CHIER

Discussion Paper

The Implicit Value of Life in the Labor Market in Taiwan

Li-Min Hsueh & Su-Wan Wang*

CHUNG-HUA INSTITUTION FOR ECONOMIC RESEARCH
75 Chang Hsing St. Taipei, Taiwan
Republic of China

ISN - 32119

Discussion Paper
No. 8801

The Implicit Value of Life in the Labor Market in Taiwan

Li-Min Hsueh & Su-Wan Wang*

CHUNG-HUA INSTITUTION OF ECONOMIC RESEARCH

The Implicit Value of Life in the Labor Market in Taiwan

by

Li-Min Hsueh & Su-Wan Wang*

Abstract

By using a hedonic wage equation, this study estimats the implicit value of life for the labor market in Taiwan. The data were obtained from the Taiwan Area Labor Force Survey of 1984, from which two samples, the main and the sub, were drawn. The value of life was found to range from NT$21-34 million which, relatively speaking, is no less than that obtained from the U.S. studies. The estimated risk premium was found to be higher for any level of job risk in the case of the sub-sample. This may be due to this group of workers' perceived job risk being higher than the actual risk, hence their asking for and receiving a higher wage compensation.

I. Introduction

A job with a higher risk of death is expected to have a higher wage to compensate for the risk, all other things being equal. This risk premium reveals implicitly what the market is willing to pay to reduce the risk so that the life of an unspecified person can be saved. More specifically, by using the risk premium we can calculate the amount of wages workers are

---

* Li-Min Hsueh is an associate research fellow and Su-Wan Wang an assistant research fellow of the Chung-Hua Institution for Economic Research, 75 Chang-Hsing St., Taipei, Taiwan, R.O.C.

collectively willing to give up to save one life at the margin, which we define as the value of life.

Thaler and Rosen (1975) have shown theoretically that the observed market wage-risk relationship in equilibrium is the locus of points of tangency between the workers' indifference curves, which reveal the marginal rate of substitution between the wage and risk, and the isoprofit curves for firms which correspond to the rate of substitution between risk and the cost of reducing risk. Empirically, market risk premium can be found by estimating a hedonic wage equation which regresses observed market wage rates on job risk as well as other variables which also determine wage rates.

Although a great number of studies encompassing this general framework for estimating the wage-differentials due to job risk and using the results to estimate the value of human life have already appeared in the literature, the range of these estimations of the value of life has been very wide. It has ranged from about 0.65 million (Thaler and Rosen, 1975) to 8.1 million (Olson, 1981) when valued in terms of 1986 U.S. dollars. The variation in the size of the estimates results from the use of different data sets, different definitions of job risk and various other kinds of concerns.[1]

In this study, a hedonic wage equation will also be used to estimate the implicit value of life for the labor market in

---

1. A comprehensive review of the empirical studies can be found in Violette and Chestnut (1983).

Taiwan.

The labor market in Taiwan has several characteristics which make using its data for this type of study especially advantageous. First, the labor market in Taiwan is very competitive. The wage rate is basically determined by the labor productivity and the labor demand-supply situation.[2] So far, government regulations and labor unions have only had a very minor impact on the wage rate. At the same time, the unemployment rate has been lower than 3 percent for the past 20 years. In other words, the labor market in Taiwan more or less resembles the competitive market which it is assumed to be in Thaler and Rosen's model. Therefore, the risk premium estimated from the wage equation can more accurately reflect the trade-off relationship between risk and the wage rate. Second, the government-sponsored labor insurance program is the only provision for compensation benefits for work accidents in Taiwan. Therefore, the wage differentials due to job risk are not affected by the differences in insurance programs. This is a concern of R. Arnould & L. Nichols (1983) and W. Kip Viscusi & Michael J. Moore (1987).

In the remainder of this paper, we first specify the empirical model, describe the data, and then discuss the results of our estimation. Finally, we present the conclusion.

---

2. A detailed discussion on the competitiveness of the labor market in Taiwan can be seen in Wu, Hui-lin (1987).

II. Model Specification and Data

Besides job risk, wage differentials can also be explained by the productivity of a worker and the characteristics of his job. Hence, the hedonic wage function can be expressed as:

Wage = f(job risk, worker's productivity, job characteristics)

However, variables actually included in the estimated function to explain the wage differential depend on the data we have. These variables are discussed later in this section.

