CHAPTER 4

MODELLING ECONOMIC LOSS

4.1 Introduction

The trends of economic loss and cost indicator of road accidents will be modelized. The model will be used as an instrument of economic analysis. This economic analysis includes the total costs, which will be used to find the economic loss, and the multiple regression.

This chapter is comprised of three major sections dealing respectively with the estimation the individual earnings, the evaluation the trends of economic loss and cost indicator of road accidents.

4.2 Research Design

The trends of the economic loss and cost indicator of road accidents are the time - series study design. Data will be collected retrospectively from the year 1981 to the year 1995.

4.3 Estimated Individual Earnings

4.3.1 Estimated Earning Principles

The road accidents are a phenomena occurring at all ages and sex. Analyzing, higher costs are associated with the lost productivity when an individual is disabled, killed and injured in the working period. Those dependent on a victim suffer the immediate economic hardship from lost income. Thus, this section will study the estimated individual earnings for finding average individual income of victims from road accidents by Thailand socio - economics survey (SES) in 1988 . This data will be derived from the National Statistics Office (NSO).

According to Chidswick (1976), there are four main characteristics to be estimated for individual earnings such as age, sex, years of schooling and self occupation. This study will also use four characteristics to relate to individual average income.

4.3.2 Characteristics of Estimated Earnings

This point will focus on the characteristics of the individual labor force in Thailand. There are two kinds: quantitative characteristics and qualitative characteristics. We should take into account the following general characteristics :

1. Quantitative characteristics

The quantitative characteristics or independent quantitative variables that can be related to the estimated earning are as follow:

(i) Age

According to Becker (1964), earnings typically increase with age at a decreasing rate. The older the labor force and the highest experience, the more rate of earning increases. This study will therefore use the age variable and the age square variable to find the average individual income of victims and families due to road accidents.

(ii) Schooling years.

Training or education has an important effect on earnings. In both the studies of Becker and Chidswick mentioned above, the education level is a significant factor for individual earning. As a consequence schooling years of individual labor force are to be estimated in this study. In the survey of NSO in 1988, data were collected in form of a possible code replacing the education level of the labor force. In this study, we will convert this code of education level by attributing an approximate number of years spent in school. Santisart (1996, 40) computed the approximates of schooling years in 1996, and this study will bring this data to construct the years of schooling. Table 4.1 shows the approximates of schooling years.

Table 4.1 : Approximates of Schooling Years

SES Code	Level of Education	Schooling Years
01	No formal education	0
10	Kindergarten	1
11	Elementary grade 1	2
12	Elementary grade 2	3
13	Elementary grade 3	4
14	Elementary grade 4	5
15	Elementary grade 5	6
16	Elementary grade 6	7
17	Elementary grade 7	8
19	Elementary not specified grade	-
20	Secondary grade 1 (revised scheme)	8
21	Secondary grade 1	8
22	Secondary grade 2	9
23	Secondary grade 3	10
24	Secondary grade 4	11
25	Secondary grade 5	12
26	Secondary grade 6	13
29	Secondary not specified grade	-
31	University year 1	14
32	University year 2	15
33	University year 3	16
34	University year 4	17
35	University year 5	18
36	University year 6	19
37	Bachelor degree	17
38	Higher than bachelor degree	19
39	University not specified level	15
40	Lower vocational	13
50	Upper vocational	15
60	Higher vocational	15
61	Teacher training	13

Table 4.1 : Approximates of Schooling Years (continued)

SES Code	Level of Education	Schooling Years
62	Technical and advanced vocational	14
90	other education	-
99	Unknown or not reported	0

Source : Educational Expansions and Labor Earnings Inequality in Thailand 1988 and 1992 (Santisart, 1996 , 40 - 41)

Remarks : Other education (code 90), upper elementary education not specified grade (code 19), and upper secondary education not specifies grade (code 29) are excluded.

2. Qualitative characteristics

(iii) Sex

Also, the study of Chidswick (1966), found that the coefficient of estimating earning in male is higher than in female. For this reason, this study will select the sex variable to determine the individual income of victims and families due to road accidents as well.

