VALUE OF LIFE IN PROJECT EVALUATIONS: PROCEDURES AND IMPLICATIONS OF THE HOFFMAN METHOD FOR MALAYSIA AND JAPAN

Md. Nor NOR GHANI
Lecturer
Faculty of Economics
Universiti Kebangsaan Malaysia
Bangi 43600, Selangor
Malaysia
Fax: +60-3-8929-3161
Email: norghani@ukm.my

Kazuhiro OHTA
Associate Professor
School of Commerce
Senshu University
Higashimita 2-1-1, Tama ward, Kawasaki,
Kanagawa, 214-8580
Japan
Fax: +81-44-900-7816
Email: kaz-ohta@isc.senshu-u.ac.jp

Abstract: This paper outlines and compares the use of the Hoffman Methods in transport investment evaluations in Japan and Malaysia. The Hoffman Method is the conventional way to evaluate the value of life (VOL) lost in traffic accidents. This paper reviews trends in the values of lives in Japan and Malaysia evaluated by the Hoffman Method for twenty years between 1980 to 1999. The comparison of the VOL and intertemporal trends of the VOL between Malaysia and Japan makes the relative price change problem over time clear in the context of project evaluation. Fuel prices have different trends over time from the VOL in Malaysia and Japan, which creates some policy implications. In the final part of this paper, the setting of the minimum value of life in the world is suggested to control the change of human value over time and the bias of the value among countries.

Key Words: Project evaluation, Value of Life, the Hoffman Method, Initial prices, Price changes over time

1. INTRODUCTION

Death and serious injuries as a result of road accidents represent a considerable waste of a nation's resources and cause anguish and grief to families and friends. In 1999, there were 223,116 road accidents reported in Malaysia resulting in a total of 5,761 deaths, 10,383 serious injuries and 36,886 slight injuries. The number of road accidents more than tripled from 1976 to 1999, while figures for fatalities more than doubled within the same period (Road Transport Department Statistics, 1999). For a country of about 20 million people, such statistics are alarming.

The Japanese National Police Agency reports that in 1999 there were 850,363 road traffic accidents in Japan. These accidents caused 9,006 casualties[1] and 1,050,397 injuries. In 1975 there were 472,938 traffic accidents, 10,165 deaths and 462,773 injuries. The number of road traffic accidents more than doubled from 1975 to 1999. In the same period, the number of deaths slightly declined, while the number of injured more than doubled. It is cle… that road

[1] In the Japanese National Policy Agency Statistics, only persons who died within 24 hours of the accident were classified as fatal casualties. Therefore, the number of deaths by traffic accidents may be underestimated in Japan in comparison with road accident statistics in other countries.

safety projects have been effective to reduce or at least keep in low fatalities caused by traffic accidents. Needless to say, it is still a primary agenda to reduce fatal traffic accidents.

Due to the high and rising toll of deaths, injuries and material damage caused by road accidents, there is an increasing awareness among policy makers of the need to introduce accident-reducing initiatives including the design and construction of safer roads and highways. Such measures are, however, invariably expensive. The additional investments required to build safer road infrastructures may be justified if the potential benefits in the form of lives saved and injuries avoided are sufficiently large to bring about net benefits to society. Hence, failure to include the benefits arising from avoidance of fatalities, injuries and material damages will result in inefficient allocation of public funds away from safety augmenting transport investment.

Even if safety factors are included in evaluation of a transport investment project, safety improvement benefit occupies only a small part of the total benefits of the transport investment project. For instance, in a construction project of new highway, the ratio of time saving benefit against total benefits is generally more than 80 percent. In practice, the safety improvement factor has little effect on the priority order of project ranking. Decision makers and planners have a tendency to treat safety factors as factors that can be neglected. However, it is important to establish a method of evaluating safety factors, and to incorporate these factors into project evaluations.

Incorporating these benefits into the investment evaluation process requires a method of estimating, in monetary terms, the value of lives saved and injuries and material damages avoided. This paper focuses on the first item, the value of lives saved. To this end, a review of the literature indicates that several methods have been developed to assess the monetary value of lives saved. At present, the loss of productive capacity method appears to be the most popular among road investment analysts in Malaysia and Japan. The popularity of this method can be attributed to its practicality and ease of computation. In addition to these technical advantages, the stability of the values computed by this method is an important advantage. The detailed methodologies adopted (described below) do differ between the two countries but they are essentially predicated upon the same idea, that the value of an individual life saved is equivalent to productivity minus the consumption of that individual for the remainder of his or her life.

