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## **Household Decision Making Models And The Value Of Child Farm Safety**

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### **Abstract**

A number of studies have tested economic models of household decision-making, yet there is no consensus regarding which is most appropriate for practical application. One area where the choice of household decision model has potentially important implications is the valuation of child health or safety. Few child health valuation studies have investigated household decision-making models, typically adopting the simplifying unitary model. This study aims to determine the implications of household decision making models on the magnitude of a child safety premium. To achieve this, a stated preference survey is conducted amongst farm households in Northern Ireland to ascertain mothers' and fathers' individual preferences regarding the value of reducing the risk of non-fatal farm accidents to their child relative to themselves. A number of interesting results emerge. Firstly, no significant difference is found between child values elicited from mothers and fathers. Secondly, the premium, which suggests that fathers are willing to pay twice as much for their child than self, is consistent with previous findings. Finally, the affect of different household models on the value of the premium will be investigated. Results show that the premium magnitude varies, with midpoint values of 1.25 from the bargaining model, 1.5 from the collective model and 2 from the unitary model.

## I Introduction

The child health premium refers to the notion that society values the health or safety of a child over that of an adult and, by implication, is willing to pay more to prevent the same illness or reduce the same risk. This concept is becoming increasingly accepted in the health policy arena. For example in the United States, the US Environmental Protection Agency published guidelines for the analysis of policies that affect child health risks (USEPA, 2003). Meanwhile, the European Union, backed by the World Health Organisation, has launched a major policy initiative through the European Child Safety Alliance (ECSA) to establish national Child Safety Action Plans in 18 European countries. Other examples which indicate society's aversion to child related risks include the introduction of speed ramps outside schools in the UK, the promotion of pool alarms and fencing to prevent occurrences of children drowning in the US, promotion of sun protection including protective clothing, high factor creams and 100 percent UV filter sunglasses in Australia.

To ensure the benefits of accident prevention policies are not underestimated, child health effects should be incorporated into economic analyses assessing health or safety policies. If a premium for child safety exists, separate evaluation of health or safety policies which impact children will be necessary to ensure such a project is potentially Pareto improving. Support for the occurrence of such a premium is exclusively based on parental values (Crocker & Agee, 2001; Dickie & Messman, 2004), predominantly mothers', who may have greater responsibility for the well being of the child (e.g. Joyce *et al.*, 1989; Carlin & Sandy, 1991; Liu *et al.*, 2000). Such studies typically report that parents are willing to pay twice as much for their child as self (Liu *et al.*, 2000; Dickie & Messman, 2004). Consideration of the effect of the severity of injury or illness is limited. Liu *et al.* and Dickie & Messman find that as number and duration of minor respiratory or cold symptoms increase, WTP increases at a decreasing rate.

The first aim of this paper is to extend the results of earlier studies by eliciting values for child injuries of considerably different severities from *both* parents of a child. This allows us to empirically address previously unanswered questions such as whether the magnitude of the child health premium remains stable when elicited from mothers and fathers and for injuries of markedly different severity.

Elicitation of parental values for child health/safety (justified by the assumption that children themselves are unable to provide rational responses) complicates standard analysis of individual responses due to the inter-relationships that exist within families. Therefore, the family household decision making structure will be an important consideration in the analysis of child health policies. Consequently, the second aim of the study is to empirically investigate the impact of imposing different household decision making approaches on the magnitude of the premium value that would be recommended for policy.

Bergstrom's (2003) framework provides a useful starting point to empirically investigate the implications of imposing different household structures on the child

health premium elicited through parental willingness to pay<sup>1</sup> and hence, on the resulting consequences for policy. In the unitary model (following Becker, 1974), the head of household's (typically the father's) willingness to pay should be adopted. Where parents agree on what is fair when determining a household welfare budget (as in the collective model, Browning & Chiappori, 1998), both willingness to pay values from mother and father will be the same, so either value can be adopted for child health valuation. Conversely, where parents do not cooperate (as in the bargaining model, Manser & Brown 1980), the minimum WTP value of either parent should be employed for child health valuation so as to adhere to the potentially Pareto improving criteria.

