household or other persons is significant only in the question on household device (Q3) with the expected positive sign. Perception of the own risk-level (below or above average risk) was significant only in the question on children devices (Q5). The sign indicates a higher acceptance probability when the risk level is perceived to be above average.

Sex is significant for the public (Q1) and the private device (Q2) and indicates that the probability to accept a bid is higher for men than for women. Income has the expected positive sign but is significant only for the children device (Q5). Age (linear) is not significant but indicates for all of the models except the private device an increased probability with age.

Table 4 Result from logit model, relatives safety.

	Q3b	Q4b
Constant	-1.342 (–1.475)	-1.274 (–1.783)
BID	-0.287 (–3.389)	-0.000315 (–4.050)
ACC EXPERIENCE	0.522 (0.906)	0.810 (1.543)
SUBJ RISK BELOW	0.364 (0.637)	-0.520 (–0.958)
SUBj RISK ABOVE	-224 (–0.182)	0.481 (0.345)
REL RISK BELOW		
REL RISK ABOVE		
SEX	0.507 (1.130)	0.481 (1.091)
AGE	-0.00167 (–0.112)	0.00644 (0.470)
INCOME	$0.205*10^{-4}$ (0.963)	$0.343*10^{-4}$ (1.341)
LRI	0.17	0.21
Correct prediction	0.828	0.778

(t-value in parenthesis)

For the relative's device the bid is significant with the expected negative sign both when a question on a household good precedes this question (Q3) and when it is the only question (Q4). Almost none of the exposure measures are significant even if private risk exposure increases significantly the acceptance probability of Q3. None of the risk perception measures are significant [testa also relatives risk].

We have only estimated the WTP for one device for relatives. Of the respondents that wanted to hire at least one device to relatives over half of them were prepared to rent one or several more devices. The benevolence goes thus beyond one close relative and may involve ten or more persons. This result is supported by Needleman (1976) who suggested that persons at the age 20 to 69 on average had 15 relatives of which 4.2 were close, i.e. parents, siblings or children, and possible 10 friends (p326, p.333).

Table 5 Acceptance probability for a 'relative's device' (Q3b,Q4b) and the number of demanded devices.

BID	Q3b	Q3c-Number of devices for relatives (Number of Responses and a) Fraction of all yes responses)				Q4b	Q4c-Number of devices for relatives (Number of Responses and Fraction of all yes responses)			
(SEK)	ProbYes	1	2	3-11	>11	Prob Yes	1	2	3-11	>11
200	0.41	7	5	4	0	0.61	6	8	9	0
1000	0.30	2	1	5	4	0.27	4	2	1	0
2000	0.22	1	2	0	1	0.24	5	3	0	0
5000	0.12	1	0	0	0	0.22	3	1	0	0
10000	0.03	1	0	0	0	0.12	2	0	0	0
20000	0.00	-	-	-	-	0.00	-	-	-	-
All	0.19	0.31 a)	0.25 a)	0.28 a)	0.16 a)	0.24	0.43 a)	0.30 a)	0.26 a)	0.00 a)

The questions on the voucher (Q3d and Q4d) were made conditional on a yes response to the question on relative's safety device (Q3b and Q4b). Of the respondents who accepted to hire a relative's device only 14% (Q3) respectively 17% (Q4) were prepared to buy a voucher for their relative's free consumption instead for the safety device. Consequently, between 2.5% and 3.5% of the persons in the sample[16] responding to Q3 and Q4 were prepared to trade the safety device for a voucher.

4.4 Mean willingness to pay

We rule out any negative WTP for both the public and the private good and estimate the mean willingness to pay (**p***) for each question (5). The term βx is the constant terms in the changed utility (Δv) where E, P and S are assigned their mean values (of each relevant subsample). (Johansson 1995).

$$p* = \int_0^{\infty} 1/\left[1+e^{-\ v}\right]dp = \frac{1}{2}\left[\ln(1+e^{\ x})\right] \qquad (5)$$

Table 6 Mean willingness to pay for a public program or a safety device (SEK p.a.)

	Non-parametric	Bivariate	Multivariate
Public good	2459	2594 (623)	2400 (560)
Private device	4812	5231 (1469)	4921 (1358)
Children device	7831	7314 (1478)	6966 (1572)
Household device	7500	9032 (1963)	9555 (2198)
Relative's device 3	1597	3025 (818)	3479 (1026)
Relative's device 4	2914	3758 (940)	3175 (783)
Relative's voucher 3	270	589 (426)	-
Relative's voucher 4	570	3228 (3471)	-

16 % (0.19*0.14 and 0.24*0.17)

The standard errors presented in parenthesis imply that all estimates of mean WTP except for the voucher in Q4 are different from zero at conventional levels of significance[17].

Table 7 Ratio between mean WTP for different devices and the private device (Q2)

	Non-parametric	Bivariate	Multivariate
Relative's valuation ratio (Q3)	***0 .33***	***0 .58***	***0 .71***
Relative's valuation ratio (Q4)	***0 .61***	***0 .72***	***0 .65***
Pulic good (Q1)	**0 .51**	**0 .50**	**0 .49**
Children safety (Q5)	**1 .63**	**1 .40**	**1 .42 (1.65)**
Household device (Q3)	**1 .56**	**1 .73**	**1 .94**

4.4.1 Relatives valuation ratio

The respondents show on average a positive WTP for relative's safety. We can thus rule out *selfishness* as the dominant category of preferences in relation to traffic safety. The 'relative's valuation ratio' is between 0.33 and 0.58 (0.71) when a question on a household device precedes the relevant question (Q3). Without this extra budget constraint the b/a ratio is between 0.61 and 0.72.

This is high compared to previous international results that circle around a ratio of 0.45 for many relatives [Needleman (1976), Jones-Lee (1989[18], 1992[19])] even if one later study[20] suggest a **b/a** ration above 1 for one close relative. Mishan's (1971) assumption that *'the gradual loosening of family ties and the decline of emotional interdependence' will cause (**b)** to decline over time'* (p704) may thus not be rectified.

4.4.2 Children safety

Children safety is valued 50% above a private safety device. However, the reported mean values are based on background information of each subsample. As mothers mainly answer the children question we introduce this subsamples mean values in the multivariate private good model (Q2) which results in a 'children valuation ratio' of 1.65. Viscusi (1998) indicates a children valuation ratio' from 1.19 to 2.37[21].

4.4.3 Household versus private safety

The mean WTP for a household device is between 60% and 94% higher than for a private device. With an average family size of 2.6 persons the WTP per

[17] The standard errors are estimated with the WALD command of LIMDEP 7.0 (see Greene 191 p156-159).

[18] The result in from a questionnaire on car-safety implies a b/a-ratio of 0.43 if only passengers safety is considered and 0.24 if both driver's and passenger safety are taken into account.

[19] Across the UK population the value of statistical life for a "caring" society will be some 10% to 40% larger than the value that would be appropriate for a society of purely self-interested individuals.

[20] Schwab Christe (1995) asked the respondents to name one relative and tried to assess the WTP related to the respondents' own mental suffering from the increased risk of the named relative. (Preliminary) result suggests that this value may be of the same magnitude as the users own "value of life".

[21] Table 2.1 page 14. Product - Insecticide. Children premium as (inhalation + children safety)/(inhalation + skin poisoning). Starting risk 15/10,000 and 10/10,000; Children premium 1.77 and 1.59; For total safety 2.37. Toilet bowl cleaner (gassing + child poisoning)/(gassing + eyeburn); Same risks as above, 1.52, 1.26, 1.19.

personal safety is between 2885 SEK and 3675SEK. The household budget constraint thus reduces the WTP per personal safety with a factor 0.6 – 0.7

4.4.4 Pure altruism

Only 2.5% to 3.5% of the sample can be said to have *pure altruistic* preferences, i.e. they accepted to change the safety device for a voucher for free consumption. The mean WTP for the persons answering the question (i.e. also accepting the bid on a relative's device) was 533 SEK for the voucher. To make an example we may assume that people who responded NO on the question on relative's device (Q3b) should have answered NO also on the voucher question which results in a mean WTP of approximately 100 SEK (0.19*533). The average bid given to this group (Q3b) was 6127SEK. Furthermore, if it is assumed that a person is prepared to pay the nominal price[22] for a voucher to himself we calculate a '**g/m** ratio' of 0.016 (100/6127). The decision rule equation 2 could take the following numeric form;

$$\mathbf{a(1.50)+c > C(1.016)} \qquad (2')$$

Although, the last assumptions are speculative the result suggests that the assumption on pure altruism underpinning the conclusion by Bergstrom (1982) does not pass an empirical test.