Before proceeding further, it must be noted that the method (where one variant is also known as the Hoffman method) has been the subject of several criticisms. Exclusive use of this method in valuing the cost of life has been criticised by economists such as Mishan(1971) and Schelling(1968) because it is inconsistent with the principles of cost benefit analysis. They argued that costs should reflect the amount road users themselves are willing to pay for a reduction in the risk of an accident. Most people value safety more out of an aversion to injury or death than out of a wish to preserve future levels of income. Later, other economists argued that this method belittles the contributions of older generations by giving negative values since their consumption generally exceeds their contributions (Rice *et al.*, 1989). At best, the method can be considered as giving a lower boundary to the value of life (Haight, 1994) and the use of loss of output alone will create significant resource misallocation (Miller, 1996).

Despite all the theoretical criticisms leveled against it, the method continues to be the method of choice in Malaysia and Japan mainly because of, as mentioned earlier, its practicality, ease of computation, and the stability of the computed values. Assuming that this scenario is not going to change anytime soon, this paper takes the more pragmatic approach of considering the method as it is currently applied in Malaysia and Japan and then proceeding to evaluate its current application. In particular, this paper assesses the potential bias that may arise from the convention of using the initial year value as a basis for estimating the future net contributions of individuals saved and differences in the degree of bias between Malaysia and Japan due to variations in productivity growth rates in the past 10 and 20 years. In addition, this paper deals with relative price change through time between the value of time and fuel price.

This paper is organized as follows. The next section deals with the problem of relative price changes for project evaluation, which describes the motivation of this paper. The third section provides a brief description of the Hoffman method as it is applied in Malaysia and Japan. Subsequently, a time series analysis of the annual benefit of saving one life for a period of 20 years (1980-1999) in Japan and Malaysia is presented with discussions on possible biases in individual countries' applications of the method and between-country comparisons. The final section discusses the findings and their implications for the method of evaluating the value of lives in cost benefit analysis.

2. THE PROBLEM OF RELATIVE PRICE CHANGE

This paper focuses on an intertemporal value change of life, but it is useful to explain a traditional problem of relative price change of before and after project implementation. Figure 1 demonstrates this problem. In this figure, two goods, x and y, are on the axes. Good x is the transportation related one, while good y is numeraire. A transportation investment project improves transportation services and decreases the relative price of the good x, which increases the consumed volume of the good x. In this figure, the project moves the social state from Q_0, initial state, to Q_1, a new state.

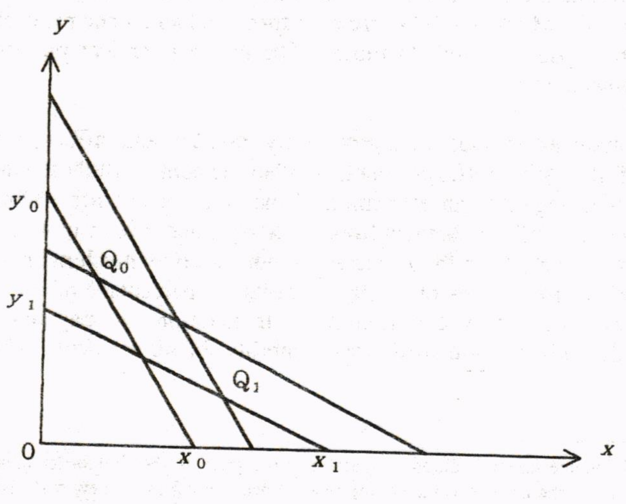

Figure 1. Relative Price Change and the Scitovsky Paradox

Figure 1 also shows two-price lines y_0x_0 and y_1x_1 showing the relative prices in situation Q_0 and Q_1 relatively. The change from situation Q_0 to Q_1 in real income valued at state 0 prices is positive, while the change in real income valued at state 1 price is negative for the same situation change[2]. This is a typical explanation of the Scitovsky paradox in terms of prices and quantities.