Whilst pluralistic models (ie. bargaining and collective models) are thought to be more realistic in assuming that decisions are reached collectively, the complications associated with how that decision is reached reduce the plausibility of adopting this approach (Dickie & Gerking, 2002). Furthermore, Bateman & Munro (2005) point out that limitations of the data used in studies supporting pluralistic models restrict their ability to make reliable interpretations. Rather, the availability of information on household income and not wage rate may account for observed changes in expenditure patterns. The unitary model simplifies the task, and has been most frequently used in child health valuation studies for this reason. Previous studies in household decision making cast doubt on the credibility of the unitary model (Thomas, 1990; Lundberg et al, 1997; Attansio & Lechene, 2002), however, Bergstrom (2003) argues that it should not be dismissed, as it may still be appropriate in more traditional family settings.

Few child health valuation studies have investigated the effect of adopting different household decision making models. Comparing preferences elicited from partners individually with preferences elicited from partners' joint decisions, Dosman & Adamowicz (2006) and Bateman & Munro (2005) show that choice of household decision model could potentially have significant effects on the results and how they translate to policy recommendations. These studies show that individual responses differ significantly from joint responses, suggesting that use of unitary or collective models could produce quite different outcomes. However, as these studies do not specifically consider child welfare contexts making it difficult to draw definitive conclusions. Dickie & Messman (2004) also found that mothers and fathers made similar decisions in their study which investigated parental valuation of preventing acute illness to self and child. However, mothers and fathers were not drawn from the same household, hence providing justification for this study.

To achieve the aims of this study, a stated preference survey is conducted amongst farm households in Northern Ireland to ascertain mothers' and fathers' individual preferences regarding the value of avoiding the pain, suffering and inconvenience

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<sup>1</sup> Parental valuation of child health or safety is preferable since parents will usually act in the best interests of the child, have the means to pay, the cognitive ability to make a rational decision (which could occur if a value were directly elicited from affected children, Dockins *et al*, 2002) and to avoid double counting (which could occur if a value were elicited from society who ultimately pay for policies through taxation, Jones Lee, 1992).

associated with non-fatal farm accidents to themselves and their child<sup>2</sup>. The agricultural industry is reported to have the highest occupational fatality rate in Northern Ireland with 24.1 fatalities per 10,000 workers (HSENI, 2002). A proportion of reported fatalities and injuries involved children, for example, children under the age of 16 accounted for 5% of agricultural accidents (Magee, 2002). The farming scenario provides a common framework to value injuries to adults and children. Furthermore, this is one of the first child morbidity valuation studies to examine the existence of a child premium based on non-fatal injuries rather than acute illnesses.

Further details on the the survey and sampling procedures are provided in the subsequent section. Section 3 reports results which are presented in two subsections. Subsection 1 indicates that there is no significant difference between mothers' and fathers' WTP to prevent an injury to their children or to themselves. Significant child health premiums (i.e. difference between WTP to prevent injury to child and to self) were not entirely consistent in all cases. Subsection 2 demonstrates the considerable divergence in the premium magnitude when the household decision making model is varied. These results suggest that the household decision making structure has the potential to significantly affect the magnitude of the child health premium recommended for policy. Further implications are discussed in the final section.

## **II Survey and Sampling**

To elicit values of safety to children, a stated preference survey was conducted throughout Northern Ireland. Two hundred and ninety three farms were selected using a three-stage approach. Firstly, geographical clusters of 3-4 electoral wards in each of 12 rural districts (i.e. 2 per county) were selected to minimise travel distance between farms. 1,830 farms were identified as suitable through application of systematic sampling with proportional allocation in relation to six strata (3 types: Dairy; Cattle & Sheep; Cereal and 2 sizes: 16-40 European Size Units (ESU) and 40+ ESU). Farmers were then contacted by telephone to ensure that a spouse and at least one child under 18 years resided on the farm site and that both farmer and spouse were willing to participate. Eighty two percent of the 1,830 farms contacted lived with their spouse on the farm. Of those farms, 34% had at least one child under the age of 18 years living on the farm<sup>3</sup>, of which 72% were willing to participate. The final sample was selected to be representative of target farms in Northern Ireland according to type, size and county.

