

## EVALUATION OF CASUALTY COST OF MOTORCYCLIST'S SLIGHT INJURY IN INDONESIA

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**Abstract:** There have various ways of assessing the cost and impact of road traffic casualties. Willingness to pay and Gross output are the two methods, which are usually used to estimate the value of safety. The purpose of this study is to propose a method to estimate the best figure for valuing the slight motorcycle casualty. To find the best figure, this study looks at evaluation of gross output and willingness to pay methods for costing slight motorcycle casualty in Surabaya, Indonesia, where the number of motorcycles has grown by an average of 6.25% yearly and correspond growth of with the casualties especially those with slight injury. In order to obtain a real value that reflects the economic burden of the casualty, a questionnaire survey has been undertaken. The results of both methods have been analyze and compared.

**Key Words:** motorcycle, gross output, and willingness to pay

### 1. INTRODUCTION

It is well known that valuing the financial burden of an accident casualty make possible of casualty and accident cost to be identified. The purpose of that is to ensure that the best figure is used in economic evaluation for investment at the national planning level for road safety improvement (Jacobs (2000) and Downing (1997)). Furthermore, Downing (1997) has highlighted that the value has to reflect the real economic burden of casualty.

In the last few decades, motorcycles account for the most common mode of transport used in Surabaya, Indonesia, where the number of motorcycles has grown by an average of 6.25% yearly (Widyastuti and Bird (2004)). On the other hand the motorcycle is reported as having the highest portion of the vehicles involve in accident in Surabaya, Indonesia. Most motorcycle accidents lead to some degree of casualty to the motorcyclist, due to the vulnerable position of motorcycle riders. A descriptive analysis finds that casualties incurred using motorcycles are higher comparing other vehicles. Mannering and Grodsky (1995) have identified that motorcycling is generally a relatively risky activity.

Knowing that there are three classes of injury, slight, serious and fatal; this study looks only in detail at slight injury, which is the accident class prevalent for the motorcyclist. Moreover the numbers of motorcycle slight casualties that are reported by Police tend to be less than the reality due to unreported cases. Given these circumstances, this research will assess the casualty cost of slight motorcycle injuries in Surabaya, Indonesia. It will look at how the impact of the costs of a slight injury motorcycle accident casualty can be measured. This is

not because fatal and serious injuries are not important but to explain methodology, each class of injury needs to be considered separately.

The purpose of this paper is to find an appropriate method for valuing motorcycle slight casualty as well as the human cost. In order to estimate this value, household interviews have been carried out. The questionnaire was created in order to reveal a direct cost and loss of productivity time of the casualty and willingness to pay of reducing a few probability risks using contingent a valuation method. The motorcycle casualty cost using both methods have analyzed and compared with previous results.

## **2. REVIEW OF RELATED LITERATURE**

Various methods have been devised to analyze accident costs. The decisions in which the method will be chosen clearly depend on the objective of the research. When the objectives are to maximize national output or pursue social welfare, gross output and willingness to pay method are recommended. Hills and Jones-Lee (1981) noted that the gross output method is definitely relevant when considering the wealth of a country, whereas the willingness to pay is more appropriate when considering social welfare objectives. Moreover, Elvik (1995) mentioned that the cost should reflect the user willingness to pay for reducing their risk of accident, therefore willingness to pay method should be used. TRL (1995), Ghee, Silcock et al (1997) and Silcock and TRL (2003) mentioned that, even though willingness to pay is the most appropriate method to show the measurable cost for an accident casualty, there are some weaknesses with regard to the complexity of questionnaires used to determine the valuation. Furthermore the questionnaires are more appropriate for adult people. In addition, Alfaro, Chapuis et al (1994) mention that in practical weighting system, gross output method leads to have the highest score for human cost, although its coverage incomplete. However that study conclude that gross output is inappropriate for calculating human cost of non- fatal accident and suggested to that a combination of gross output and individual willingness to pay will give a better value especially for valuing human cost. On the other hand, Jones-Lee, Loomes et al (1995) suggesting willingness to pay is also appropriate, however revealed that willingness to pay responses is tend to “insensitive” to risk reduction.