However, in question Q3b and Q4b it is stressed that the relative will not have the opportunity to rent the device. The respondent is thus the only person that could give his relative complete safety. A NO answer will for sure leave the relative out in the risky world. That assumption has to be relaxed when we question the person about the acceptance probability for a voucher, which gives the relative the opportunity to choose between free consumption and a safety device. A NO answer on this question does only mean that the relative has to hire the device himself. This may have affected the outcome of this question.

4.4.5 Public and private provision

Against this conclusion of strong benevolence concerning safety is the result of the comparison between the private and public good. The mean WTP for public good is half of the private (Q2) and one third of the household WTP (Q3a). The result is not unique and is similar to Johannesson et al (1996) who reports the public good to be valued 55% to 80% of the private good. The difference between public and private may basically be found either on the type of product or the type of financing.

Previous result has shown that individuals may prefer self rather than collective provision of safety (Shogren (1990)). Shogren and Crocker (1991) suggest in experiments including endogenous risk that if the marginal effectiveness of successive public provision declines the value of the private provision of safety will increase. Consequently, if people believe public provision of safety will be inefficient they will favour the private alternative.

[22] It could be argued that a person require a uncertainty discount on the nominal price to accept to buy the voucher

Another explanation for the difference may be found in the payment vehicle. With pure altruistic preferences the respondents' belief of the relationship between a common fee and relative's own WTP will affect the response. If he believes the fee level to be above his relatives WTP he will be reluctant to impose the public project on them as their utility decreases and *vice versa* if he believes the fee to be below his relatives WTP (Johannseson et.al. 1996). Another explanation on the financial side is negative preferences for common taxes and fees as such.

If the respondents have perfect information about their relatives WTP and relatives are evenly distributed in relation to socio-economic characteristics and they show benevolence the respondents should conclude that the WTP of their relatives for the public programme equals the sum of the a-value and b-value. To accept a bid slightly above what they accepted for the private device (a) should therefore not worry them of imposing an extra cost on relatives. Instead, we believe that this difference between private and public provision of safety is due to generally negative preference towards public programme and financing.

4.5 Value of statistical life and severe injuries

Finally, we derive a number of "value of statistical lives" as the ratio between the mean WTP ($\mathbf{p_x*}$) and the (mean) current risk level 20/100.000 ($\mathbf{z_o*}$). For the household device the risk level times the average family size (2.6) have been applied.

$$VOSLx = p^* / z_o^* \qquad (6.)$$

Table 8 Value of statistical life, private children and relative's (MSEK)

	Non-parametric	Bivariate	Multivariate
Public good	12.3	13.0	12.0
Private device	24.1	26.2	24.6
Children device	39.2	36.6	34.8
Household device	14.4	17.4	18.4
Relative's device 3	8.0	15.1	17.4
Relative's device 4	14.6	18.8	15.9

5 Discussion

The value of statistical life and severe injury (VOSLsi) is for a selfish private risk reduction around 25 MSEK. The study was about total safety and we thus expected a certainty premium in our values (but also a stricter budget constraint). Assume that the certainty premium is 100%. The VOSLsi comparable to values derived for small risk-reductions is then 12.5 MSEK and the certainty premium 12.5 MSEK.

The current official values used by the Swedish National Road Administration in their CBA are for fatalities 13 MSEK and for severe injuries 2.0 MSEK. An average value for fatalities and severe injuries based on the frequency of national traffic casualties is 3.5 MSEK. Our estimate of the private VOSLsi, excluding relatives and friends, is 3.5 (=12.5/3.5) times above the official values used today in Sweden.

To suggest new official values of VOSL was not the purpose of the study but we have to conclude that our study supports a significant increase in the current values based on small risk reduction of private safety. For a programme aimed solely at children safety an even higher increase in the VOSL is endorsed.

In addition we have found a relatives valuation ratio of around 0.5 and basically safety paternalistic preferences suggesting that even higher VOSL can be supported.

For a programme affecting a whole household the VOSLsi per person is reduced to around 17 MSEK. As a zero-accident program will affect all household members we argue that this is a more relevant 'selfish' private value to use for evaluations of public zero-accident programmes. For general road programmes it can be argued that only few members[23] of the household are affected and thus that the household approach is not appropriate. Nevertheless, with the same assumption on the certainty bonus as above this support that the current VOSL can be increased 2.5 times.

A zero-accident programme in Örebro will with the current official values generate a benefit of 84 MSEK annually. With the selfish household values we have estimated the programme will generate benefits of 400 MSEK annually of which 200MSEK could be seen as the certainty bonus for a totally safe city.

However, the respondents in our survey show implicitly a rather negative attitude towards public provision of safety. The VOSLsi their responses imply is around 12.5 MSEK. With the same assumptions as above our study can only support an increase of the current official VOSL with 75%. The Örebro programme will nevertheless generate benefits of 300 MSEK of which 150MSEk is the certainty bonus.

For policy purpose this discrepancy between a large private VOSL, a huge VOSL if relatives and friends are included and a rather low VOSL if individuals are asked about public safety programmes

[23] The average occupancy rate in Swedish cars (1.4) should be compared to the family size of 2.6

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7 Annex.

7.1 Provision of public good under altruistic preferences

Consider two households consuming *m* different private commodities (**x**), which can be bought at a fixed price (**p**)[24], and a public good ($\mathbf{z^i}$). In addition, they supply *k* different kinds of labour (**L**) at the wage rate **w**, which they view as fixed, and may have net profit income ($\mathbf{y^i}$) which is reduced with a lump sum tax (or increased with a transfer). We introduce their concern for their relatives' consumption of public good ($\mathbf{z^j}$) and general well being ($\mathbf{y^j}$). The indirect utility function of household **i** can be written as eq A1.[25]

$$\begin{aligned} V^i &= V^i(p,w,y^i,z^i,z^j,y^j) \\ &= U^i\left\{x^i(p,w,y^i,z^i,z^j,y^j), L^i(p,w,y^i,z,z^j,y^j), z^i,z^j,y^j,\right\} \qquad \mathrm{i} \neq \mathrm{j} \end{aligned} \qquad \textit{(A1.)}$$

The economy consists of F different private firms producing all *m* goods **x** with all *k* inputs **L**. The profit function[26] **P** of a firm is increasing in prices and decreasing in wages. The production of the public good is written as a restriction $z=F(x^p,L^p)$ and is financed through lump-sum taxes (**t**) (eq A2.).

$$t^1 + t^2 = px^p + wL^p \qquad \textit{(A2.)}$$

We maximise a social welfare function of a simple type where $\mathbf{a^i}$ is a distributional weight[27] which can be seen *as societies marginal welfare of increased utility for household i (*eq. A3).

$$\mathrm{SWF} = a^1V^1 + a^2V^2 \qquad \textit{(A3.)}$$

A social planner controls prices, wages, taxes and the provision of the public good. The first-order conditions are standard; prices and wages should be set to ensure equilibrium in the commodity and the labour market[28]. Taxes should be set so that the *marginal social welfare of income* (**Q**) is equal between households. This will differ from the traditional condition as the exact form depends on the concern for relatives' income (dV^i/dy^j).

Finally, the aggregate marginal willingness to for the public good should be equal to the marginal cost of providing the good (A4.). In this general form the marginal cost should equal the sum of both *use value* and *non-use value* adjusted with the *marginal social welfare of income* (**Q**).

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24 Non-negative quantities and strictly positive prices

25 dU/dx>0, dU/dL<0 ; dU/dz….,

26 $\Pi^f = \Pi^f(p,w) \ \forall f$

27 $a^i = d\mathrm{SWF}/dV^i$ in a more general social welfare function (see…….)