On each farm, separate interviews were successively conducted with the farmer and spouse to ensure there could be no collusion concerning responses. The stated preference survey began with warm up questions to familiarise respondents with the characteristics of the injuries to be valued and with the nature of the tasks they would complete. In all cases, injuries were assumed to have been sustained from farm machinery accidents.

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<sup>2</sup> By presenting the question in terms of WTP for recovery from a certain injury that has already occurred, rather than WTP for a reduction in the risk of sustaining an injury, the benefit value is mutually exclusive. Therefore problems associated with joint product confounds are avoided.

<sup>3</sup> This compares with 82% of couples married and living on farms (Magee, 2002) and an anticipated 42% who have at least one child under 18 years, based on 2001 UK Census.

Following this, a willingness to pay question was presented to elicit the maximum amount that a respondent would be willing to pay for extra treatment (i.e. in addition to standard NHS treatment<sup>4</sup>) that would return them to normal health within 3-4 days<sup>5</sup>. Respondents were prompted to bear in mind what they could realistically afford and were informed that income loss would be covered by insurance and that no legal compensation for the injury would be issued. It was also emphasised that they should not attempt to guess the cost of the treatment.

The symptoms associated with the non-fatal injuries included in the questionnaire are described in Table 1. Injury F is the less severe injury, which does not require a stay in hospital, the effects of the injury last weeks and there are no long term effects. Injury W necessitates a short stay in hospital, effects of the injury are felt for weeks or months and normal health is restored after 3-4 months.

**Table 1 Descriptions of non-fatal farm machinery injuries (Jones Lee et al, 1995)**

	<b>Immediate Effects</b>	<b>After Effects</b>	<b>Long Term Effects</b>
<b>Injury F</b>	Seen as hospital outpatient	<ul style="list-style-type: none"> <li>• Slight-mod pain for 2-7 days</li> <li>• Some pain for several weeks</li> <li>• Some limitation to normal activities for several weeks</li> </ul>	None
<b>Injury W</b>	<i>In Hospital</i> <ul style="list-style-type: none"> <li>• 2-7 days</li> <li>• Slight to moderate pain</li> </ul>	<i>After Hospital</i> <ul style="list-style-type: none"> <li>• Some pain/discomfort for several weeks</li> <li>• Some restrictions to work and/or leisure activities for several weeks/months</li> </ul>	After 3-4 months, return to normal health with no permanent disability

Money amounts were elicited using a payment card which showed 15 amounts, exponentially increasing from £5 to £1million, to minimise bid range and centring effects Rowe *et al* (1996)<sup>6</sup>. The money amounts were also presented on cards which the respondent was asked to sort into three piles, corresponding to amounts that they definitely would pay, definitely would not pay or amounts about which they were not sure<sup>7</sup>. [ALBERINI PAPER]

The second question in the survey sought to obtain a value of safety for a child. As before, parents were asked how much they were WTP for extra treatment that would return their child to normal health in 3-4 days, following the occurrence of a farm machinery accident resulting in either Injury F or W (Table 1). The WTP question was asked in reference to only one child, where child was defined as less than 18 years of age. A number of procedures were employed following Dickie & Messman (2004). Firstly, where respondents had two or more children, one child was randomly selected by the interviewer. Secondly, information relating to the child was collected

<sup>4</sup> This follows the methodology adopted in Carthy *et al* (1999) where respondents refused or found it difficult to indicate an amount they would be willing to pay for treatment for a road injury because in reality such treatment in the UK is provided free of charge by the National Health Service.

<sup>5</sup> A proxy for the prevention of the occurrence of a non-fatal injury.