The Scitovsky paradox is usually discussed in relation to the relative price change caused by a project implementation, though this paper deals with the intertemporal and long-term price change of value of life. A similar problem, however, appears for both cases. The problem is that the relative price change influences a ranking of the projects. In the context of this paper, the priority ranking of alternative projects evaluated at the initial relative value of life can differ from that at the future relative value.

Now, we have to face one practical problem. Which relative price, the present or future ones, should be used? No economist or practitioner has yet found the answer. But, it is very common that almost all agencies in the world apply the present relative value for project evaluation because of practical ease in collecting data.

3. THE HOFFMAN METHOD

The western countries have more than thirty years' experience applying of Cost-Benefit Analysis to improve the efficiency of transport investments, while Japan has just started official applications of Cost-Benefit Analysis on public investments. In December 1997, the Hashimoto Administration required all public investments to be evaluated by Cost-Benefit Analysis or Cost-Effective Analysis before any decision regarding their implementation. From that point, each agency such as the Ministries of Transport and Construction[3] started to establish an official manual to evaluate public projects. For example, the Institute for Transport Policy Studies published the first draft of a Cost-Benefit Analysis manual for railroad projects in 1998 under the control of the Railroad Bureau of the Ministry of Transport. As for highway projects, the Ministry of Construction formatted an ad hoc research project to cowrite a manual with Japan Research Institute. The research project published a draft manual for highway projects in 1999.

These official draft manuals include transport safety matters and offer procedures for evaluating the value of life lost in traffic accidents or other incidents. All these manuals adopt the Hoffman Method with regard to an estimation of the value of lost life. More precisely, they use the data on the value of life obtained from the Marine and Fire Insurance Association of Japan. The value of life data from the Association indicates how much member insurance companies paid on average for victims of traffic accidents. A percentage of cars that caused fatal accidents were not covered by car insurance. In addition, the payment amount of insurance companies depends on ratio of the responsibility for an accident. Therefore, the

---

[2] The amount of the real income change valued at initial relative price is the first order approximation of equivalent variation (EV), while the amount valued at the relative price ruling in the new state is the first order approximate value of compensation variation (CV). Even in theory, economists cannot yet decide which variation concept is more appropriate for evaluation of welfare change.

[3] Japan reformed its national public administration system in January 2001. The Ministries of Transport and Construction have been integrated with the National Land Agency, and since January 2001 renamed the Ministry of Land, Infrastructure and Transport.

amount from the data based on the Marine and Fire Insurance Association of Japan may underestimate the productive value of life lost in traffic accidents.

In the Hoffman Method, the lost value of life is computed as the residual of annual gross income minus annual living cost multiplied by the new Hoffman coefficient. The new Hoffman coefficient discounts future incomes to present value. Therefore, the coefficient depends on a predetermined interest rate. The predetermined interest rate differs among countries. It is almost five percent in Japan. The annual gross income of an adult working casualty comes from real income date. That for housewives, the unemployed and children is calculated from the average wage. Calculation of an annual living cost follows an assumed living cost calculation manual. For example, the living cost of a person who is the main income earner in a household is 30-40 percent of the person's annual income. That for a single male is half of his income.

There are no official guidelines or documents on the method to be used in calculating the monetary value of life in Malaysia. In order to identify the method that has been used in the absence of any official guidelines, face to face interviews were conducted with officials from the Highway Planning Unit and the Malaysian Ministry of Works[4] , which are responsible for transport project evaluations. Where necessary, responses were substantiated by referring to reports of feasibility studies of transport projects that had been previously approved by the unit. The interviews and reviews confirm that a variant of the Hoffman method had been exclusively used for the purpose of valuing lives in major transport investment projects in Malaysia.

The method as it is applied to investment evaluation in Malaysia (hereinafter referred to as the Malaysian method) turns out to be a much simpler version of the one applied in Japan. Instead of taking the residual of the annual gross income minus annual living cost multiplied by a predetermined Hoffman coefficient in order to estimate the benefit of saving one life, the Malaysian method only computes the annual gross income of an average individual before multiplying it with the expected remaining life span (in years) of that individual. In the reviewed feasibility studies, the average remaining life span of individuals was assumed to be in the range of 30 to 35 years. Within the framework of the Hoffman method, essentially the Malaysian method assumes that the annual living cost and the Hoffman coefficient are equal to zero and thirty respectively. It was also established that the initial value of life used for the first year of the project duration (the initial value) is usually used, without adjustment for growth, for subsequent years. No justification is given other than that it is a standard practice in project evaluation.