TRL (1995) and Silcock and TRL (2003), concluded that Gross Output method should be supplemented with some human element which is very subjective. This should reflect the pain, grief and suffering of those involved in road traffic accidents. Those studies suggest adding 38 % for fatal, 100% for serious and 8% for slight injury on the top of total amount of direct cost and loss of productivity cost where using the gross output method for covering the subjective cost. Even though these numbers base on UK reference, developing country including Indonesia have taken these numbers for analyzing accident cost, (Downing (1997), MS and Malkhamah (2004) and Sari and Sutomo (2004)).

## **3. STUDY BACKGROUND**

This paper tries to evaluate motorcyclist slight casualty cost derived from gross output and willingness to pay method based on data collected from motorcyclist casualties in Surabaya, Indonesia. Even though previous research use secondary data for valuing casualty cost using gross output method together with some assumptions when no data available; In this study, primary data is used to obtain the appropriate value that reflect the casualty's economic

burden using the questionnaire. The respondents were the slight motorcycle casualties.

As mention previously that developing country including Indonesia using gross output while valuing the subjective cost. The formula following TRL (1995), Ghee, Silcock et al (1997) and Silcock and TRL (2003) suggestion which is adding 8% from total of direct and loss of productivity cost for covering, grief and suffering in the gross output method while using in developing country. This method has been used for analyzing in this study.

Contingent Valuation (CV) surveys have been used by some researches to look at willingness to pay methods when valuing human cost for fatal and non fatal casualty. The respondents are asked to answer whether they are willing to pay or not for reducing a several areas of probability risk. An example question is as follows: how much are you willing to pay to reduce the probability injury from 24/100.000 to 14/100.000. As well as gross output method above, the willingness to pay using a contingent valuation has used for analyzing too.

#### **4. METHODOLOGY OF STUDY**

The methodology of this study is as describe below:

- A review and assessment of previous studies and research on valuing accident cost and related issues followed by design of on questionnaire for data collection;
- Gross output method with human cost supplemented and willingness to pay are both method analyzing for the motorcycle casualty cost.
- Household interview is the methodology collecting the data for both methods; gross output and willingness to pay method. Asking the real expenses of direct casualty cost incurred and lost of productive time is the methodology for gathering data of gross output method, while contingent valuation is used for willingness to pay method.
- Data analysis was used to calculate the casualty cost in both methods and to determine the differences.
- A confirmation through comparative study of previous research, either modeling or analytical basis of the results.

#### **5. COLLECTING DATA**

A questionnaire has been used for gathering data. The respondents were the slight motorcycle casualty.

##### **5.1. Formation of the Questionnaire**

The questionnaire includes three sections described:

1. The first section asks general information including: age, gender, job and income.
2. The second section is related to accident data including the direct cost data such as: medical cost and non medical costs which were incurred. In this section, the respondent is asked about unproductive time following the motorcycle accident. Respondents are also asked to predict the total direct and indirect cost incurred.
3. The last section consists of a willingness to pay questionnaire using the contingent valuation method.

## 5.2. Attribute of Respondents

The interviews were carried out during July and August 2004 in the casualties' home. As the time and cost was limited, only fifty motorcyclist slight casualties were interviewed. Moreover, even though the respondents have no more than slight injury, but they tend to keep the bad experience privately, therefore some of those refuse being respondent. The sample gender was predominantly male (86 % of total respondents). 56 % of sample fell into the age range (20-29). This is not out of line of Police accident record, which is record all accidents.

## 6. RESULT

### 6.1. Gross Output Method

The gross output method for calculating accident cost in developing country has been used to analyze the casualty cost. The casualty cost was broken down into two components, direct and indirect cost. Indirect costs have been divided into two components, loss of productivity and loss of quality of life. Loss of productivity cost is the cost of loss of time being productive as a result of the accident such as, time spent in hospital and care at home. Loss of quality of life is the cost covering pain, grief and suffering as a result of the accident that could reduce the quality of life reduce.