28 To ensure a classical market clearing condition for **x** and **L** with the 'altruistic' utility function we have specified, relatives' **p** and **w** have to be added. This problem is solved directly if an interdependent utility function is used (see Johansson 1992).

$$\frac{a1}{\Theta}\left[\frac{dV^1}{dz^1}+\frac{dV^1}{dz^2}\right]+\frac{a2}{\Theta}\left[\frac{dV^2}{dz^2}+\frac{dV^2}{dz^1}\right]=$$

$$\frac{1}{\Theta}\left[a^1\frac{dV^1}{dz^1}+a_2\frac{dV^2}{dz^1}\right]+\frac{1}{\Theta}\left[a^2\frac{dV^2}{dz^2}+a^1\frac{dV1}{dz^1}\right]=MC^p \qquad (A4.)$$

Before we examine this in detail, consider a case with only selfish individuals. We will then have the traditional Samuelsonian equilibrium where *the marginal cost of providing the public good should equal the sum of their private marginal willingness to pay for the good* (see Table 9)*.* This can easily be seen from eq. A4. when $dV^1/dz^2=dV^2/dz^1=0$ and the taxation Lagrange multiplier **Q** includes only selfish elements (A5).

$$\Theta = a^1\frac{du^1}{dx^1} = a^2\frac{du^2}{dx^2} \qquad (A5.)$$

If individuals have *safety paternalistic preferences* they only care about their relatives safety but not for their general well being. In the two household model we adjust eq. A1. and write each utility function $V^i=V(p,w,y^i,z^i,z^j)$. The taxation Lagrange multiplier **Q** will still only have selfish elements as in the pure selfish case above (A5). The *marginal costs of providing the public good should now equal a sum of use value* (dVi/dzi) *and non-use values* (dVi/dzj)[29] (see Table 9). This equilibrium condition is the same as the condition derived by Jones-Lee (1991) and Johansson (1992).

Let us now return to the general utility function A1. Individuals impose both a traditional externality and an externality in the form of income on each other. The taxation Lagrange multiplier **Q** will include an element reflecting this concern over relatives increased tax burden (A6).

$$\Theta=\frac{dU^1}{dx^1}\left[a^1+a^2\frac{dU^2}{dx^1}\frac{dx^1}{dU^1}\right]=\frac{dU^2}{dx^2}\left[a^2+a^1\frac{dU^1}{dx^2}\frac{dx^2}{dU^2}\right] \qquad (A6.)$$

alt. $\Theta=\frac{dV^1}{dy^1}\left[a^1+a^2\frac{dV^2}{dy^1}\frac{dy^1}{dV^1}\right]=\frac{dV^2}{dy^2}\left[a^2+a^1\frac{dV^1}{dy^2}\frac{dy^2}{dV^2}\right]$

The optimal provision of the public good may be both above and below the provision in the selfish case (see Table 9). If the concern over relatives' safety is much stronger than the concern over their income we approach a provision rule similar to the safety paternalistic case above; the optimal provision will be above the optimal provision in the selfish case. In the opposite case where their concern over income is much stronger than their concern over safety the opposite is true; the optimal provision of the public good should be reduced compared to the selfish case.

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[29] as both $dV^1/dz^2\neq 0$ and $dV^2/dz^1\neq 0$ in eq. 3.2.

A certain special case is worth exploring. If the concern over relatives wealth preserves the relatives' marginal rate of substitution (MRS) of safety for income ($\gamma=\lambda$ in Table 9)) the public good provision rule will collapse to the simple selfish Samuelson version. This is of course the basic finding of Bergstrom. The same result of altruism may be derived with interdependent utility functions (see Johansson 1992): with the utility function $V^i=V^i(p,w,z^i,V^j)$ the basic condition to preserve the MRS of safety for income of relatives is ensured as $\gamma=\lambda=dV^i/dV^j$.

Finally, assume that household 1 only consumes the 'public good' and that all taxes also fall on household 1. Household 2 still have preferences over the other households safety and income. It can easily be verified from the double externality case (where dV2/dz2=0) (see Table 9) that with altruistic preferences (i.e. preserved relative's MRS, $\gamma=\lambda$) the provision rule will be the same as under selfish preferences. With safety paternalistic preferences household 2 will not care for the increased taxation burden on household 1 ($\lambda^2=0$) but only value their increased safety ($\gamma^2>0$). *Household 2 would therefore vote for a project that increases the safety of household 1 beyond their private preferences!*

Table 9 Public good provision rule under alternative forms of preferences.

Type of preferences	***Public Good Provision Rule***
Selfish	$\left[\frac{dy^1}{dV^1}\frac{dV^1}{dz^1}\right]+\left[\frac{dy^2}{dV^2}\frac{dV^2}{dz^2}\right]=MC^p$
Single externality or safety paternalistic	$\frac{dy^1}{dV^1}\left[\frac{dV^1}{dz^1}+\frac{dV^1}{dz^2}\right]+\frac{dy^2}{dV^2}\left[\frac{dV^2}{dz^2}+\frac{dV^2}{dz^1}\right]=MC^p$
Dual externality - relative's safety and income included in the utility function	$\frac{dy^1}{dV^1}\frac{dV^1}{dz^1}\left[\frac{(a^1+a^2g^2)}{(a^1+a^2l^2)}\right]+\frac{dy^2}{dV^2}\frac{dV^2}{dz^2}\left[\frac{(a^2+a^1g^1)}{(a^2+a^1l^1)}\right]=MC^p$ $where \quad \frac{dV^i}{dz^j}=g^i\frac{dV^j}{dz^j} \qquad \frac{dV^i}{dy^j}=l^i\frac{dV^j}{dy^j}$
Altruistic preferences - relative's safety and income included in the utility function such that relative's MRS of safety for income is preserved	$\left[\frac{dy^1}{dV^1}\frac{dV^1}{dz^1}\right]+\left[\frac{dy^2}{dV^2}\frac{dV^2}{dz^2}\right]=MC^p$
Dual externality with a 'private good' - relative's safety and income included in the utility function. The good is only consumed by Hh1 and all taxes paid by Hh1.	$\frac{dy^1}{dV^1}\frac{dV^1}{dz^1}\left[\frac{(a^1+a^2g^2)}{(a^1+a^2l^2)}\right]=MC^p$ *where* g^i and l^i defined as above

7.2 Responses

	Characteristics	Q1	Q2	Q3	Q4	Q5	TOT
SampleSize	Number	390	390	390	390	390	1950
Unknown address	Number	9	12	9	10	4	44
Actual Sample	Number	381	378	381	380	386	1906
	sex (% female)	51%	48%	54%	49%	100%	60%
	Dist to CBD (km)	2.9	3.0	2.9	3.1	3.3	3.0
	Average Bid (SEK)	6442	6407	6390	6383	6373	6399
Returned- empty	Number	31	30	44	40	11	156
	sex (% female)	59%	74%	73%	57%	100%	68%
	Dist to CBD (km)	2.9	3.3	2.9	2.7	3.0	2.9
	Average Bid (SEK)	6871	5767	6527	5870	6218	6259
No response	Number	128	132	135	145	159	699
	sex (% female)	51%	45%	51%	48%	100%	61%
	Dist to CBD (km)	3.0	3.0	2.8	3.2	3.1	3.0
	Average Bid (SEK)	6391	6584	7107	7073	5932	6605
Complete responses	Number	222	216	202	195	206	1041
	sex (% female)	50%	46%	52%	48%	100%	59%
	Dist to CBD (km)	2.7	2.9	2.9	3.1	3.4	3.0
	Average Bid (SEK)	6413	6401	5865	6008	6059	6158
	Income per consumption unit (SEK thousand p.a.) – all respondent	86.8	95.1	92.0	89.2	70.2	85.3
	Income per consumption unit (SEK thousand p.a.) –respondent age 20-64	87.0	95.6	89.4	89.1	70.2	84.6
Response rate by bid level	200	67	58	61	61	56	61
	1000	60	45	47	41	42	47
	2000	47	49	60	53	66	55
	5000	58	82	52	55	52	60
	10000	59	55	58	51	58	56
	20000	58	54	42	44	45	49
Response rate	All bids	58	57	53	51	53	55