The data used for estimating the wage equation are obtained from the Taiwan Area Labor Force Survey of 1984 which is an annual survey conducted by the Directorate-General of Budget, Accounting and Statistics, Executive Yuan (DGBAS). 57,363 persons were interviewed in this survey. We selected from the sample those who worked more than 40 hours a week. Professionals and managers were excluded because their job market is characteristically very different from the rest of the market.[3] Since the remaining sample size of 23,531 was still regarded as being too large to operate, a 20% sample was drawn at random to comprise the final data set. This data set, which was designated as the main sample, consists of 4,628 observations. At the same time, a sub-sample drawn from the main sample was also used for

---

3. Using professionals and managers as a separate data set which is 7.8% of those who worked over 40 hours, we find that the wage-risk relationship is insignificant. In some cases, the risk premium is even negative.

purposes of comparison and consists of 2,224 observations which include only production workers, transportation operators and laborers. These groups of workers are considered to have the most homogeneous characteristics in the labor market, and hence it was deemed that the wage-risk relationship could be estimated more efficiently by using regression analysis.

Although the determination of the risk premium is based on the perceived risk rather than on actual risk, most of the past studies use actual data to measure job risk. In this study, job risk is defined as the death rate due to job hazards per thousand insured workers in 1984 (DEA). Data concerned with job risk are from the Bureau of Labor Insurance. Statistics are available for 57 industries (two-digit classification). For a certain individual, job risk is assumed to be the death rate of the industry in which he is employed.

Variables which affect an individual's productivity that are included in the equation are age (AGE), marital status (MARR), education (EDUC), sex (MALE), and working experience (EX). Variables which could be used to approximate job characteristics are quite limited in our data set. They are employment status (DI1, DI2, DI3), employed occupation (CLERK, SALES, SERVE, LABORI, LABORII, LABORIII)[4], and in an urbanized area or not (URBAN). In addition, weekly working hours (MH) is included to take into account the fact that those who had longer working

---

4. Instead of occupatinal, dummies models with a set of dummy variables representing employed industries are also estimated. For the main sample, the estimated results were found to be as good as the one with occupational dummies, but for the sub-sample the results were not satisfactory.

hours earned more. The definitions of all the variables are listed in Table 1, and their means are given in Table 2.

Table 1. Variable Definitions

Variable Name	Definition
WAGE	Monthly earned income (NT$)
AGE	Age
MARR	Marital status: 1 if married, 0 otherwise
EDUC	Years of education
MH	Weekly hours of work
MALE	Sex dummy variable: 1 if male, 0 otherwise
EX	Working experience, total months worked for the current job
DEA	Yearly death rate due to job hazard (0/00)
DI1,DI2,DI3	Employment status dummy variable DI1=1 if employer, DI2=1 if self-employed, DI3=1 if employed by government, Omitted class if employed by private sector
	Occupational dummy variables
CLERK	CLERK=1 for clerical workers
SALES	SALES=1 for sales workers
SERVE	SERVE=1 for service workers
LABORI LABORII LABORIII	LABORI, LABORII, LABORIII for production workers, transportation operators and laborers. Agricultural and related workers is the omitted category.
URBAN	1 if employed in the urbanized area 0 otherwise

Table 2. Means of All Variables

Variable	Main Sample	Sub Sample
WAGE	11740.328(NT$)	10973.504(NT$)
AGE	34.954	31.311
MARR	0.642	0.569
EDUC	8.568	8.119
MH	49.982	50.006
MALE	0.689	0.688
EX	87.474	56.947
DEA	0.348	0.384
DI1	0.043	0.014
DI2	0.246	0.090
DI3	0.112	0.074
URBAN	0.539	0.489
CLERK	0.166	
SALES	0.145	
SERVE	0.082	
LABORI	0.120	0.249
LABORII	0.167	0.347
LABORIII	0.194	

Although the choice of the functional form of the wage equation is not guided by theory, semi-log and linear forms have most often been used in the literature. In this study, we used three functional forms: the linear, semi-log and log-linear. AGE^2, $EDUC^2$ and DEA^2 were also entered into the linear and semi-log forms to account for the non-linear relationship between wages and these variables. According to Thaler and Rosen's theoretical framework, the first derivative of the wage function with respect to risk, i.e., Wage'(DEA), must be positive, but the sign for the second derivative is uncertain. When the coefficient for DEA^2 becomes negative, i.e., Wage"(DEA)<0, this means that, at the market equilibrium, the marginal risk premium is less for a riskier job. Olson (1981) has found this relationship to exist. Interactions between DEA, AGE and EDUC were also tested but the results were found to be unsatisfactory.