Direct cost in this study encompasses of some items which are: cost at scene, hospital cost, as out-patient treatment, psychotherapy, administration, vehicle reparation and other cost. The result as follow:

- Cost at scene is the cost incurred at scene either for first aid or transportation from scene to hospital. Result shows that only 12 (24%) of respondents had to pay cost at scene with the average cost being Rp. 8,000.00 (rounded) amongst the 12 respondents. The low percentage might be caused by casualties being brought by somebody surrounding the accident scene to the hospital rather than by using ambulance.
- Medical costs are the costs for medical treatment either as in-patient or as out patient. However, most of slight casualties who have scratches, twisted legs or hands prefer to be cared for at home instead of having medical treatment. Purchasing pain killer medicine, disinfectant liquid and traditional massages are a part of their solution. Even though they have not acquired formal medical treatment cost, in fact they have spent money on the recovery process. As the motorcycle is a slight casualty, in this study, it meant the casualties had not spent time in hospital for medical treatment and therefore the hospital cost would not incurred by every slight injury. Most respondents (72%) had no hospital cost. No more than 9 (18%) of respondents had to pay hospital cost with an average payment of Rp. 180,000.00 (rounded) paid by them. Only 10 (20%) of respondents were treated as outpatient obtaining medical treatment with a minimum cost is Rp. 10,000.00 and a maximum cost of Rp. 750,000.00, whereas the average cost is Rp. 190,000.00 for those who paid any outpatient cost. Only 1 (2%) of the respondents required physiotherapy regarding a twisted ankle. And Rp. 20,000.00 was paid for the physiotherapy cost.
- Administration cost is the cost incurred for payment such as police and insurance administration. From the data, only one person (2%) paid in administration costs and the cost that was incurred was Rp. 25,000.00

- Vehicle reparation cost is normally the highest share of the direct cost incurred by motorcycle slight casualties, even though 20 % of respondents had made no payment for this. The minimum vehicle reparation cost is Rp 15,000.00, while the maximum is Rp. 800,000.00 with an average of Rp. 165,000.00 for the respondent who paid vehicle reparation cost.
- The other cost in this study covers any direct expenses regarding the accident, which are not included in the items above such as payment to third parties. Only 1 (2%) of the casualties had to pay other costs to a third party and the cost incurred was Rp. 75,000.00.

The total direct cost is the sum of all direct costs incurred above. Table 1 below shows that half the respondents had a direct cost less than Rp. 100,000.00, while the second largest group between Rp. 100,000.00 – Rp. 199,000.00. The average total direct cost is Rp.208, 500.00 of all respondent.

Table 1: Distribution of Total Direct Cost Incurred Among Respondents (Rp)

Range (Rp,-)	Number of Respondent
No cost incurred	8
<100,000	17
100,000 - 199,000	10
200,000 - 299,000	4
300,000 - 399,000	3
400,000 - 499,000	1
500,000 - 599,000	2
600,000 - 699,000	2
700,000 - 799,000	0
800,000 - 899,000	2
900,000 - 999,000	0
>1,000,000	1

Moreover, Figure 1 shows that the vehicle repair cost take the most portion of the total direct cost (63.65%), following with medical cost (outpatient and hospital cost), whereas the psychotherapy cost is the lowest cost.

Loss of productivity is the indirect cost incurred in respect of the loss of casualties' productive working time as a result of the accident. In this study, the loss of productivity has been valued using the loss of casualties' working time multiplied by their income or wages. In the case of casualties who have no job, such as housewives and children, average wages derived from secondary sources have been used. These wages were based on a previous study (Sari and Sutomo (2004)), where 36% of respondents lost production time with an average cost of Rp. 105,000.00 (rounded) of 18 respondents.