<sup>6</sup> They argue that the exponential scale complies with the notion that the accuracy of respondents estimates are proportional to the value, with Weber's Law that 'just noticeable' differences in value changes increase exponentially and finally, with an observed 'natural' error distribution in WTP values

<sup>7</sup> This approach was adopted to encourage respondents to consider all amounts and avoid problems such as anchoring, protest and non-responses, yes-saying and bid range effects.

to help explain the elicited value. Finally, to prevent parents expressing altruism towards their child due to a concern for what the interviewer will think the severity of the child injury valued differed from the severity of the injury that respondents had previously valued for themselves.

Two versions of the questionnaire were issued. Each father and mother from the same household completed the same version of the questionnaire in every case. The experimental design is illustrated in Table 2 below.

**Table 2 Experimental Design**

	<b>Version 1 (150 Households)</b>		<b>Version 2 (143 Households)</b>	
	<i>WTP: Injury to Self</i>	<i>WTP: Injury to Child</i>	<i>WTP Injury to Self</i>	<i>WTP Injury to Child</i>
<i>Father Respondent</i>	W	F	F	W
<i>Mother Respondent</i>	W	F	F	W

Conventional parametric analysis relies on strict assumptions regarding the underlying distribution of responses. Analysis will be accurate only if the correct functional form is specified. Where these assumptions do not necessarily hold for example due to random sampling, or as is typical in the case of morbidity valuation, the Turnbull estimator offers a non-parametric approach to calculating the mean and median willingness to pay estimate.

Within non-market valuation, the Turnbull estimator (Turnbull 1974, 1976) has been most commonly applied to discrete choice contingent valuation (Kristrom, 1990) Carson et al, 1994; Haab & McConnell, 1997). Haab & McConnell (2002) also outline how the Turnbull estimator can be applied to payment card data. Due to the nature of the payment card where every respondent is presented with every bid level, the cumulative density function is assured to be monotonically increasing, so long as every bid on the scale was indicated by some respondent as their lower bound WTP. Bids that were not selected should be eliminated to ensure monotonicity. Haab & McConnell show that a standard mean calculation is exactly equivalent to the Turnbull lower bound mean.

#### **IV Results**

The results are reported in two parts. Subsection 1 reports values elicited from mothers and fathers representing WTP to prevent the occurrence of injuries F and W to self and child (henceforth denoted  $WTPF_{SELF}$ ,  $WTPF_{CHILD}$ ,  $WTPW_{SELF}$ ,  $WTPW_{CHILD}$ ) (Table 3). These values are firstly analysed to test for statistically significant difference between mothers' responses compared to fathers' responses. This illustrates whether the choice of household member has any effect on the value of the household commodity. The paired t-test for two related samples is used to take into account household effects. Secondly, t-tests are carried out to examine whether there are significant differences between how parents value their own safety relative to their child's safety to establish a significant child health premium.

Subsection 2 determines the impact of the choice of household decision making model on the magnitude of the premium value that would be recommended for policy. The premium value is calculated by dividing the  $WTP_{CHILD}$  by  $WTP_{SELF}$  for each household and then calculating a mean across all households. Whether mothers' or fathers' WTP values or some combination are used to calculate the premium, will depend on the choice of household model applied.

### Subsection 1

**Table 3 Mothers' and Fathers' WTP for Prevention of Injuries to Self and Child**

		<b>n</b>	<b>Mean (£)</b>	<b>SE (£)</b>	<b>Median (£)</b>
Mother	$WTPF_{SELF}$	143	756.57	43.49	250
	$WTPF_{CHILD}$	149	2470.74	226.17	500
	$WTPW_{SELF}$	149	2555.17	207.05	500
	$WTPW_{CHILD}$	143	3384.06	254.45	1,500
Father	$WTPF_{SELF}$	141	1233.58	287.29	250
	$WTPF_{CHILD}$	149	1466.28	271.89	250
	$WTPW_{SELF}$	150	1985.87	222.95	500
	$WTPW_{CHILD}$	143	2740.56	232.54	1,500