7.3 Estimated individual objective risk

z_{own} = CARTRIPR * 52 * Distance (postal code) * RiskCar + BUSTRIPR * 52 * Distance (postal code) * RiskBus + CYCR * 52 * RiskUnprotected

$z_{household}$ = CARTRIPHH * 52 * Distance (postal code) * RiskCar + BUSTRIPHH * 52 * Distance (postal code) * RiskBus + CYCHH * 52 * RiskUnprotected

Fatality and severe injury risks, Sweden

RiskUnprotected	0,2552 Million pkm
RiskCar	0,0319 Million pkm
RiskBus	0,0032 Million pkm

Source: own calculation based on Nilsson and Thulin XXX

7.4 Descriptive Statistics

Variable	Std.Dev	Mean	Minimum	Maximum	Cases	Definition
BID						Yes=1, No=0
RELATIVE						Yes=1, No=0
REL_NR						No devices, zero=1, one=2,two-ten=3, >ten=4
ALTRUISM						Yes=1, No=0
RISK EXPOSURE						
CBD	2.99950465	1.97576757	.342636034	20.8210492	1947	Postal code area km from CBD
CARMILHH	1523.48802	1498.81106	.000000000	10000.0000	1002	10km annual
CARMILR	838.923625	1063.13825	.000000000	10000.0000	982	10km annual
CARTRIPH	6.72465209	11.1046236	.000000000	200.000000	1006	Trips to CBD per week
CARTRIPR	3.99595551	9.43263237	.000000000	200.000000	989	Trips to CBD per week
BUSTRIPH	1.92112950	4.51298878	.000000000	74.0000000	1027	Trips to CBD per week
BUSTRIPR	.870443350	2.48827889	.000000000	28.0000000	1015	Trips to CBD per week
CYCR	14.0847784	14.5614297	.000000000	80.0000000	1038	Km per week
CYCCHILD	3.69047619	12.2445078	.000000000	160.000000	2100	Km per week
CYCTOTHH	15.5047619	28.1065569	.000000000	280.000000	2100	Km per week
RISKR	207.519170	190.292204	.000000000	1061.49333	972	
RISKHH	450.240937	444.482859	.000000000	3721.65994	998	
RISKCYCC	48.9676984	162.468292	.000000000	2122.98667	2100	
RISKHHR	247.430339	341.619347	.000000000	3190.91327	956	
RISK PERCEPTION						
LUM	.561722488	.496413284	.000000000	1.00000000	1045	Uses luminous tag Yes=1, No=0
ACCEXPHH	.189292543	.391928219	.000000000	1.00000000	1046	Accident experience Yes=1, No=0
ACCEXPOT	.499042146	.500238718	.000000000	1.00000000	1044	Accident experience Yes=1, No=0
ACCEXPAL	.152963671	.360124663	.000000000	1.00000000	1046	Accident experience Yes=1, No=0
SUBJ	.170192308	.375982462	.000000000	1.00000000	1040	Lower risk own tand average Yes=1, No=0
X39	.500000000E -01	.218049804	.000000000	1.00000000	1040	Higher own risk than average Yes=1, No=0
REL LOW						Lower risk for relat. than av. Yes=1, No=0
REL HIGH						Higer risk for relat. Than av. Yes=1, No=0
SOCIO ECONOMIC						
SEX	.578947368	.493964378	.000000000	1.00000000	1045	Male=0, Female=1
AGE	42.6854685	14.6327129	18.0000000	76.0000000	1046	Years
MUNICIP	25.7895494	16.9524019	1.00000000	75.0000000	1043	Years living in Örebro
MUNI_PER	60.1693563	34.3410156	1.49253731	100.000000	1043	MUNICIP/AGE * 100
CHILD .	478095238	.932191826	.000000000	7.00000000	2100	Number of children in household
SIZEHH	1.40285714	1.71132245	.000000000	9.00000000	2100	Number of persons in household
INCOME	18296.9849	8766.28786	2550.00000	47600.0000	995	Monthly netincome SEK

Note: HH=Total household; R=only Respondent ; OT=Outside Household

7.4.1 Correlation Matrix for Listed Variables

	CBD	CARMILHH	CARMILR	CARTRIPH	CARTRIPR	BUSTRIPH	BUSTRIPR	CYCR
CBD	1.00000	.12382	.07241	-.01529	-.04559	.11823	.11117	.00166
CARMILHH	.12382	1.00000	.76202	.24186	.13733	-.02655	-.08536	-.17212
CARMILR	.07241	.76202	1.00000	.14667	.18882	-.04559	-.13043	-.23135
CARTRIPH	-.01529	.24186	.14667	1.00000	.89797	.06368	-.00974	-.14614
CARTRIPR	-.04559	.13733	.18882	.89797	1.00000	.02231	-.04121	-.16610
BUSTRIPH	.11823	-.02655	-.04559	.06368	.02231	1.00000	.67852	-.00256
BUSTRIPR	.11117	-.08536	-.13043	-.00974	-.04121	.67852	1.00000	.01201
CYCR	.00166	-.17212	-.23135	-.14614	-.16610	-.00256	.01201	1.00000

	CBD	CARMILHH	CARMILR	CARTRIPH	CARTRIPR	BUSTRIPH	BUSTRIPR	CYCR
CYCCHILD	.00558	.03811	-.04250	.12097	.09380	.19690	.06369	.25158
CYCTOTHH	.03053	-.03992	-.11322	-.01994	-.03731	.11703	.03774	.70539
RISKR	.06362	-.13946	-.19725	-.03180	-.04901	.01014	.00968	.98504
RISKHH	.08067	-.00499	-.09561	.06000	.02097	.13624	.04647	.68575
RISKCYCC	.00558	.03811	-.04250	.12097	.09380	.19690	.06369	.25158
RISKHHR	.07014	.07214	-.01436	.09682	.05522	.17337	.05562	.34553
LUM	.08278	-.02184	-.06922	-.03335	-.03714	.03426	.04604	.03568
ACCEXPHH	-.02099	.05892	.05286	.07907	.04801	.02100	-.02970	-.02068

	CYCCHILD	CYCTOTHH	RISKR	RISKHH	RISKCYCC	RISKHHR	LUM	ACCEXPHH
CYCCHILD	1.00000	.72795	.26618	.73557	1.00000	.81669	.00989	-.02270
CYCTOTHH	.72795	1.00000	.70794	.99306	.72795	.90588	.01691	-.01927
RISKR	.26618	.70794	1.00000	.70529	.26618	.36278	.03237	-.00607
RISKHH	.73557	.99306	.70529	1.00000	.73557	.91649	.01778	-.00817
RISKCYCC	1.00000	.72795	.26618	.73557	1.00000	.81669	.00989	-.02270
RISKHHR	.81669	.90588	.36278	.91649	.81669	1.00000	.00511	-.00732
LUM	.00989	.01691	.03237	.01778	.00989	.00511	1.00000	-.04452
ACCEXPHH	-.02270	-.01927	-.00607	-.00817	-.02270	-.00732	-.04452	1.00000

	CBD	CARMILHH	CARMILR	CARTRIPH	CARTRIPR	BUSTRIPH	BUSTRIPR	CYCR
ACCEXPOT	.10339	.04608	.04413	.03089	.00914	-.03069	-.02507	.06358
ACCEXPAL	.00072	.05789	.06101	.06131	.03366	.01307	-.00611	-.00736
SUBJ	-.04815	-.03984	-.01533	.01517	.01647	-.03445	-.02533	-.08544
X39	.04139	-.01852	.01071	.00492	.02492	.02823	.09687	-.01514
SEX	.00465	-.08377	-.30684	-.08725	-.15807	.06823	.09271	.09947
AGE	.03152	-.04332	.05418	-.07173	-.02815	-.01976	-.12122	-.24683
MUNICIP	.06755	-.05754	-.00503	-.02007	-.00335	-.06390	-.08384	-.08508
MUNI_PER	.06278	.00003	-.01676	.04472	.02212	-.06525	-.03383	.06132