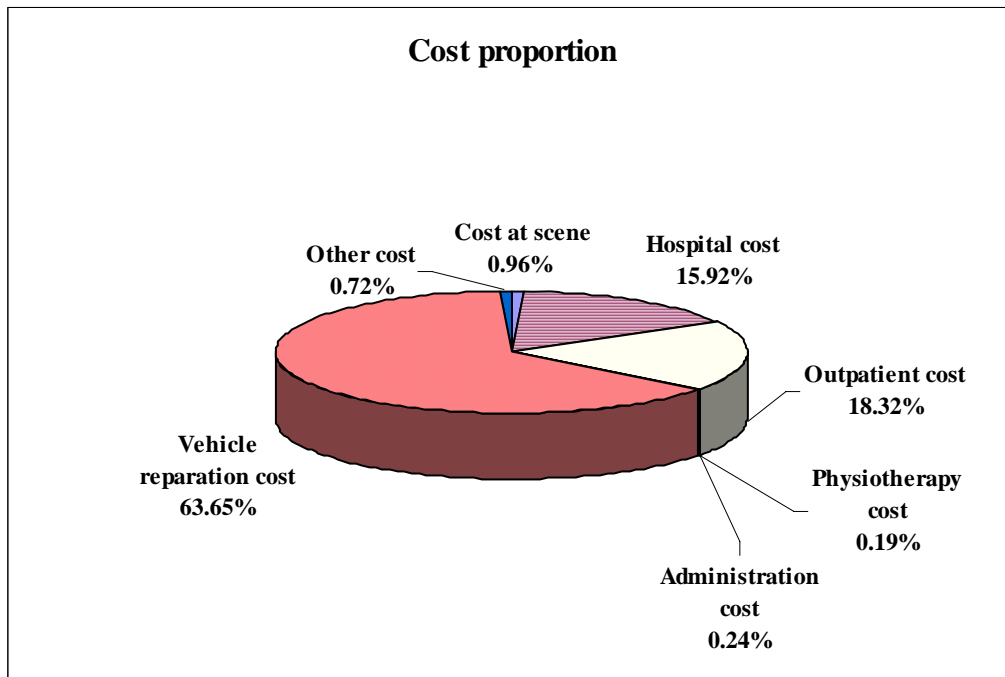


Figure 1 Cost proportion of direct cost

As well as direct and loss of productivity described above, the other aspect which should be taken into account is pain, suffering and inconvenience incurred by the casualties and relatives regarding the accident. The subjective cost which is including pain, grief and suffering comprising of loss of quality of life have to be taken into account in gross output method. TRL (1995) and Silcock and TRL (2003) recommend adding 8% of total direct cost and loss of productivity cost to cover loss of quality of life. Based on this method, the total slight casualty cost has been calculated, some of respondent pay nothing, and the maximum payment is Rp. 2,310,000 with an average cost of Rp. 270,000 (rounded) for all respondents (Table 2).

Table 2 Slight casualty cost based on gross output method

Total cost based on gross output method (Rp)			95% confidence interval (Rp)	
min	max	average	min	max
-	2,310,000	270,000	180,615	439,489

However, when the slight casualty respondents were asked about their prediction of the total cost incurred regarding the accident, the result tends to be higher than the result of gross output method. The average cost of slight casualty cost prediction is Rp.1, 310,000.00 for the entire sample (Table 3).

Table 3 Total cost incurred as casualties' prediction

Prediction of total cost (Rp)			95% confidence interval (Rp)	
min	max	average	min	max
-	8,000,000	1,310,000	626,861	2,049,670

## 6.2. Willingness to Pay Method

Identifying a value of statistical life using willingness to pay method is as follows; if the respondent is willing to pay Rp X for reduction 1/Y of risk, then the value of statistical life of the person would be  $X*Y$ . Therefore, in this study, respondent were asked how much the respondent be willing to pay for a risk reduction. The reductions had to be considering were:

- How much would you be willing to pay for 4 in 100,000 (11,76%) reduction on motorcycle fatality
- How much would you be willing to pay for 9 in 100,000 (26,47%) reduction on motorcycle fatality
- How much would you be willing to pay for 24 in 100,000 (70.59%) reduction on motorcycle fatality
- How much would you be willing to pay for 50 in 100,000 (40%) reduction on motorcycle slight injury

As mentioned before that Jones-Lee, Lomes et al (1995)revealed that willingness to pay responses tend to be “insensitive” to number of risk reduction. This statement has a connection with the results of this study. The result reveals: 18% of respondents stated zero willingness to pay for any type of reduction, another 18% of them gave exactly the same amount for all types of reduction shown above; 6 (12%) stated they willing to pay more for slight injury than fatality reduction and 5 (10%) of them were willing to pay less for slight injury than fatality reduction.

Figure 2 below shows the distribution of respondent willing to pay for few risk reduction at any types.