Rather than getting tangled in detailed discussions of the Malaysian and Japanese methods, this paper shall proceed in subsequent sections by delving into universal issues that are relevant to both methods within the context of transport investment evaluation. Because this paper focuses on not only intertemporal comparison but also international comparison, in the following sections, the simpler Malaysian method is applied to evaluate the value of life in Malaysia and Japan.

4. TIME SERIES DATA FOR THE VALUE OF LIFE IN MALAYSIA AND JAPAN

[4] The Highway Planning Unit is the government body responsible in the conduct of the feasibility studies and eventual approvals of all major road transport infrastructure projects in Malaysia.

4.1 VOL in Malaysia

The time series data for the value of life for Malaysia was computed from the aggregate macroeconomic data published by the Malaysian central bank (the Bank Negara Malaysia) in its annual reports. Computations were done by multiplying the per-capita Gross Domestic Product (at constant 1980 prices) by 30 (the average remaining life of individuals saved) for the years 1980 to 1999. Getting the Gross Domestic Product figures at constant prices (1980) is necessary to control for inflation so that only the increase in real income is incorporated in the computation of the value of life. Table 1 below shows the value of the life of an individual computed using the Hoffman Method for the said period (in Malaysian Ringgit and the US dollar). Exchange rates on July 31 of every year for US dollar are used as the rate of conversion.

Table 1. Gross Domestic Product, Population, Value of Life for Malaysia (1980-1999)

(At market prices in 1980)

Year	GDP in Malaysian Ringgit (millions)	Population (millions)	GDP per capita in Ringgit	VOL: Value of Life (Ringgit)	VOL Index in Ringgit (=100 in 1990)	Exchange Rate (Ringgit/ dollar)	VOL In dollars	VOL Index in dollars (=100 in 1990
1980	133,270	13.70	9,728	291,832	72.8	2.160	135,107	90.8
1981	142,471	14.11	10,097	302,914	75.5	2.360	128,354	86.3
1982	150,932	14.51	10,402	312,059	77.8	2.353	132,622	89.2
1983	160,395	14.89	10,772	323,161	80.6	2.347	137,691	92.6
1984	172,779	15.27	11,315	339,448	84.6	2.345	144,754	97.3
1985	171,145	15.68	10,915	327,447	81.6	2.465	132,838	89.3
1986	172,878	16.11	10,731	321,934	80.3	2.623	122,735	82.5
1987	182,197	16.53	11,022	330,665	82.4	2.541	130,158	87.5
1988	198,185	16.94	11,699	350,977	87.5	2.637	133,097	89.5
1989	216,338	17.35	12,469	374,072	93.3	2.611	143,268	96.3
1990	237,476	17.76	13,371	401,142	100.0	2.697	148,737	100.0
1991	257,791	18.33	14,064	421,917	105.2	2.788	151,360	101.8
1992	278,026	18.76	14,820	444,605	110.8	2.501	177,771	119.5
1993	301,141	19.21	15,676	470,289	117.2	2.565	183,348	123.3
1994	329,012	19.66	16,735	502,053	125.2	2.595	193,507	130.1
1995	360,012	20.11	17,902	537,064	133.9	2.457	218,585	147.0
1996	391,062	21.17	18,472	554,173	138.1	2.496	222,007	149.3
1997	421,505	21.66	19,460	583,802	145.5	2.639	221,221	148.7
1998	416,418	22.18	18,774	563,235	140.4	4.145	135,883	91.4
1999	426,512	22.71	18,781	563,424	140.5	3.800	148,270	99.7

In order to demonstrate the bias that will be generated by the method if the initial year value is used, Table 1 provides the time series data of the value of life in Malaysia. Notice that using the initial value without any adjustment for growth results in a downward bias in the estimated value of life. More importantly, the bias keeps growing such that towards the end of the twenty-year period, the growth-adjusted value of life is about twice as large as the unadjusted initial year value (1980). In order to check it in Table 1, the VOL (value of life) Index in Ringgit in 1999 divided by that in 1980 makes 1.93 (=140.5/72.8).