Paired t-tests reveal there is no significant difference between mothers' and fathers' mean WTP values for child safety for either injury (Injury F:  $t = 1.245$ ,  $p = 0.215$ ; Injury W:  $t = -1.142$ ,  $p = 0.255$ ) which suggests that from a policy perspective, a value for child safety on farms could be obtained from either parent. There is also no significant difference between mothers' and fathers' values for their own safety for either injury (Injury F:  $t = -1.411$ ,  $p = 0.160$ ; Injury W:  $t = -0.985$ ,  $p = 0.326$ ).

Mothers' values are found to be significantly higher for their child than for self at the 5% level in both injury cases (Injury F:  $t = 7.443$ ; Injury W:  $t = 2.527$ ). When the same tests are replicated on fathers' values, which are also higher for child than self in both injury cases, the difference is significant only for the more severe injury, W (Injury F:  $t = 0.588$ ; Injury W:  $t = 2.343$ ). These results show that parents appear to be considering the value of improved safety for specific members of the family, i.e. self or child rather than applying a constant value which represents WTP to avoid the injury. They support the existence of a significant child health premium.

Due to the specialised nature of the sample, i.e. farming parents of children aged up to 18 years, we found little variation in explanatory variables such as age of parent. Covariate analysis on WTP revealed that as income was positively significant. This lends credibility to the results.

### Subsection 2

The child health premium magnitude is calculated for each household decision making model as follows:

1. *Unitary Model:* The head of household is the dictator so his or her values are adopted. The head of the household would traditionally be the father, however, in today's modern society, it is just as plausible that the head could be the mother. Therefore, the premium is calculated for both cases.



- 1a. Unitary Premium: Father = Father WTP<sub>SELF</sub> / Father WTP<sub>CHILD</sub>  
 1b. Unitary Premium: Mother = Mother WTP<sub>SELF</sub> / Mother WTP<sub>CHILD</sub>
2. *Collective model:* Parents cooperate therefore household averages are utilised.

Premium = Average of Mother & Father WTP<sub>SELF</sub> / Average of Mother & Father WTP<sub>CHILD</sub>

3. *Bargaining model:* The minimum value in the household would be utilised to calculate the premium in order to ensure Pareto efficiency following Bergstrom's principle discussed in the introduction.

Premium = Minimum of Mother & Father WTP<sub>SELF</sub> / Minimum of Mother & Father WTP<sub>CHILD</sub>

Table 4 summarises the magnitude of premiums calculated using the different approaches described above.

**Table 4**

<b>Injury F</b>			<b>Injury W</b>		
Model	Calculation (£)	<b>Premium</b>	Model	Calculation (£)	<b>Premium</b>
Unitary: Father	1466.28/1233.58	<b>1.2</b>	Unitary: Father	2740.56/1985.87	<b>1.4</b>
Unitary: Mother	2470.74/756.57	<b>3.3</b>	Unitary: Mother	3384.06/2555.17	<b>1.3</b>
Collective	1,975.05/995.08	<b>2.0</b>	Collective	3,050.07/2,270.37	<b>1.3</b>
Bargaining	602.97/426.89	<b>1.4</b>	Bargaining	1,280.77/983.67	<b>1.3</b>

## **V Discussion and Conclusion**

Evidence for the existence of a significant child safety premium reported by parents supports the majority of other parental valuation studies (eg. Liu *et al*, 2000). Statistical tests comparing values elicited for self and child show that mothers' premiums are significant for both injuries and fathers' premiums are only significant for the more severe injury. Values of child safety are most frequently elicited from mothers and so the finding that mothers have a consistently significant premium complies with the studies previously discussed (Liu *et al*, 2000; Carlin & Sandy, 1991; Joyce *et al*, 1989). The finding that fathers only have a significant premium for the more severe injury is perhaps not surprising, given that all fathers included in the sample were farmers who are likely to be very familiar with minor injuries and perhaps have a more realistic perspective of the effects that such a minor injury has. Their attitude towards these minor injuries is likely to be less cautious.