(iv) Occupation

The occupation of individual labor force can explain such diverse phenomena as interpersonal and interarea differences in earning. This rationale will support the set of an estimated individual function for this study.

4.3.3 Measurement of the variables

1. Quantitative variables measurement

Table 4.2 displays, for the dependent variable and for each of the independent quantitative variables, the units of measurement, the scales of measurement, the types of data and the sources the data. All the quantitative data are secondary ones and will be obtained by interview of the NSO in 1988.

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Table 4.2 : Measurement of the Quantitative Variables

Variable	Factors	Unit	Scales of Measurement	Types of Data	Sources of Data
income	# individual income	Baht	continuous	secondary data	NSO
age	age	years	continuous	secondary data	NSO
school	# years of schooling	years	discrete	secondary data	NSO

2. Qualitative variables measurement

Table 4.3 displays, for each of the independent qualitative variables, the units of measurement, the scales of measurement, the types of data and the sources of the data. The qualitative data are secondary ones and will be obtained by interview of the NSO in 1988.

Table 4.3 : Measurement of the Qualitative Variables

Variable	Factors	Unit	Scales of Measurement	Types of Data	Sources of Data
sex	sex	male, female	interview	secondary data	NSO
occup	occupation	groups of prof / sales/ agricultural	interview	secondary data	NSO

Remarks: 1. Occup1 represents the groups of professional, administration and clerical occupation.
2. Occup2 represents the groups of sales and services occupation.
3. Occup3 represents the groups of production, agricultural and labor occupation.
4. Occp4 represents the groups of none occupation.

4.3.4 Multiple Regression Analysis of the Identified Factors

Regression analysis helps to estimate the relationship between variables. The objective of the method analysis here is to estimate the average individual income of labor forces, the dependent variable (income), corresponding the characteristics of labor force such as age, sex, numbers of years of schooling and occupation, etc. which are the independent variables.

In this study we will pool all the samples from SES in 1988 to find the mean of all the variables that will be used in this study from age 15 years to 75 years.

The estimated earning of labor force is measured by the individual total income of Thailand labor force. The estimated earning is assumed to be a function of the set of both quantitative and qualitative factors identified in section 4.3.3 as shown by the function below :

income = f (age, sex, school, occup)

where
income is the total individual income of labor force. (dependent variable)

The independent quantitative variables are
age represents the age of the individual
school represents the numbers of year of schooling

The independent qualitative variables are :
sex represents the labor force sex
occup represents the groups of the occupation of labor force.

- Occup1 represents the groups of professional, administration and clerical occupation.
- Occup2 represents the groups of sales and services occupation.
- Occup3 represents the groups of production, agricultural and labor occupation.

The qualitative independent variables must be quantified in some manner. This may be accomplished through the use of dummy variable. The

dummy variable in this model is a finite number of value for the purpose of identifying the different categories of the qualitative variables.

Tables 4.4 shows the dummy variable of the qualitative factors that are some characteristics of the labor force.

Table 4.4 : Dummy Variables for the Measurement of Qualitative Characteristics.

Variables	Qualitative Characteristics	Number of Categories	Dummy Variables
sex	sex	2 (male , female)	sex = { 1 for male { 0 for female
occup	occupation	4 (groups of prof / sales / farmer / no)	occup1 = {1 for prof. Gr { 0 otherwise occup2 = 1 for sales. Gr { 0 otherwise occup3 = {1 for prod. Gr { 0 otherwise if occup1 = occp 2 = occp3 = 0 , then occupation = no occupation

Remarks: 1. Occup1 represents the groups of professional, administration and clerical occupation.
2. Occup2 represents the groups of sales and services occupation.
3. Occup3 represents the groups of production, agricultural and labor occupation.
4. Occp4 represents the groups of none occupation.

The data of multiple regression of earning function as shown in appendix 3, the value of variable sex and occupation are not equal 1 or 0 because of estimating the probability of variable sex and occupation from all observations in the data set of survey.