III. Regression Results

The OLS regression results for the main sample and sub-sample are presented in Table 3. The coefficients for all variables have expected signs and are very significant. The coefficients for DEA in both samples have expected positive signs. Furthermore, the coefficients for DEA^2 have negative signs as in the case of Olson's study. The levels of significance of these coefficients are higher for the sub-sample in all three functional forms which verifies that, by using a more homogeneous sub-sample, we can obtain a more efficient estimation on the wage-risk relationship.

Table 3. Regression Results for the Wage-Risk Equation

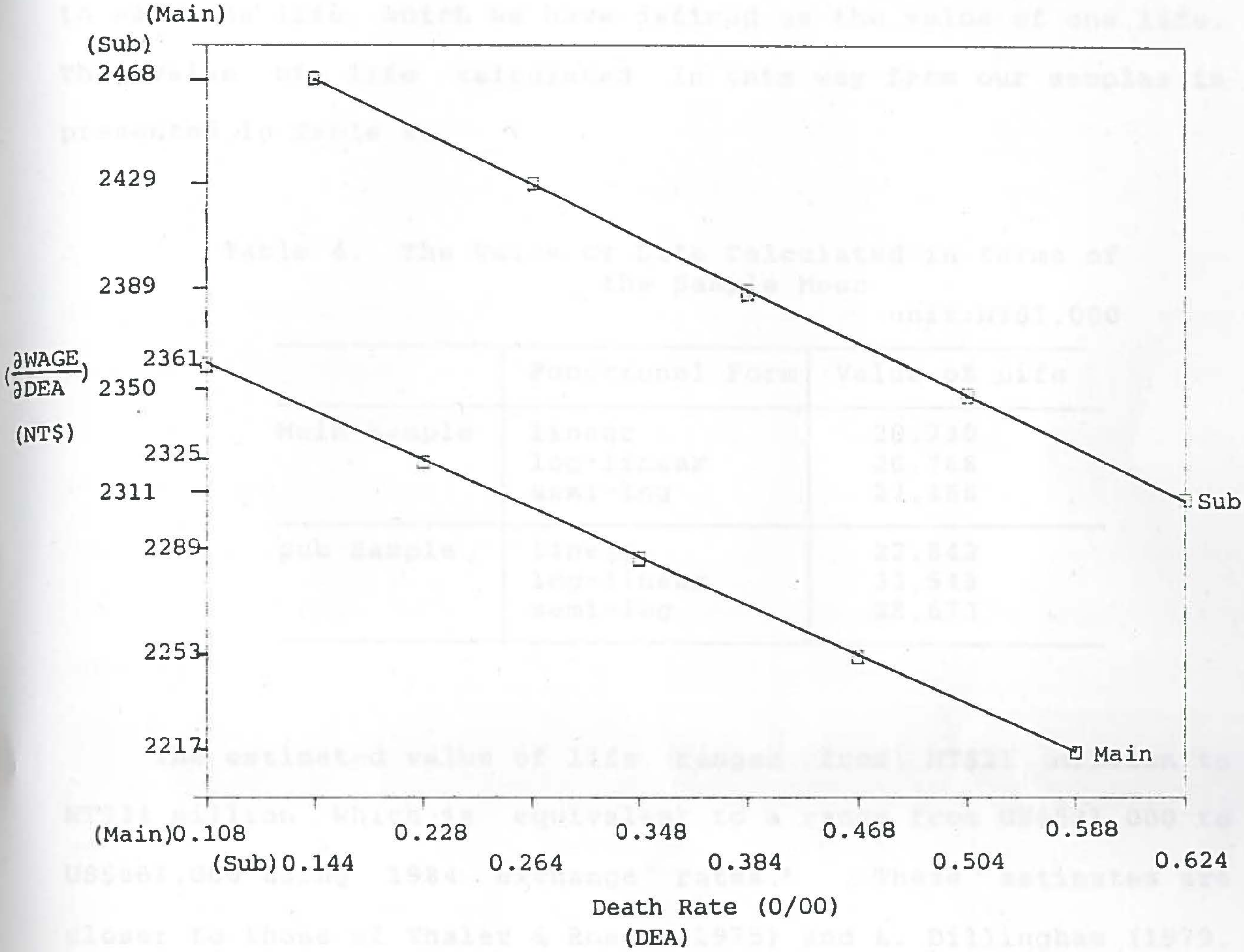
	Linear		Log-linear		Semi-log	
	Main	Sub	Main	Sub	Main	Sub
INTERCEPT	-15742.478	-8076.065	5.612	6.670	6.664	7.324
	(-15.815)	(-7.024)	(26.883)	(24.700)	(82.712)	(70.585)
AGE(lnAGE)	502.094	428.331	0.066	0.116	0.051	0.047
	(11.741)	(8.785)	(2.462)	(3.771)	(14.857)	(10.723)
AGE^2	-5.821	-5.401			-0.0006	-0.00059
	(-11.245)	(-8.601)			(-14.838)	(-10.476)
MARR	1122.949	1055.505	0.159	0.126	0.019	0.083
	(5.290)	(4.714)	(9.835)	(6.760)	(5.282)	(4.131)
EDUC(lnEDUC)	79.164	295.153	0.142	0.123	0.015	0.039
	(0.983)	(2.746)	(10.444)	(7.037)	(2.316)	(4.021)
$EDUC^2$	15.636	-6.004			0.001	-0.0014
	(3.425)	(-0.949)			(1.632)	(-2.438)
MH(lnMH)	112.749	93.921	0.548	0.418	0.010	0.007
	(11.152)	(7.325)	(11.890)	(6.845)	(11.085)	(6.009)
MALE	3147.836	3014.460	0.306	0.304	0.306	0.308
	(16.475)	(14.744)	(19.585)	(16.827)	(19.764)	(16.711)
EX(lnEX)	4.402	11.414	0.059	0.710	0.0003	0.001
	(4.197)	(7.764)	(10.452)	(11.570)	(3.723)	(7.127)
DEA(lnDEA)	1806.255	1951.924	0.051	0.099	0.2039	0.229
	(4.717)	(5.373)	(5.501)	(9.882)	(6.577)	(6.993)
DEA^2	-113.14	-126.292			-0.01286	-0.01498
	(-4.000)	(-4.976)			(-5.619)	(-6.539)
DI1	8806.296	5963.859	0.447	0.412	0.472	0.384
	(21.882)	(8.579)	(13.547)	(6.637)	(14.524)	(6.116)
DI2	1463.006	2971.734	0.022	0.193	0.051	0.174
	(5.857)	(10.012)	(1.081)	(7.253)	(2.535)	(6.501)
DI3	662.274	1252.440	0.075	0.086	0.080	0.102
	(2.380)	(3.693)	(3.314)	(2.911)	(3.573)	(3.318)
URBAN	1615.169	778.590	0.145	0.072	0.131	0.067
	(9.747)	(4.749)	(10.683)	(4.953)	(9.801)	(4.534)
CLERK	6276.178		0.698		0.672	
	(15.363)		(21.516)		(20.316)	
SALES	5529.276		0.592		0.588	
	(15.199)		(21.042)		(19.984)	
SERVE	4954.597		0.558		0.548	
	(11.382)		(15.426)		(15.552)	
LABORI	5677.761	619.262	0.599	0.114	0.628	0.113
	(14.287)	(2.759)	(19.012)	(5.788)	(19.530)	(5.586)
LABORII	5083.131	94.070	0.562	0.077	0.573	0.061
	(13.329)	(0.473)	(18.702)	(4.420)	(18.564)	(3.410)
LABORIII	5140.943		0.524		0.528	
	(14.544)		(18.850)		(18.456)	
$\bar{R}^2$	0.409	0.442	0.420	0.459	0.435	0.448
F	161.318	110.989	197.904	146.173	179.012	113.550