The average willingness to pay for a respondent at fatality reduction of 4/100,000 fatality is Rp. 17,000.00, then Rp. 20,000.00 for 9/100,000 reduction and Rp. 26,800.00 for 24/100,000 reduction. The average willingness to pay of respondent at 50/100,000 slight injury reduction is Rp. 29,100.00. Then the value of fatalities have three result (Table 4), there are Rp. 435,000,000.00 for 4/100,000 reduction; Rp. 220,000,000.00 for 9/100,000 and Rp 120,000,000.00 for 24/100,000 reduction, while the average is Rp. 260,000,000.00. The value of slight injury is 60,000,000.00, which are 0,23 of value of fatality.

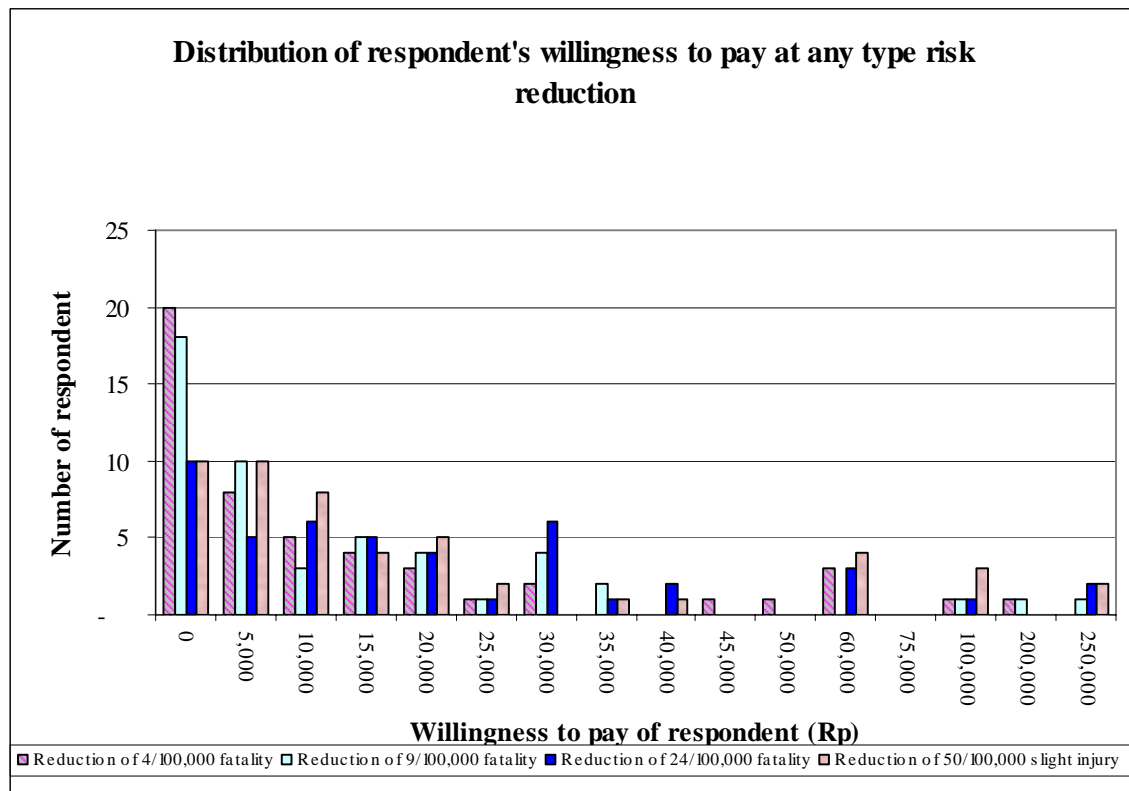


Figure 2 Distribution of Respondent's Willingness to pay at any Type Risk Reduction (Rp)

Table 4 Average Value of Fatality and Slight Injury (Rp) base on any Type Risk Reduction

Type of prevention	Min risk-value at any type of prevention (Rp/each reduction)	Max risk-value at any type of prevention (Rp/each reduction)	Average risk-value at any type of prevention (Rp/each reduction)
Reduction of 4/100,000 fatality	-	5,000,000,000.00	435,000,000.00
Reduction of 9/100,000 fatality	-	2,800,000,000.00	220,000,000.00
Reduction of 24/100,000 fatality	-	1,040,000,000.00	120,000,000.00
Average value of fatality	-	2,940,000,000.00	260,000,000.00
Reduction of 50/100,000 slight injury	-	500,000,000.00	60,000,000.00



## 7. DISCUSSION

Assessing values of road traffic accident have been carried out over three decades in developed countries and this is very different in Indonesia as a developing country, where the method used for valuing cost accident have followed previous gross output method research, especially for costing pain, grief and suffering. This is due largely to lack of data and the complexity of putting a monetary value on indirect cost (pain and suffering).