4.3.5 The Multiple Regression Model

The sample multiple regression equation of the estimated earning function will consider all the quantitative variables. The qualitative variables will also to be included. The multiple regression model is as follows :

$$\text{income} = \beta_0 + \beta_1 \text{age} + \beta_2 \text{agesqur} + \beta_3 \text{school} + \beta_4 \text{schoolsqr} + \beta_5 \text{sex} + \beta_6 \text{occp1} + \beta_7 \text{occp2} + \beta_8 \text{occp3} + \varepsilon_i$$

where (i) income is a value of total individual income; (ii) β_1 are called the regression coefficient of age, agesqur, school,.....etc. (iii) Age, agesqur, school, ..., occp3 are respectively particular value of the independent variables age, agesqur, sex,...occp3. (iv) The ε_i is a random variable with mean equal zero. The variance σ^2 is the common variance of the subpopulation of income values.

4.4 The Economic Loss from Road Accidents

4.4.1 Economics Loss Principles

According to Pattamasiriwat (1993), the economic loss from road accidents in this study will be calculated into six main losses as follows:

(i) Loss on medical treatment
(ii) Loss on damaged properties
(iii) Opportunity cost of injured persons
(iv) Opportunity cost of disabled persons
(v) Opportunity cost of families care
(vi) Income foregone of deaths

Total Loss = Loss on Treatment + Loss on damaged properties + Opportunity cost of injured persons + Opportunity cost of disabled persons + Opportunity cost of family care + Income foregone of deaths

4.4.2 General Consideration about the Economic Loss

The economics loss from road accidents should take into account the following general considerations :

1. Loss

There are many losses related to the road accidents. In this study will select only the main losses as stated by Pattamasiriwat (1993) :

(i) Loss on medical treatment

Most of the road accidents injury needed to get medical treatment. Every years many injured persons from road accidents are treated in the hospitals. For this reason, medical cost on treatment of road accidents victims are a heavy economic burden on the hospitals, especially the government hospitals. Cost of medical treatment will be estimated in this study.

(ii) Loss on Damaged Properties

Road accidents destroy the properties such as mobile vehicles, road, traffic symbols etc. According to the report of National Safety Council(1996), the value of damaged properties in the year 1996 is approximately 1,562 million Baht. The economics loss of road accidents in terms property should also be studied in this research.

(iii) Opportunity Cost of Injured Persons

Some of the victims from road accidents were unable to work. They experiment loss in individual income. Society loses in productivity. This might have a negative influence to the society' s economy. In this study this loss will be chosen to evaluate the impact of road accidents .

(iv) Opportunity Cost of Disabled Persons

Generally the physical skills in disabled persons due to road accidents will decrease. They can bare a large decrease of their income. In addition, most of them are a burden to the society which has to support them. This influences the society, families and victims. This research will study this loss as well.

v. Opportunity Cost of Family Care

Some of the injured persons from road accidents need the families to take care of them in the period of treatment or rehabilitation. The families care can lead to opportunity cost of work. For this reason, this has an impact on other individuals. It should be studied for the one of loss of road accidents.

vi. Income Foregone of Deaths.

This loss is very important as the society loses some main resources that can increase the growth of economics. Higher costs are associated with the lost productivity when an individual dies at working age. This supports the estimation of this loss because of road accidents.

2. Type of Loss (Type of Costs)

To analyze the structure of loss, the loss of road accidents will be classified into direct loss and indirect loss.

(i) Direct Loss

- costs borne by treatment
- costs borne by properties losses

(ii) Indirect Loss

- Opportunity costs of injured persons
- Opportunity costs of disabled persons
- Opportunity costs of family care
- Income forgone of deaths

3. Information for Economics Loss

The model to measure in the trends of economic loss and cost index of road accidents requires some key information regarding the six necessary items as shown in tables 4.5