The finding of no significant difference between mothers' and fathers' values on both child injuries are consistent with the results in Dupont (2001) who found no significant difference between mothers' and fathers' WTP to improve the

environmental status of a local harbour used for recreation. In addition, Bateman & Munro (2005) could not reject the hypothesis of no difference between male and female partners' WTP for a reduction in dietary health risks. Other studies have shown that the preferences of males and females differ significantly (Dosman & Adamowicz, 2003). However, it is difficult to draw definitive conclusions from studies that do not specifically consider matters related to child welfare. This study provides the first attempt at addressing this issue. Results suggest that either parent will provide an accurate estimate for child health/safety valuation.

It is not evident that the results produced in this study will apply to other child welfare related matters. The primary reason for this is that where mothers may have greater responsibility for the well being of the child within a non farm household (e.g. Liu *et al*, 2000), the context examined in this study involves the father to a greater extent, given that the risks faced by the child arise from the father's workplace, i.e. the farm, for which he has responsibility. In this way, both parents are accountable for the well being of the child in this specific scenario. In addition, it may be that mothers and fathers may value their own health or safety differently in other circumstances and this will affect the premium value. More studies comparing child values obtained from individual parents within the same household should be carried out to provide stronger evidence that a consistent valuation of child health or safety premium can be elicited from either parent for policy purposes.

Investigation of the effect of estimating the premium through application of Bergstrom's alternative household decision models to the results obtained in this study show that the premium exists in each case. However, variation in the magnitudes of the premium could substantially affect the value adopted for policies related to child health or safety. A child health premium calculated using the head of household's premium (assumed to be the father) would result in a premium of between 1.2 (Injury F) to 1.4 (injury W). However, if the mother's value were used, as is common in child health valuation studies, a mid point of 2.3 is similar to the magnitude reported in previous studies, which typically state that parents are willing to pay twice as much for their child (Liu *et al*, 2000; Dickie & Ulery, 2001; Dickie & Messman, 2004). However, application of the other household models result in smaller premium magnitudes (with midpoints of 1.65 for the collective model and 1.35 for the bargaining model).

In addition, it can be noted that the severity of injury reverses in the premium range when the model changes. That is, the minimum premium value is obtained from the less severe injury under the unitary household model but is obtained from the more severe injury under the other models. Closer examination reveals that if based on injury W, the premium varies markedly according to the adopted model from 1.2 to 3.3. If based on injury F, it varies from 1.2 to 3.3. The variation is due to the substantial difference in how mothers and fathers valued the more severe injury. In particular, farming fathers and mothers appear to have different preferences about the child safety premium to attach to injury W. Given Bergstrom's definition of the unitary, collective and bargaining models, preferences regarding injury W appear to drive the difference in premium between models.

The implications of these findings suggest that different family structures could be inaccurately represented if *one* of these models were applied generally to represent all

households. This further emphasises the need to take the family household decision structure into account. This paper has shown that it is practically plausible to conduct interviews with both parents. However, more empirical research is necessary to develop a protocol for two parent interviews that can reveal the actual underlying household decision making model. Given the inherent differences, an alternative approach might be to develop controlled experiments. Furthermore, it remains a debatable issue as to whether parents' preferences best represent the value of child welfare, particularly if, as shown in Cockerill *et al* (2006), altruism toward child safety on farms is widespread throughout society.

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## **Appendix :**

### **Response Rate**

Eleven respondents assigned a zero WTP response for Injury W and 40 for Injury F. Twenty-eight respondents (out of 300) were not willing to pay any amount for the quick recovery of their child from Injury F, whilst 14 respondents (out of 286) were not willing to pay for the quick recovery of their child from Injury W.

There was 1 WTP non-responses for Injury W and 9 for Injury F. In addition, there were two non-responses for the Child Injury W question and four for Child Injury F. These responses were omitted from the data.