In this study, all motorcyclists experienced slight injury with an average cost for direct costs of more than two hundred thousand rupiahs and a total casualty cost using gross output method of Rp. 270,000.00 including pain, grief and suffering as pervious research suggestion which is 8% of total direct and loss of productivity cost. However based on their prediction, the casualties value their injury is Rp. 1,310,000.00 which is more than 4 times the total casualty cost calculated using gross output method.

Previous studies have revealed that using a willingness to pay method could mean that the cost casualty predicts a result higher than that identified by using gross output method. However some studies mention that willingness to pay might be difficult to undertake in a developing country because of the complexity of the questionnaire. This is because most willingness to pay questionnaires asks about people willingness to pay for reduction in casualty, rather than the cost actually incurred by the casualty.

This study has asked casualties about their willingness to pay for small risk reduction. The result reveals an inconsistency between respondents at different risk reductions. When the average result of value of fatality used on the analysis of value of motorcycle slight casualty, then the ratio of value of slight injury is 0.23 of value of fatality (Figure 4)

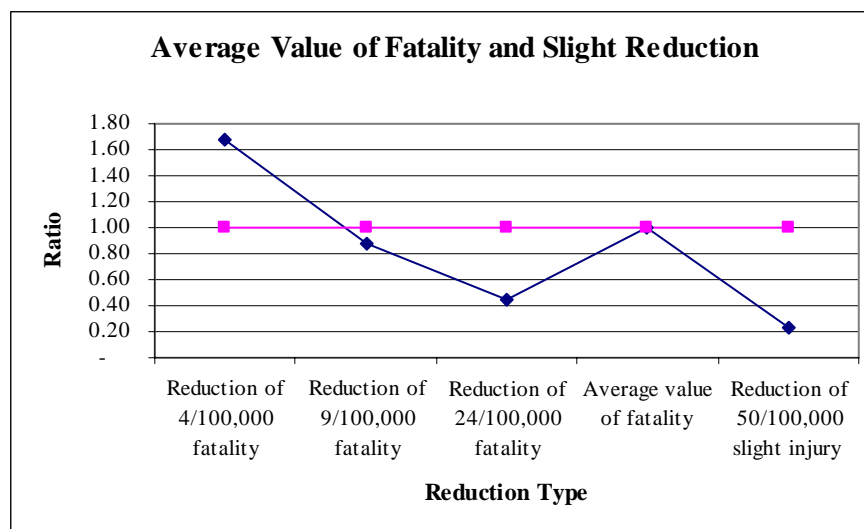


Figure 4: Ratio of every type reduction on average value of fatality

As mentioned earlier that TRL (1995) and Silcock and TRL (2003), suggest adding 38% for fatal, 100% for serious and 8% for slight injury on the top of total amount of direct cost and loss of productivity cost when use gross output method. Comparing the reduction in slight injury with the average value of fatality in Table 3, then the ratio of slight injury to average

value of fatality is equal with 0.23. Then 0.23 of 38% is equal with 8.7%, which is not far markedly different from the 8%, which is suggested by the previous study. However the value of slight casualty using willingness to pay approach (Table 4) is much higher than using gross output method (Table 2) also much higher than the casualty's own prediction of the total economic burden as motorcycle slight casualty (Table 3).

## 8. CONCLUSION

Knowing that number of motorcycles in Surabaya, Indonesia increases rapidly causing an increase in motorcycle accidents, this means lost of productivity and quality of life of motorcyclist increase too. Therefore a new policy for motorcycle safety has to be developed. A best figure for motorcycle casualty is needed to give economic evaluation for any investment at the national planning level for road safety improvement including for motorcyclist safety.

Regarding the result above, the big difference in values between gross output method, casualty's own assessment and willingness to pay means that future research, the authors would like to expand the willingness to pay samples for other classes injury and non casualty. Moreover the probability of uncertainty of willingness to pay result could be analyzed based on such circumstances of the respondents, income and age.

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