	CYCCHILD	CYCTOTHH	RISKR	RISKHH	RISKCYCC	RISKHHR	LUM	ACCEXPHH
ACCEXPOT	.01868	.04948	.08224	.06060	.01868	.03325	-.02855	.28890
ACCEXPAL	-.00768	-.00563	.00459	.00317	-.00768	.00157	-.04127	.87067
SUBJ	-.03130	-.04326	-.08161	-.03848	-.03130	-.00453	.02022	-.07541
X39	.00695	.01192	-.00462	.01468	.00695	.02190	.03364	.00350
SEX	.16691	.12445	.07644	.11929	.16691	.11366	.17664	-.01523
AGE	-.11160	-.19354	-.25541	-.20012	-.11160	-.11893	.13135	.00218
MUNICIP	-.06204	-.06345	-.07917	-.06171	-.06204	-.03644	.05007	-.00074
MUNI_PER	.00291	.06314	.07547	.07204	.00291	.05211	-.04093	-.01187

	ACCEXPOT	ACCEXPAL	SUBJ	X39	SEX	AGE	MUNICIP	MUNI_PER
ACCEXPOT	1.00000	.42620	-.11844	.05421	.02841	-.17518	-.09608	-.01234
ACCEXPAL	.42620	1.00000	-.08334	.02775	-.01175	-.04165	-.02042	-.01458
SUBJ	-.11844	-.08334	1.00000	-.09814	-.08053	.08617	-.01303	-.06671
X39	.05421	.02775	-.09814	1.00000	-.00664	-.07849	-.08635	-.05871
SEX	.02841	-.01175	-.08053	-.00664	1.00000	-.13062	-.07820	-.01363
AGE	-.17518	-.04165	.08617	-.07849	-.13062	1.00000	.55313	.03041
MUNICIP	-.09608	-.02042	-.01303	-.08635	-.07820	.55313	1.00000	.80264
MUNI_PER	-.01234	-.01458	-.06671	-.05871	-.01363	.03041	.80264	1.00000

	CBD	CARMILHH	CARMILR	CARTRIPH	CARTRIPR	BUSTRIPH	BUSTRIPR	CYCR
CHILD	.13282	.11185	.00203	.09630	.03611	.17157	.03528	.08814
SIZEHH	.15549	.21243	.02331	.15419	.04627	.19621	.04307	.05382
INCOME	.07891	.31224	.17342	.20870	.11298	.01130	-.05391	-.06309

	CYCCHILD	CYCTOTHH	RISKR	RISKHH	RISKCYCC	RISKHHR	LUM	ACCEXPHH
CHILD	.48390	.36227	.10112	.37758	.48390	.43926	.00999	-.01641
SIZEHH	.45107	.40235	.06980	.42520	.45107	.51954	.01232	-.00390
INCOME	.15022	.15312	-.04501	.17553	.15022	.25613	-.05846	.06140

	ACCEXPOT	ACCEXPAL	SUBJ	X39	SEX	AGE	MUNICIP	MUNI_PER
CHILD	.06198	.00975	-.06266	.02107	.18107	-.29204	-.18052	-.00658
SIZEHH	.04497	.00655	-.03349	.02559	.14667	-.23275	-.14600	.01602
INCOME	.02844	.04436	-.00704	-.02912	-.03528	.05531	.05796	.08157

	CHILD	SIZEHH	INCOME
CHILD	1.00000	.90523	.21369
SIZEHH	.90523	1.00000	.37835
INCOME	.21369	.37835	1.00000

7.5 Non-parametric model

For the majority of the questions the probabilities (**P**) are non-increasing with increased bid-level. The vector of **P** is then a maximum-likelihood estimate of the probability of acceptance of a bid (Kolla Ayer et al 1955). However, in one of the questions (Q4d) **P** increases with increased bid-level such that $P_x<P_{x+1}$. In this case Px and Px+1 are replaced by (yx+yx+1)/(nx+nx+1) until **P** is non-increasing (in parenthesis). Mean WTP is estimated under the assumption that P=1 for bid level 0, P=0 for bid level above the highest bid (20,000 SEK respectively 40,000SEK) and that the proportions between the observed P can be approximated by a linear interpolation. Median WTP is estimated as P=0.5.

Probabilities (P) and non-parametric estimate of mean and median WTP

BID	Q1	Q2	Q3a (2xbid)	Q3c	Q3d	Q4c	Q4d	Q5
0	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
200	0.465	0.763	0.667	0.410	0.211	0.605	0.214	0.861
1000	0.351	0.679	0.533	0.300	0.071	0.269	0.000 (0.125)	0.704
2000	0.172	0.355	0.351	0.222	0.000	0.235	0.250 (0.125)	0.571
5000	0.184	0.204	0.188	0.094	0.000	0.222	0.000	0.382
10000	0.027	0.194	0.135	0.027	0.000	0.121	0.000	0.395
20000	0.105	0.147	0.074	0.000	0.000	0.000	0.000	0.207
>20000	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Mean WTP	2459	4812	7500	1597	270	2914	570	7831
Median WTP	187	1552	1183	170	127	451	127	3133

7.6 LIMDEP output

7.6.1 Questionnaire 1 – Public device

```
BIVARIATE
+-----------------------------------------------+
              | Multinomial Logit Model                      |
              | Maximum Likelihood Estimates                 |
              | Dependent variable                 OWN       |
              | Weighting variable                 ONE       |
              | Number of observations             222       |
              | Iterations completed                 8       |
              | Log likelihood function      -87.23300       |
              | Restricted log likelihood    -111.9161       |
              | Chi-squared                   49.36612       |
              | Degrees of freedom                   1       |
              | Significance level            .0000000       |
              +----------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
          Characteristics in numerator of Prob[Y = 1]
 Constant -.1803961905      .23782216        -.759   .4481
 BID      -.3855215903E-03  .92639596E-04   -4.162   .0000  6412.6126

            Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0       177    0  |   177
  1        45    0  |    45
------  ----------  +  -----
Total     222    0  |   222
--> WALD;FN1=(1/B_BID)(LOG(1+EXP(B_ONE)));FN2=(B_ONE)/B_BID$
               +-----------------------------------------------+
               | WALD procedure. Estimates and standard errors |
               | for nonlinear functions and joint test of     |
               | nonlinear restrictions.                       |
               | Wald Statistic            =     28.66533      |
               | Prob. from Chi-squared[ 2] =      .00000      |
               +-----------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
 Fncn( 1) -2593.888449      623.30723       -4.161   .0000
 Fncn( 2)  467.9275949      693.16132         .675   .4996

--> TYPE>>>>NO EXPOSURE<<<<<<$
--> NAMELIST;P1=ACCEXPAL,SUBJ,X39$
--> NAMELIST;S1=SEX,AGE,INCOME$
--> LOGIT;LHS=OWN;RHS=ONE,BID,P1,S1$
              +----------------------------------------------+
              | Multinomial Logit Model                      |
              | Maximum Likelihood Estimates                 |
              | Dependent variable                 OWN       |
              | Weighting variable                 ONE       |
              | Number of observations             207       |
              | Iterations completed                 8       |
              | Log likelihood function      -74.52309       |
              | Restricted log likelihood    -107.0872       |
              | Chi-squared                   65.12814       |
              | Degrees of freedom                   7       |
              | Significance level            .0000000       |
              +----------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
          Characteristics in numerator of Prob[Y = 1]
 Constant  .6529696149E-01  .78367194         .083   .9336
```

```
 BID      -.4166041288E-03  .97260605E-04    -4.283   .0000  6690.8213
 ACCEXPAL -.4722206469      .55727627         -.847   .3968  .15942029
 SUBJ     -.8239805092      .54455049        -1.513   .1302  .20289855
 X39      -1.634972714      1.1443617        -1.429   .1531  .57971014E-01
 SEX      -1.083504041      .43309939        -2.502   .0124  .49275362
 AGE       .1625029054E-01  .14308241E-01     1.136   .2561  42.966184
 INCOME    .3023885075E-06  .24160328E-04      .013   .9900  17138.164

           Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0       152   11  |    163
  1        25   19  |     44
------  ----------  +  -----
Total     177   30  |    207
--> MATR;B_P1=B_ACCEXP,B_SUBJ,B_X39;M_P1=MEAN(P1);Z_P1=B_P1*M_P1$
--> MATR;B_S1=B_SEX,B_AGE,B_INCOME;M_S1=MEAN(S1);Z_S1=B_S1*M_S1$
-->
WALD;FN1=(1/B_BID)(LOG(1+EXP(B_ONE+Z_P1+Z_S1)));FN2=(B_ONE+Z_P1+Z_S1)/B_BID$
               +------------------------------------------------+
               | WALD procedure. Estimates and standard errors |
               | for nonlinear functions and joint test of     |
               | nonlinear restrictions.                       |
               | Wald Statistic            =     19.89403      |
               | Prob. from Chi-squared[ 2] =      .00005      |
               +------------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Fncn( 1) -2400.360272      560.39252        -4.283   .0000
 Fncn( 2)  245.9295372      1897.9063          .130   .8969
```