Note: t-ratios are in parentheses.

The fit of each of the three functional forms is quite similar. For the main sample, the semi-log form has the highest $\bar{R}^2$ of 43.5%; the log-linear form the second highest of 42%, and the linear form 40.9%. The fit is better in general for the sub-sample with an $\bar{R}^2$ of 44.8% for the semi-log form, 45.9% for the log-linear form and 44.2% for the linear form.

According to the estimated coefficients for DEA and DEA^2, a job with mean DEA has risk premiums of about 7.3% (main sample, semi-log form) and 8.4% (sub-sample, semi-log form) of the wage, compared with a job with no risk. Since the coefficient for DEA^2 is negative, the marginal risk premium becomes less when job-risk increases. The relationship can be depicted in Figure 1. Olson argues that this result may be due to the fact that a less risk-averse worker may ask for less risk premium, and hence is placed in a more dangerous job. From Figure 1, we can also see that the marginal risk premium is higher for the sub-sample at any level of risk than that for the main sample. This may be due to the perceived job risk being higher than the actual risk for this group of workers. This would explain why they demand and receive higher risk premium.

Figure 1. Marginal Risk Premium at Different Level of Risk



From the marginal risk premium, we can calculate the value of life as being the amount of wages workers are collectively willing to give up to save one life at the margin. More specifically, let us suppose that at mean DEA, the monthly marginal risk premium is NT$1,727. This means that a worker is willing to give up this amount of his wages per month to reduce his probability of death by 0.1%. Looked at differently, this can also be explained by saying that one thousand workers are collectively willing to give up NT$20,724,000 annually in order to save one life, which we have defined as the value of one life. The value of life calculated in this way from our samples is presented in Table 4.