On the other hand, another result is found if we focus on the time series change of the VOL in US dollars. The comparison of the VOL in dollars during this period resulted in less than 10 percent appreciation of the VOL from 1980 to 1999. In order to avoid bias from the recent recession since 1998, which has devaluated the Ringgit against US dollar, let us compare the initial VOL in 1980 with that in 1997 instead of in 1999. During this period, the VOL in Malaysia increased in by more than 60 percent (148.7/90.8=1.64). However, the amount of the increase of the VOL in Malaysia is smaller than expected.

4.2 VOL in Japan

As noted above, Japanese Agencies of Transportation apply the value of life data from the Marine and Fire Insurance Association of Japan for their project evaluation manuals. This paper, however, does not use this data or methodology. In order to compare the trends of the VOL between Malaysia and Japan and discuss the problems and implications of intertemporal changes of relative price and international difference of value of human life, this paper should apply the same method, the above-mentioned Malaysian method, for the both countries. Therefore, the VOL in Japan is also computed by multiplying the Japanese GDP per capita by 30, which is regarded as the average remaining life of individuals saved.

Table 2. Gross Domestic Product, Population, Value of Life for Japan (1980-1999)

(At market prices in 1980)

Year	GDP in Japanese yen (billions)	Population (millions)	GDP per capita in yen	VOL: Value of Life in yen (thousands)	VOL Index in yen (=100 in 1990)	Exchange Rate (yen/dollar)	VOL in dollars	VOL Index in dollars (=100 in 1990
1980	240,286	117.06	2,052,671	61,580	71.4	227.40	270,801	45.9
1981	247,904	117.90	2,102,628	63,079	73.1	240.40	262,391	44.4
1982	255,483	118.73	2,151,831	64,555	74.8	258.10	250,116	42.4
1983	261,416	119.54	2,186,919	65,608	76.0	241.75	271,386	46.0
1984	271,656	120.31	2,258,063	67,742	78.5	245.30	276,159	46.8
1985	283,620	121.05	2,343,015	70,290	81.4	236.45	297,274	50.3
1986	291,832	121.66	2,398,749	71,962	83.4	153.85	467,744	79.2
1987	303,969	122.24	2,486,676	74,600	86.4	149.90	497,667	84.3
1988	322,799	122.75	2,629,832	78,895	91.4	133.05	592,972	100.4
1989	338,395	123.21	2,746,603	82,398	95.5	136.95	601,665	101.9
1990	355,598	123.61	2,876,754	86,303	100.0	146.13	590,588	100.0
1991	369,103	124.10	2,974,211	89,226	103.4	137.42	649,296	109.9
1992	372,875	124.57	2,993,371	89,801	104.1	127.35	705,152	119.4
1993	374,037	124.94	2,993,783	89,813	104.1	105.05	854,959	144.8
1994	376,448	125.27	3,005,212	90,156	104.5	100.05	901,113	152.6
1995	381,986	125.57	3,042,019	91,261	105.7	88.34	1,033,061	174.9
1996	401,276	125.86	3,188,172	95,645	110.8	106.77	895,806	151.7
1997	407,673	126.17	3,231,243	96,937	112.3	118.37	818,935	138.7
1998	397,445	126.49	3,142,209	94,266	109.2	144.65	651,685	110.3
1999	399,386	126.69	3,152,563	94,577	109.6	114.70	824,559	139.6

Table 2 provides the same kinds of data in Table 1 for Japan. The VOL Index in Yen increased in the same pace as in Malaysia until the early 1990s, though the amount of the VOL after the mid 1990s has remained almost unchanged. In a comparison of 1990 and 1997 in domestic currency, the VOL in Malaysia increased by up to 45.5 percent, while that in Japan is increased by only 12.3 percent. The time series trend of the VOL in US dollars, however, shows a different consequence. The Japanese VOL in dollars more than triples from 1980 to 1999 (139.6/45.9=3.04). The cause of this large-scale increase is the appreciation of the Japanese currency, yen, since the Plaza Agreement in 1985.