7.6.2 Questionnaire 2 – Private device

```
Bivariate
              | Multinomial Logit Model                      |
              | Maximum Likelihood Estimates                 |
              | Dependent variable                  OWN      |
              | Weighting variable                  ONE      |
              | Number of observations              142      |
              | Iterations completed                  6      |
              | Log likelihood function       -81.93786      |
              | Restricted log likelihood     -91.49649      |
              | Chi-squared                    19.11727      |
              | Degrees of freedom                    1      |
              | Significance level             .1229203E-04 |
              +----------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
          Characteristics in numerator of Prob[Y = 1]
 Constant  .1613701210      .26004778          .621   .5349
 BID      -.1911827820E-03  .53707808E-04    -3.560   .0004  5191.5493
Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0        84    9  |     93
  1        32   17  |     49
------  ----------  +  -----
Total     116   26  |    142
--> WALD;FN1=(1/B_BID)(LOG(1+EXP(B_ONE)));FN2=(B_ONE)/B_BID$
               +------------------------------------------------+
               | WALD procedure. Estimates and standard errors |
               | for nonlinear functions and joint test of     |
               | nonlinear restrictions.                       |
               | Wald Statistic            =     24.27191      |
               | Prob. from Chi-squared[ 2] =      .00001      |
               +------------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
```

```
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Fncn( 1) -5230.596550      1469.4397        -3.560   .0004
 Fncn( 2) -844.0619984      1208.4747         -.698   .4849
```

```
--> TYPE>>>>NO EXPOSURE<<<<<<$
--> NAMELIST;P1=ACCEXPAL,SUBJ,X39$
--> NAMELIST;S1=SEX,AGE,INCOME$
--> LOGIT;LHS=OWN;RHS=ONE,BID,P1,S1$
+---------------------------------------------+
              | Multinomial Logit Model                       |
              | Maximum Likelihood Estimates                  |
              | Dependent variable                OWN         |
              | Weighting variable                ONE         |
              | Number of observations            142         |
              | Iterations completed                6         |
              | Log likelihood function     -78.48017         |
              | Restricted log likelihood   -91.49649         |
              | Chi-squared                  26.03265         |
              | Degrees of freedom                  7         |
              | Significance level           .4969463E-03     |
              +---------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
         Characteristics in numerator of Prob[Y = 1]
 Constant  1.367202432     .83180614         1.644   .1002
 BID      -.2031865989E-03 .56073350E-04    -3.624   .0003   5191.5493
 ACCEXPAL  .6794855845E-02 .51576843          .013   .9895   .19014085
 SUBJ     -.5851935429     .54829609        -1.067   .2858   .17605634
 X39       .4896250343     .72503716          .675   .4995   .77464789E-01
 SEX      -.7820479685     .41930938        -1.865   .0622   .44366197
 AGE      -.2233430520E-01 .13246200E-01    -1.686   .0918   44.816901
 INCOME    .1118799613E-04 .23039692E-04      .486   .6273   19007.746

            Predicted
------  ----------  +  -----
Actual     0     1  |  Total
------  ----------  +  -----
  0       83    10  |     93
  1       27    22  |     49
------  ----------  +  -----
Total    110    32  |    142
--> MATR;B_P1=B_ACCEXP,B_SUBJ,B_X39;M_P1=MEAN(P1);Z_P1=B_P1*M_P1$
--> MATR;B_S1=B_SEX,B_AGE,B_INCOME;M_S1=MEAN(S1);Z_S1=B_S1*M_S1$
-->
WALD;FN1=(1/B_BID)(LOG(1+EXP(B_ONE+Z_P1+Z_S1)));FN2=(B_ONE+Z_P1+Z_S1)/B_BID$

               +----------------------------------------------+
               | WALD procedure. Estimates and standard errors |
               | for nonlinear functions and joint test of     |
               | nonlinear restrictions.                       |
               | Wald Statistic           =     14.68193       |
               | Prob. from Chi-squared[ 2] =      .00065      |
               +----------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Fncn( 1) -4921.584421      1358.2412        -3.623   .0003
 Fncn( 2) -827.4924436      4025.3480         -.206   .8371
```

7.6.3 Questionnaire 3a – household device

BIVARIATE

```
--> LOGIT;LHS=OWN;RHS=ONE,BIDHH$
              +---------------------------------------------+
              | Multinomial Logit Model                       |
              | Maximum Likelihood Estimates                  |
              | Dependent variable                OWN         |
              | Weighting variable                ONE         |
```

```
              | Number of observations              203     |
              | Iterations completed                  7     |
              | Log likelihood function       -108.5980     |
              | Restricted log likelihood     -128.7453     |
              | Chi-squared                    40.29478     |
              | Degrees of freedom                    1     |
              | Significance level             .0000000     |
              +---------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
          Characteristics in numerator of Prob[Y = 1]
 Constant  .2173729958      .21361898        1.018   .3089
 BIDHH    -.1107201696E-03  .23702813E-04   -4.671   .0000  11692.611

            Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0       123   13  |    136
  1        41   26  |     67
------  ----------  +  -----
Total     164   39  |    203
```

--> WALD;FN1=(1/B_BIDHH)(LOG(1+EXP(B_ONE)));FN2=(B_ONE)/B_BIDHH$

```
               +---------------------------------------------+
               | WALD procedure. Estimates and standard errors |
               | for nonlinear functions and joint test of     |
               | nonlinear restrictions.                       |
               | Wald Statistic            =     37.23696     |
               | Prob. from Chi-squared[ 2] =       .00000    |
               +---------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Fncn( 1) -9031.778077      1933.6677       -4.671   .0000
 Fncn( 2) -1963.264657      1689.7807       -1.162   .2453
```

--> TYPE>>>>NO EXPOSURE<<<<<<$
--> NAMELIST;P1=ACCEXPAL,SUBJ,X39$
--> NAMELIST;S1=SEX,AGE,INCOME$
--> LOGIT;LHS=OWN;RHS=ONE,BIDHH,P1,S1$

```
              +---------------------------------------------+
              | Multinomial Logit Model                     |
              | Maximum Likelihood Estimates                |
              | Dependent variable                  OWN     |
              | Weighting variable                  ONE     |
              | Number of observations              192     |
              | Iterations completed                  7     |
              | Log likelihood function       -98.43760     |
              | Restricted log likelihood     -120.0250     |
              | Chi-squared                    43.17470     |
              | Degrees of freedom                    7     |
              | Significance level             .0000000     |
              +---------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
          Characteristics in numerator of Prob[Y = 1]
 Constant -.6970851298      .74622029        -.934   .3502
 BIDHH    -.1046524262E-03  .24073701E-04   -4.347   .0000  12062.500
 ACCEXPAL  .9197055307      .49848330        1.845   .0650  .12500000
 SUBJ     -.4913471448      .52252319        -.940   .3470  .15104167
 X39      -.3128986534      .98911157        -.316   .7517  .36458333E-01
 SEX       .2977819333      .36959626         .806   .4204  .52604167
 AGE       .1295088618E-02  .12098597E-01     .107   .9148  43.432292
 INCOME    .3036210972E-04  .17924084E-04    1.694   .0903  18509.635

            Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
```

```
  0       120   11  |    131
  1        37   24  |     61
------  ----------  +  -----
Total     157   35  |    192
--> MATR;B_P1=B_ACCEXP,B_SUBJ,B_X39;M_P1=MEAN(P1);Z_P1=B_P1*M_P1$
--> MATR;B_S1=B_SEX,B_AGE,B_INCOME;M_S1=MEAN(S1);Z_S1=B_S1*M_S1$
-->
WALD;FN1=(1/B_BIDHH)(LOG(1+EXP(B_ONE+Z_P1+Z_S1)));FN2=(B_ONE+Z_P1+Z_S1)/B...
+------------------------------------------------+
               | WALD procedure. Estimates and standard errors |
               | for nonlinear functions and joint test of     |
               | nonlinear restrictions.                       |
               | Wald Statistic            =     19.70920      |
               | Prob. from Chi-squared[ 2] =       .00005     |
               +-----------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
 Fncn( 1) -9555.440194      2198.2846       -4.347   .0000
 Fncn( 2) -1023.792404      7086.3282        -.144   .8851
```