Table 4.5 : Information for the Economics Loss

Items to be costed	Information needed for loss	Data source
Direct loss		
1. costs on treatment (TL1)	- numbers of injured persons (n1) - average cost/episode / persons	- IPD , MOPH - previous study
2. costs on property loss (TL2)	- the value of cost on damaged properties.	- Insurance Department
Indirect Loss		
1. opportunity cost of injured persons (TL3)	- numbers of injured persons (n1) - average day in hospitals - average cost of individual income (earning function)	- IPD , MOPH - previous study - this study
2. opportunity cost of disabled persons (TL4)	- average disabled in Thailand (n2) - no. of years loss - average cost of individual income (earning function)	- previous study - National Safety - this study
3. opportunity cost of families care (TL5)	- same L3 because of using rate 1 : 1	
4. income foregone (TL6)	- numbers of death persons (n3) - average cost of individual income from age die to 60 years.	- MOPH - this study

4.4.4 Computing the Income Foregone

The earning function to calculate the future value of individual income, we will be obtained by summation of the total income from age at death to 60 years. The calculation is performed as follows.

$$IF = \sum_{i=t+1}^{60} Y_i$$

Where :

IF = Income Foregone

Y_i = Income at age i.

T = Age

For example, if a victim from road accidents dies at the age of 10 years, she will lose a value of income corresponding to :

income at 11 years + income at 12 years.....+ income at 60 years.

4.4.5 Assumptions for The Trends of Economics Loss

The necessary assumption for the trends of economics loss in the model are as follows:

1. All injured persons are assumed to be treated only in the inpatients department of MOPH hospital affiliation and they are assumed to be admitted in hospitals for 20 days, according to Janjaroen (1994) and to convalesce at their home for 3 days.

2. Cost of the treatment per individual injured in road accidents is 4,542 Baht, according to the study of Janjaroen (1994).

3. Families are assumed to care for the patient on the basis one to one ratio. (one patient : one family care)

4. The disabled persons are assumed to be affected only by the paralysis type of disability and the work days loss for one is assumed to be 6,000, according to the National Safety (1988).

5. To find the average individual income from earning function, this study will use the average values of labor force from age of death to age 60 years.

6. Income foregone of deceased individuals will be calculated from died age to age at 60 years.

7. The average individual income is derived from the earning function in section 4.3. It is already a constant price because this function is estimated from cross - sectional data in year 1988.

4.4.6 The Methodology of Calculation

Total loss of road accidents (TLRA) is :

$$TLRA = TDL + TIDL$$

where :

TDL = is the total direct loss from road accidents between 1981 - 1995

TIDL = is the total indirect loss from road accidents between 1981 - 1995

Total Direct Loss

The total direct loss (TDL) for the road accidents between 1981 - 1995 is the summation of each of the value of each the loss in the model.

$$TDL = TL1 + TL2$$

where :

- TL1 is the value of the total loss on treatment the injured persons from road accidents.
- TL2 is the value of the total loss on damaged properties.

Total Indirect Loss

The total indirect loss is TIDL, and its equation is the following :

$$TIDL = TL3 + TL4 + TL5 + TL6$$

where :

- TL3 is the value of opportunity cost of injured persons.
- TL4 is the value of opportunity cost of disabled persons.
- TL5 is the value of opportunity cost of family cares.
- TL6 is the value of income foregone of deaths.

4.4.7 Calculation of the Economic Loss at Constant Price

(i) Value of the Loss in Treatment

The value of the loss in treatment of road accidents, is calculated from inpatients department of MOPH hospital affiliation during year 1981 - 1995. According to, Janjaroen et al (1994) the cost of treatment per persons affected by is 4,542 Baht. This value will be adjusted to 1988 constant

prices by using general consumer price index in health and personal care items for Thailand.

TL1 = n1 * 4,542 * CPI

where

TL1 = total loss in treatment

n1 = numbers of injured persons in each year.

costs of road accidents / episode = 4,542 Baht

CPI = consumer price index of health and personal care items

(ii) Value of the Loss on Damaged Properties

The value of the loss on damaged properties will be calculated on the basis of the net losses incurred during the year of the road accidents during the years 1981 - 1995 according to the Insurance Department. This value will be adjusted to the 1988 constant prices by using general consumer price index in non food and beverages items for Thailand. The price index was set at 100 for 1988. This value should be adjusted to constant price with mobile vehicles items but the Department of Business Economics is not available it.