4.3 Comparisons of VOL trends between Malaysia and Japan

In the preparation of this paper, we established a hypothesis: If the Hoffman method with the initial values is applied to evaluations of transport projects, traffic safety improvement programs in the rapidly developing countries such as Malaysia would have disadvantages compared to those in the developed countries such as Japan. The reason is that the ratio of the VOL in developing countries to the VOL in developed countries in the initial year would be significantly smaller than that ratio in future years. Therefore, if the initial value of life is applied to worldwide projects for the evaluation of transportation safety programs, the benefit of projects in developing countries would be underestimated compared to those in developed countries.

If this hypothesis is right, the following implication would arise: The bias, the intertemporal change of the VOL, is clearly greater in the case of Malaysia relative to Japan. Since the Malaysian economy has been growing at a much faster rate compared to Japan (8% as opposed to 2%), the incompatibility between the initial value of life and the later value of life gets larger with the passage of time in Malaysia compared to in Japan. The implication of this observation on the between-country comparison of project evaluation is quite obvious: other things being equal, investment projects appear to be relatively less attractive in Malaysia than they actually are compared to Japan if the impact of income growth on the value of life is not incorporated in project evaluation, i.e. if the initial relative prices are applied throughout the project evaluation.

Table 3 provides some data to examine this hypothesis. The ratio of the VOL in Japan to the VOL in Malaysia, on the far right column in Table 3, is the appropriate scale to test this hypothesis. If this hypothesis is right, this ratio would decline from year to year. On the contrary, this ratio has a tendency to increase, for example, from 2.00 in 1980 to 5.56 in 1999. The ratio before 1985 had hovered around 2.00, though after 1986 this amount increased up to about 4.00. The sudden appreciation of the yen by the Plaza Agreement causes this result. This becomes clear in a comparison of intertemporal changes of exchange rate of the Ringgit for to the dollar in Table 1 with those of the yen to the dollar in Table 2. The Ringgit kept a rate of 2 to the dollar except in 1998 and 1999, while the yen appreciated from 200 before 1985 up to 100 after 1986. This is the most direct and appropriate way to conduct international comparisons of the VOL using the US dollar. Unfortunately, results obtained this way did not support our hypothesis.

Let us proceed with more careful examinations using Table 3. Also, refer to the Figure 2, which draws the four Indices and the Fuel Index based on the same data. If the VOL Indices in dollars are focused on, the Japanese VOL has increased more than Malaysian one. This is not surprising because this comparison theoretically arrives at the same result as the examination of the ratio of the VOL in Japan to the VOL in Malaysia.

Table 3. Comparisons among VOL Indices and Fuel Index in Malaysia and Japan

Year	Malaysia		Japan		Fuel Index	Ratio of VOL (Japan/ Malaysia)
	VOL Index in Ringgit	VOL Index in US Dollar	VOL Index in Yen	VOL Index in US Dollar		
1980	72.8	90.8	71.4	45.9	201.0	2.00
1981	75.5	86.3	73.1	44.4	173.8	2.04
1982	77.8	89.2	74.8	42.4	159.6	1.89
1983	80.6	92.6	76.0	46.0	146.3	1.97
1984	84.6	97.3	78.5	46.8	128.0	1.91
1985	81.6	89.3	81.4	50.3	126.3	2.24
1986	80.3	82.5	83.4	79.2	82.8	3.81
1987	82.4	87.5	86.4	84.3	82.8	3.82
1988	87.5	89.5	91.4	100.4	71.8	4.46
1989	93.3	96.3	95.5	101.9	80.1	4.20
1990	100.0	100.0	100.0	100.0	100.0	3.97
1991	105.2	101.8	103.4	109.9	101.5	4.29
1992	110.8	119.5	104.1	119.4	87.7	3.97
1993	117.2	123.3	104.1	144.8	81.6	4.66
1994	125.2	130.1	104.5	152.6	70.1	4.66
1995	133.9	147.0	105.7	174.9	80.7	4.73
1996	138.1	149.3	110.8	151.7	84.9	4.04
1997	145.5	148.7	112.3	138.7	96.4	3.70
1998	140.4	91.4	109.2	110.3	60.7	4.80
1999	140.5	99.7	109.6	139.6	75.5	5.56