7.6.4 Questionnaire 3b – Relative's device

```
BIVARIATE
--> LOGIT;LHS=RELATIVE;RHS=ONE,BID$
              +--------------------------------------------+
              | Multinomial Logit Model                    |
              | Maximum Likelihood Estimates               |
              | Dependent variable             RELATIVE    |
              | Weighting variable                  ONE    |
              | Number of observations              203    |
              | Iterations completed                  8    |
              | Log likelihood function       -81.11360    |
              | Restricted log likelihood     -97.87154    |
              | Chi-squared                    33.51587    |
              | Degrees of freedom                    1    |
              | Significance level             .0000000    |
              +--------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
          Characteristics in numerator of Prob[Y = 1]
 Constant -.4359090649      .24997615       -1.744   .0812
 BID      -.3305841199E-03  .89425026E-04   -3.697   .0002  5846.3054

            Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0       165    0  |    165
  1        38    0  |     38
------  ----------  +  -----
Total     203    0  |    203
--> WALD;FN1=(1/B_BID)(LOG(1+EXP(B_ONE)));FN2=(B_ONE)/B_BID$
+------------------------------------------------+
               | WALD procedure. Estimates and standard errors |
               | for nonlinear functions and joint test of     |
               | nonlinear restrictions.                       |
               | Wald Statistic            =     22.79847      |
               | Prob. from Chi-squared[ 2] =       .00001     |
               +-----------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
 Fncn( 1) -3024.948689      818.27461       -3.697   .0002
 Fncn( 2)  1318.602554      1020.0161        1.293   .1961

--> TYPE>>>>NO EXPOSURE<<<<<<$
--> NAMELIST;P1=ACCEXPAL,SUBJ,X39$
--> NAMELIST;S1=SEX,AGE,INCOME$
--> LOGIT;LHS=RELATIVE;RHS=ONE,BID,P1,S1$
```

```
               +---------------------------------------------+
               | Multinomial Logit Model                     |
               | Maximum Likelihood Estimates                |
               | Dependent variable              RELATIVE    |
               | Weighting variable                   ONE    |
               | Number of observations               192    |
               | Iterations completed                   8    |
               | Log likelihood function        -73.09229    |
               | Restricted log likelihood      -88.09859    |
               | Chi-squared                     30.01261    |
               | Degrees of freedom                     7    |
               | Significance level             .9445477E-04 |
               +---------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
          Characteristics in numerator of Prob[Y = 1]
 Constant -1.342638702      .91037338       -1.475   .1403
 BID      -.2873979312E-03  .84810410E-04   -3.389   .0007  6031.2500
 ACCEXPAL  .5228226294      .57733348         .906   .3652  .12500000
 SUBJ      .3648026870      .57226561         .637   .5238  .15104167
 X39      -.2241518535     1.2346958         -.182   .8559  .36458333E-01
 SEX       .5065429536      .44838932        1.130   .2586  .52604167
 AGE      -.1678333942E-02  .15003505E-01    -.112   .9109  43.432292
 INCOME    .2058014121E-04  .21365461E-04     .963   .3354  18509.635

            Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0       159    0  |    159
  1        33    0  |     33
------  ----------  +  -----
Total     192    0  |    192
```

--> MATR;B_P1=B_ACCEXP,B_SUBJ,B_X39;M_P1=MEAN(P1);Z_P1=B_P1*M_P1$
--> MATR;B_S1=B_SEX,B_AGE,B_INCOME;M_S1=MEAN(S1);Z_S1=B_S1*M_S1$
-->
WALD;FN1=(1/B_BID)(LOG(1+EXP(B_ONE+Z_P1+Z_S1)));FN2=(B_ONE+Z_P1+Z_S1)/B_BID$

```
+-------------------------------------------------+
               | WALD procedure. Estimates and standard errors |
               | for nonlinear functions and joint test of     |
               | nonlinear restrictions.                       |
               | Wald Statistic              =     12.16817    |
               | Prob. from Chi-squared[ 2] =       .00228    |
               +-----------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
 Fncn( 1) -3479.496167      1026.8030       -3.389   .0007
 Fncn( 2)  2282.055222      3391.1357         .673   .5010
```

7.6.5 Questionnaire 3d – Relative's voucher

BIVARIATE
--> LOGIT;LHS=ALTRUISM;RHS=ONE,BID$

```
+-----------------------------------------------+
               | Multinomial Logit Model                     |
               | Maximum Likelihood Estimates                |
               | Dependent variable              ALTRUISM    |
               | Weighting variable                   ONE    |
               | Number of observations                37    |
               | Iterations completed                   9    |
               | Log likelihood function        -12.29933    |
               | Restricted log likelihood      -14.65322    |
               | Chi-squared                     4.707791    |
               | Degrees of freedom                     1    |
               | Significance level             .3002622E-01 |
               +---------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
```

```
          Characteristics in numerator of Prob[Y = 1]
 Constant -.7117921136      .70193201       -1.014   .3106
 BID      -.1697234693E-02  .12289739E-02   -1.381   .1673  1518.9189

Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0        32    0  |     32
  1         5    0  |      5
------  ----------  +  -----
Total      37    0  |     37
```

--> WALD;FN1=(1/B_BID)(LOG(1+EXP(B_ONE)));FN2=(B_ONE)/B_BID$

```
+------------------------------------------------+
               | WALD procedure. Estimates and standard errors |
               | for nonlinear functions and joint test of     |
               | nonlinear restrictions.                       |
               | Wald Statistic              =      3.63074     |
               | Prob. from Chi-squared[ 2] =       .16278     |
               +-----------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Fncn( 1) -589.1937068      426.63749       -1.381   .1673
 Fncn( 2)  419.3834339      660.55098         .635   .5255
```

7.6.6 Questionnaire 4b – Relative's device

BIVARIATE

--> LOGIT;LHS=RELATIVE;RHS=ONE,BID$

```
+----------------------------------------------+
              | Multinomial Logit Model                        |
              | Maximum Likelihood Estimates                   |
              | Dependent variable              RELATIVE     |
              | Weighting variable                   ONE     |
              | Number of observations               195     |
              | Iterations completed                   7     |
              | Log likelihood function        -89.35448     |
              | Restricted log likelihood      -106.5294     |
              | Chi-squared                     34.34986     |
              | Degrees of freedom                     1     |
              | Significance level              .0000000     |
              +----------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
          Characteristics in numerator of Prob[Y = 1]
 Constant -.1991393267      .23720887        -.840   .4012
 BID      -.2660959357E-03  .66553636E-04   -3.998   .0001  6008.2051

            Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0       149    0  |    149
  1        46    0  |     46
------  ----------  +  -----
Total     195    0  |    195
```