TL2 = Net losses incurred during the year of automobile from road accident. * CPI

where

CPI = consumer price index in non food and beverages items.

(iii) Value of Opportunity Cost of Injured Persons

The value of the opportunity cost of injured persons will be calculated on the basis of the average hospital day and convalescence day at home representing the day that they were unable to work. According to Janjaroean et al (1994), the number of days in hospitals of inpatients department is 20 days. In general, the patients will have to convalesce at their home for at least 3 days. Thus, in this study will be calculated the work days loss for 23 days. The equation is

TL3 = n1 *(23/365) * average income from earning function per year

(iv) Value of Opportunity Cost of Disabled Persons

The value of the opportunity cost of disabled persons is calculated using: first the number of disabled persons in Thailand by taking the data only paralysis type of disability, causes by road accidents, from National Statistics, second the work days loss by using data from The National Safety Council based on 6,000 days and third the costs lost by disabled persons using the average income per year from earning function. The equation is

TL4 = n2 * (6000/365) * average income from earning function

where

n2 = the numbers of disabled persons

the work days loss = 6,000 days, 6,000/365 year

(v) Value of Opportunity Cost of Family Care

The value of opportunity cost of family care is the same value of opportunity cost of injured persons because this study assumed the family care at the ratio 1 : 1 (one patient : one family care). The equation is

TL5 = n1 * (23/365) * average income from earning function

(vi) value of income foregone

The value of income foregone will be calculated based on: first, the numbers of deaths at each age, second the remaining working years between age of death and 60 years, third the income foregone using average income from earning function and the sum of deaths of all ages in each year. The equation of loss is :

$$TL6 = \sum_{i=t+1}^{60} Y_i * n3$$

where

Y_i = Income at age i.

t = Age

n3 = the numbers of deaths in each age

4.4.7 Calculation of the Trends of Economic Loss at Current Price

From the trends of economic loss at constant price will be adjusted to the economic loss at current price by using the general consumer price index of all items in the year between 1981 and 1995.

4.5 The Cost Indicator of Road Accidents.

The cost indicator of road accidents is constructed on the basis of the trends of economics loss both at constant price and current price in comparison to the based value. From section 4.4, we derive the value of the trends of the economic loss at constant and current price from road accidents ($TLRA_{1981}$,.....$TLRA_{1995}$) for each year.

This study will select the $TLRA_{1985}$ for the based value because this year the statistics from road accidents show the trends of mortality, morbidity and the number of road accidents, which are rather stable than the other years, as shown in figure 4.1 and 4.2