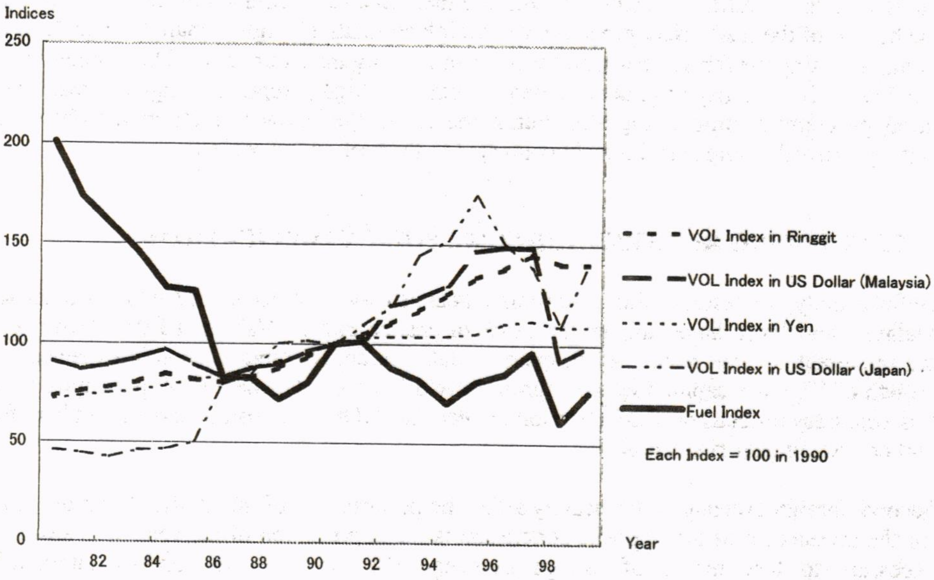

Figure 2. VOL and Fuel Indices

However, it should be noted that the Japanese VOL has rarely risen since 1990. In comparing the VOL Indices in dollars between in 1990 and 1997, the Malaysian VOL increased in by 48.7 percent, though the Japanese VOL rose by 38.7 percent. This result may support our hypothesis.

If we use the VOL Indices in the each domestic currency instead of dollars, the more favorable result appears. The Malaysian VOL in Ringgit rose by 45.5 percent, while the Japanese VOL in yen increased in by only 12.3 percent. Our hypotheses may only be valid in limited conditions such as this situation.

4.4 Comparisons of VOL Indices with the Fuel Index

The Fuel Index on Table 3 and Figure 2 comes from Japanese imported gasoline prices. The raw data on imported gasoline prices was adjusted to control inflation using the CPI (Consumer Price Index), and converted by the exchange rates to the US dollar. The imported gasoline price date at the constant price was used to induce the Fuel Index, of which the value in 1990 was 100.

The three major benefit categories of highway investments are time saving, safety improvement and driving cost saving such as decreased fuel consumption. The benefit units of the first two categories change at the same pace as GDP per capita. On the other hand, the fuel price, the unit of driving cost saving benefit, has an only weak relationship with GDP per capita. Therefore, it is interesting to compare the VOL trend with that of fuel prices, which is one of the applications of the relative price change problem.

Figure 2 shows precisely the difference between the trends of the VOLs and that of the fuel price. All of the four VOL Indices have an increasing tendency, although the Fuel Index sharply declined by 1986, and since then has kept almost the same level. The relative price of human life lost in a traffic accident against the fuel price has constantly decreased. Therefore, the benefit of the road safety programs was weighted relatively lighter than the benefit of fuel saving by using the former price, and vice versa in using the latter price. This implies that, in the 1980s, fuel saving programs gained a relatively higher reputation against road traffic safety programs or time saving ones, but, in the 1990s, the highway safety projects have been getting relatively more social weight compared to the fuel saving projects.

5. CONCLUDING REMARKS AND SOME POLICY IMPLICATIONS

Unfortunately, the result of this paper contradicts its own hypothesis. In the last two decades, Malaysia and Japan have had similar trends of change in their Values of Life. Two reasons are important for this result. First, even if Malaysia enjoys rapid economic expansion, the growth of GDP per capita does not significantly differ from Japanese GDP per capita trends. It is necessary to focus on GDP per capita rather than GDP to set parameters of unit benefit or unit cost for project evaluation.

Second, foreign exchange rates heavily affect the performance of this study. The main reason for the appearance of the opposite conclusion is the appreciation of the yen. It is absolutely necessary to take notice of foreign exchange rates in order to conduct international comparison.