--> WALD;FN1=(1/B_BID)(LOG(1+EXP(B_ONE)));FN2=(B_ONE)/B_BID$

```
+------------------------------------------------+
               | WALD procedure. Estimates and standard errors |
               | for nonlinear functions and joint test of     |
               | nonlinear restrictions.                       |
               | Wald Statistic              =     27.01867     |
               | Prob. from Chi-squared[ 2] =       .00000     |
               +-----------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Fncn( 1) -3758.043119      939.94283       -3.998   .0001
```

```
 Fncn( 2)  748.3741763      1021.2544         .733   .4637

--> TYPE>>>>NO EXPOSURE<<<<<<$
--> NAMELIST;P1=ACCEXPAL,SUBJ,X39$
--> NAMELIST;S1=SEX,AGE,INCOME$
--> LOGIT;LHS=RELATIVE;RHS=ONE,BID,P1,S1$
              +----------------------------------------------+
              | Multinomial Logit Model                      |
              | Maximum Likelihood Estimates                 |
              | Dependent variable            RELATIVE       |
              | Weighting variable                 ONE       |
              | Number of observations             185       |
              | Iterations completed                 7       |
              | Log likelihood function      -79.12407       |
              | Restricted log likelihood    -100.3068       |
              | Chi-squared                   42.36541       |
              | Degrees of freedom                   7       |
              | Significance level            .0000000       |
              +----------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
          Characteristics in numerator of Prob[Y = 1]
 Constant -1.274114914      .71472941       -1.783   .0746
 BID      -.3149566677E-03  .77764768E-04   -4.050   .0001  5918.9189
 ACCEXPAL  .8101760970      .52496900        1.543   .1228  .15675676
 SUBJ     -.5202391313      .54309086        -.958   .3381  .16216216
 X39       .4813882500      1.3958090         .345   .7302  .32432432E-01
 SEX       .4359022168      .39969771        1.091   .2755  .47567568
 AGE       .6441462962E-02  .13715290E-01     .470   .6386  43.886486
 INCOME    .3431550952E-04  .25583601E-04    1.341   .1798  17490.541

Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0       135    7  |    142
  1        34    9  |     43
------  ----------  +  -----
Total     169   16  |    185
--> MATR;B_P1=B_ACCEXP,B_SUBJ,B_X39;M_P1=MEAN(P1);Z_P1=B_P1*M_P1$
--> MATR;B_S1=B_SEX,B_AGE,B_INCOME;M_S1=MEAN(S1);Z_S1=B_S1*M_S1$
-->
WALD;FN1=(1/B_BID)(LOG(1+EXP(B_ONE+Z_P1+Z_S1)));FN2=(B_ONE+Z_P1+Z_S1)/B_BID$
+------------------------------------------------+
               | WALD procedure. Estimates and standard errors |
               | for nonlinear functions and joint test of     |
               | nonlinear restrictions.                        |
               | Wald Statistic              =     16.86178     |
               | Prob. from Chi-squared[ 2] =       .00022     |
               +------------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Fncn( 1) -3175.039942      783.94509       -4.050   .0001
 Fncn( 2)  398.8700374      2287.6001         .174   .8616
```

7.6.7 Questionnaire 4d – Relative's voucher

```
>>>>>BIVARIATE<<<<<<<<
--> LOGIT;LHS=ALTRUISM;RHS=ONE,BID$
+----------------------------------------------+
              | Multinomial Logit Model                      |
              | Maximum Likelihood Estimates                 |
              | Dependent variable            ALTRUISM       |
              | Weighting variable                 ONE       |
              | Number of observations              40       |
              | Iterations completed                 7       |
              | Log likelihood function      -17.75906       |
              | Restricted log likelihood    -18.54906       |
```

```
              | Chi-squared                    1.579993     |
              | Degrees of freedom                    1     |
              | Significance level             .2087618     |
              +---------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
          Characteristics in numerator of Prob[Y = 1]
 Constant -1.199248366      .49432791       -2.426   .0153
 BID      -.3097461950E-03  .33310750E-03    -.930   .3524  1690.0000

Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0        33    0  |     33
  1         7    0  |      7
------  ----------  +  -----
Total      40    0  |     40
```

--> WALD;FN1=(1/B_BID)(LOG(1+EXP(B_ONE)));FN2=(B_ONE)/B_BID$

```
+-------------------------------------------------+
               | WALD procedure. Estimates and standard errors |
               | for nonlinear functions and joint test of     |
               | nonlinear restrictions.                       |
               | Wald Statistic             =      1.18319     |
               | Prob. from Chi-squared[ 2] =       .55344     |
               +-----------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Fncn( 1) -3228.449666      3471.9781        -.930   .3524
 Fncn( 2)  3871.712986      5174.9161         .748   .4544
```

7.6.8 Questionnaire 5 – Children device

```
>>>>>BIVARIATE<<<<<<<<
```

--> LOGIT;LHS=OWN;RHS=ONE,BID$

```
              +---------------------------------------------+
              | Multinomial Logit Model                     |
              | Maximum Likelihood Estimates                |
              | Dependent variable                  OWN     |
              | Weighting variable                  ONE     |
              | Number of observations              205     |
              | Iterations completed                  5     |
              | Log likelihood function       -126.0528     |
              | Restricted log likelihood     -142.0342     |
              | Chi-squared                    31.96271     |
              | Degrees of freedom                    1     |
              | Significance level             .0000000     |
              +---------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
          Characteristics in numerator of Prob[Y = 1]
 Constant  .8252425791      .20547570        4.016   .0001
 BID      -.1367092075E-03  .27628896E-04   -4.948   .0000  6040.0000

            Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0        48   52  |    100
  1        18   87  |    105
------  ----------  +  -----
Total      66  139  |    205
```

--> WALD;FN1=(1/B_BID)(LOG(1+EXP(B_ONE)));FN2=(B_ONE)/B_BID$

```
+-------------------------------------------------+
               | WALD procedure. Estimates and standard errors |
               | for nonlinear functions and joint test of     |
               | nonlinear restrictions.                       |
```

```
               | Wald Statistic             =     45.24651     |
               | Prob. from Chi-squared[ 2] =       .00000     |
               +-----------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Fncn( 1) -7314.796263      1478.3976       -4.948   .0000
 Fncn( 2) -6036.481334      1123.8249       -5.371   .0000

--> TYPE>>>>NO EXPOSURE<<<<<<$
--> NAMELIST;P1=ACCEXPAL,SUBJ,X39$
--> NAMELIST;S1=SEX,AGE,INCOME$
--> LOGIT;LHS=OWN;RHS=ONE,BID,P1,S1$
              +---------------------------------------------+
              | Multinomial Logit Model                     |
              | Maximum Likelihood Estimates                |
              | Dependent variable                 OWN      |
              | Weighting variable                 ONE      |
              | Number of observations             196      |
              | Iterations completed                 6      |
              | Log likelihood function      -106.8353      |
              | Restricted log likelihood    -135.8568      |
              | Chi-squared                   58.04305      |
              | Degrees of freedom                   7      |
              | Significance level            .0000000      |
              +---------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
          Characteristics in numerator of Prob[Y = 1]
 Constant -1.373190790      1.1673181       -1.176   .2394
 BID      -.1519374842E-03  .30637649E-04   -4.959   .0000  6162.2449
 ACCEXPAL  .6359534090      .45069956        1.411   .1582  .17857143
 SUBJ     -.6033163900      .45723396       -1.319   .1870  .15816327
 X39       2.211459821      .91429951        2.419   .0156  .61224490E-01
 SEX      -.2858195583      .74397420        -.384   .7008  .94897959
 AGE       .1830326415E-01  .26192421E-01     .699   .4847  37.219388
 INCOME    .8686889696E-04  .24936401E-04    3.484   .0005  19997.704

Predicted
------  ----------  +  -----
Actual      0    1  |  Total
------  ----------  +  -----
  0        69   29  |     98
  1        25   73  |     98
------  ----------  +  -----
Total      94  102  |    196
--> MATR;B_P1=B_ACCEXP,B_SUBJ,B_X39;M_P1=MEAN(P1);Z_P1=B_P1*M_P1$
--> MATR;B_S1=B_SEX,B_AGE,B_INCOME;M_S1=MEAN(S1);Z_S1=B_S1*M_S1$
-->
WALD;FN1=(1/B_BID)(LOG(1+EXP(B_ONE+Z_P1+Z_S1)));FN2=(B_ONE+Z_P1+Z_S1)/B_BID$
+-----------------------------------------------+
               | WALD procedure. Estimates and standard errors |
               | for nonlinear functions and joint test of     |
               | nonlinear restrictions.                       |
               | Wald Statistic             =     24.62294     |
               | Prob. from Chi-squared[ 2] =       .00000     |
               +-----------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Fncn( 1) -6581.654323      1327.2245       -4.959   .0000
 Fncn( 2) -6104.636956      7737.1833        -.789   .4301
```