Figure 4.1 : Death and Injured Persons of Road Accidents Year 1981 - 1995

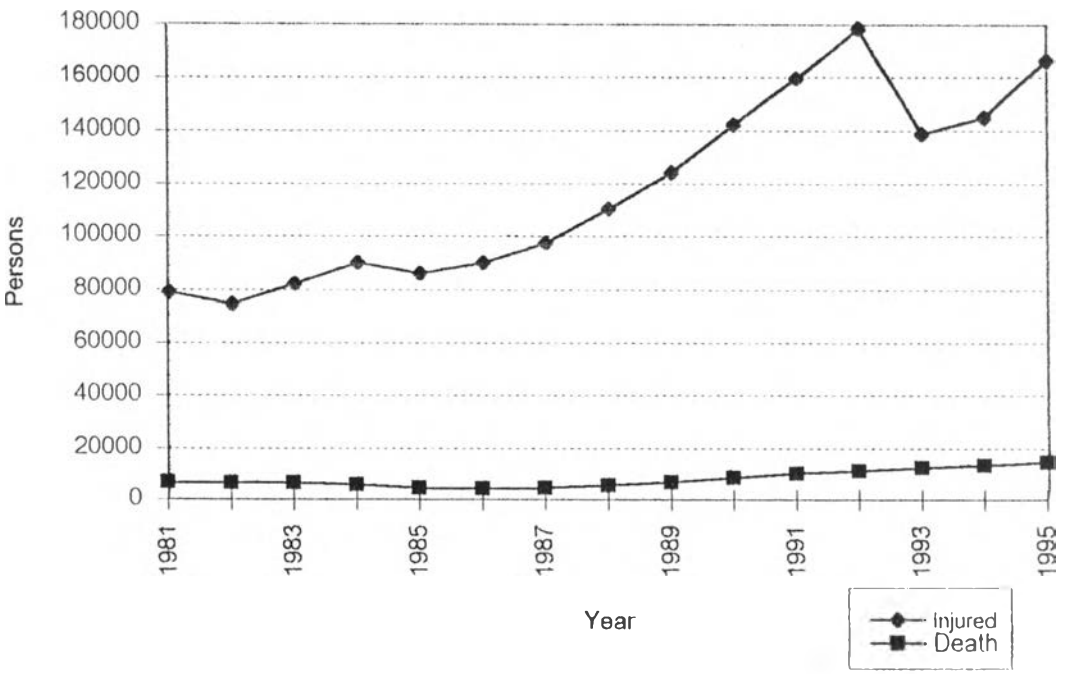
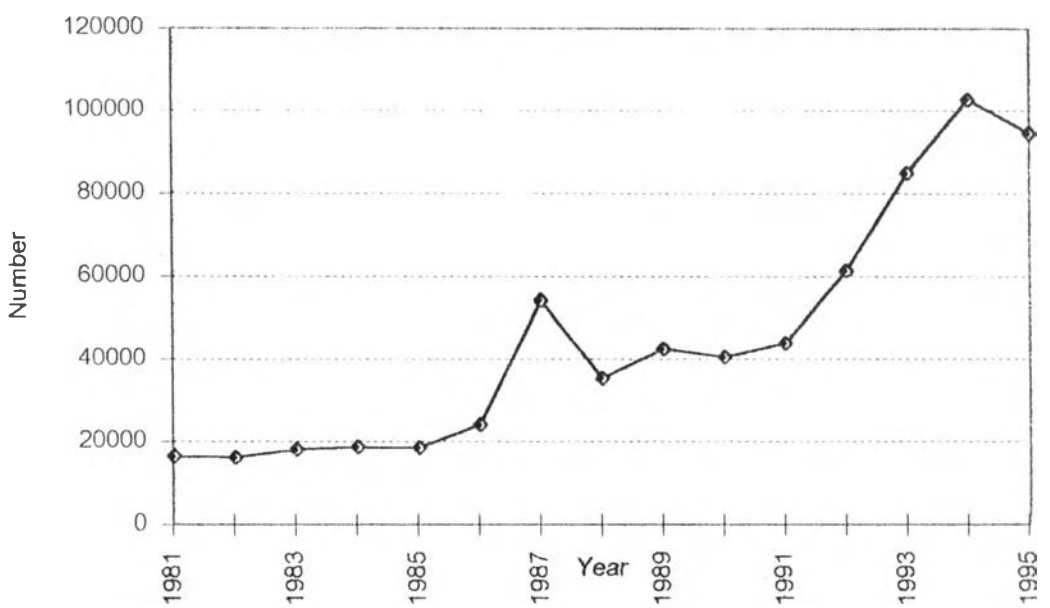


Figure 4.2 : Number of Road Accidents Year 1981 - 1995



The cost indicator of road accidents during 1981 - 1995 are calculated as a process shown in table 4.6

Table 4.6 Process of the cost indicator of road accidents

Year	The Trends of Total Loss	Process
1981	Y_1	$\frac{Y_1 * 100}{Y_0}$
1982	Y_2	$\frac{Y_2 * 100}{Y_0}$
↓	$Y\ldots$	$\frac{Y\ldots * 100}{Y_0}$
1985	Y_0	$\frac{Y_0 * 100}{Y_0} = 100$
↓	⋮	⋮
1995	Y_n	$\frac{Y_n * 100}{Y_0}$