Some positive implications can be induced from this study.

First, this study suggests the importance of adjusting the value of life for income growth over time. It is quite clear that for rapidly developing countries such as Malaysia, policy makers ought to give even more attention to the proper adjustment of the value of life computed by use of the Hoffman method in order to reflect fast growing income. Failure to do so will result in significant under-valuation of the benefits of road transport investments, especially those that are expected to bring about significant improvements in safety. The analysis above clearly shows that the underestimation of benefits is amplified in the later portions of the project duration by relatively high growth rates. To try to quantify the magnitude of the impact of correcting for this bias on national programs is likely to be a speculative endeavor. However, it is safe to anticipate qualitatively that correcting for the bias will tend to make programs that improve traffic safety more attractive and thus more deserving of development funds. Such a change will also result in some readjustment of priorities in the components of transport infrastructure of any transport project in favor of safety. The implication of this bias might be, however, less severe in the case of Japan since the economy, although more advanced, is growing at a relatively slower pace since 1990. In Japan after 1990, underestimation of benefits still occurs but at a relatively smaller magnitude. But, it should be noted that this conclusion would be appropriate under the some limited conditions.

Second, this conclusion under limited conditions also indicates that international comparisons of transport project returns derived from cost benefit analysis must also be done cautiously by paying due attention to the method adopted for valuing life and, in particular, whether an attempt has been made to adjust for growth. This is especially important for international funding agencies for transport infrastructure development that may choose projects partly, if not wholly, on the basis of social economic returns. Even when the value of lives saved is incorporated in cost benefit analysis, failure to take into account the high growth of income for some countries relative to others in the computations of benefit arising from lives saved, will result in a biased selection of projects. Highly viable projects in faster growing economies will look less attractive than they actually are, purely because of a huge underestimation of the value of lives that will be saved by such projects.

Third, at initial relative prices, transportation safety projects are underestimated relatively against practical driving cost saving projects like such as fuel consumption saving programs. Such a underestimation necessarily implies that the safety benefits of transport investment projects are significantly understated in project evaluation. This, in turn, implies that there may have been projects (especially those that were marginally not economically viable) that were unjustifiably rejected by policy makers due to failure to control for the effect of rising income.

One suggestion arising from this study is to adjust the value of life lost by traffic accidents even if other benefits and costs are evaluated at the initial prices. Though the prices of human life and time saving have the same trend over time, the value of time should be specially treated against time saving and other benefit categories. Lost human merits consideration. As for the international matter, one solution is to set a common minimum value of human life in the world. The common value may be set at the 25th percentile of the VOL from the top of all people in the world. It is obvious that further research and considerations are necessary.

REFERENCES

Haight, F. A. (1994) Problems in Estimating Comparative Costs of Safety and Mobility, **Journal of Transport Economics and Policy, Vol. 28, No.1**, 7-30.

Miller, T.R. (1996) Injury Cost Estimation: A Pain in the Neck, **Proceedings of A Conference on Measuring the Burden of Injury**, 15-16 February, Road Accident Prevention Research Unit, The University of Western Australia.

Mishan, E.J. (1971) Evaluation of Life and Limb: A Theoretical Approach, **Journal of Political Economy, Vol. 79**, 687-705.

O'Reilly, D., Hopkin, J., Loomes, G., Jones-Lee, M., Philips, P., McMahon, K., Ives, D., Soby, B., Ball, D., and Kemp, R. (1994) The Value of Road Safety: UK Research on the Valuation of Preventing Non-Fatal Injuries, **Journal of Transport Economics and Policy, Vol.28, No.1**, 45-59.

Pearce, D.W. and Nash, C.A. (1981) **The Social Appraisal of Projects**. Macmillan, London.

Rice, D. P., Ellen, J., MacKenzie and Associates. (1989) Cost of Injury in the United States: A Report to Congress, San Francisco, CA: Institute for Health and Aging, University of California and Injury Prevention Center, The John Hopkins University.

Road Transport Department Statistics (1999), *Unpublished*, Road Transport Department, Kuala Lumpur, Malaysia.

Schelling, T.C. (1968) The Life You Save May Be Your Own. In S. Chase (ed), **Problems In Public Expenditure Analysis**. Brookings Institution, Washington DC, 127-176.