Table 4. The Value of Life Calculated in terms of the Sample Mean

unit:NT$1,000

	Functional Form	Value of Life
Main Sample	linear	20,730
	log-linear	20,768
	semi-log	27,468
Sub Sample	linear	22,842
	log-linear	33,949
	semi-log	28,673

The estimated value of life ranges from NT$21 million to NT$34 million which is equivalent to a range from US$531,000 to US$861,000 using 1984 exchange rates.[5] These estimates are closer to those of Thaler & Rosen (1975) and A. Dillingham (1979, 1985), but are lower than most of the other U.S. estimates which are mostly over US$1 million. However, GNP per capita in Taiwan is only about 1/5 of that in the U.S. So, relatively speaking, the willingness to pay to save one life in Taiwan is no less than or may even be more than that in the U.S. This finding may verify the point we made in the introduction that, with the

5. The exchange rate at the end of 1984 was US$1=NT$39.5. Since then, the NT has appreciated rapidly. The current exchange rate is about US$1=NT$29.

competitiveness of the labor market and the homogeneous labor insurance program, the observed wage can reflect the risk premium more fully in Taiwan than in other countries such as the U.S.

The value of life for each observation in the sample is also calculated by using the results from the semi-log form regression. They are presented according to income class and age groups in Tables 5 and 6. From Table 5 we can see that, for each sample, the value of life increases with the wage rate. The value of life of the highest income group is about 2 times that of the lowest income group. This result is determined by the semi-log form of the wage equation. However, Table 5 also shows that the average value of life for the sub-sample is higher than that for the main sample, while the average wage is lower for the sub-sample. This seems contrary to the common belief that wealthier people value their life more preciously. Nevertheless, more studies are needed before we can claim definitely what is the relationship between wealth and the value of life.

Table 6 shows an interesting pattern for the value of life for different age groups. It is highest for those who are middle-aged, but lower in the younger and older age groups. This is mainly due to the fact that people in the 31-50 age group have the highest wages. In addition, it may also be due to the fact that middle-age people carry heavier social and family responsibilities, which makes them more risk-averse than other age groups.

Table 5. The Average Value of Life by Income Class

Monthly Wage	Main Sample (NT$1,000)	Sub Sample (NT$1,000)
less than 5,000	16,725	20,069
5,000-10,000	20,927	22,999
10,001-15,000	28,099	30,912
15,001-20,000	33,780	35,313
more than 20,000	38,820	38,403
Average	25,409	27,057

Table 6. The Average Value of Life by Age Group

unit: NT$1,000

Age Group	Main Sample	Sub Sample
below 20	17,062	18,901
21-30	24,801	26,817
31-40	29,957	31,733
41-50	27,644	30,781
51-60	24,771	29,692
over 61	20,532	21,950
Average	25,409	27,057

IV. Conclusion

By using a hedonic wage equation, this study has estimated the implicit value of life for the labor market in Taiwan. It is found to range from NT$21-34 million which, relatively speaking, is no less than that obtained from the U.S. studies. This result may be related to the competitiveness of the labor market in Taiwan.

The regression results from a sub-sample which consists of only production workers, transportation operators and laborers verify that a more homogeneous sample will estimate the wage-risk relationship more efficiently. This group of workers with an average death rate due to job hazard higher than that for the whole labor market may perceive job risk to be higher than what happens in practice, and hence ask for and receive a higher marginal risk premium at any level of job risk. This higher risk premium also implies a higher value of life. This result shows that using the sample from the whole labor market, which is the case in most of the former studies, may result in our failing to gian a very important insight on the wage-risk relationship. For future studies, it may be worthwhile subdividing the sample into even smaller groups of workers to investigate this point further.

References

1. Arnould, Richard J., and Len M. Nichols. 1983. "Wage-Risk Premiums and Workers' Compensation: A Refinement of Estimates of Compensating Wage Differentials." Journal of Political Economy 91(2): 332-40.

2. Dillingham, Alan E. 1979. The Injury Risk Structure of Occupations and Wages. Unpublished Ph.D. Dissertation. Cornell University.

3. Dillingham, Alan E. 1985. "The Influence of Risk Variable Definition on Value-of-Life Estimates." Economic Inquiry 24(2): 277-94.

4. Olson, C.A. 1981. "An Analysis of Wage Differentials Received by Workers on Dangerous Jobs." Journal of Human Resources

16(2): 167-85.

5. Thaler, R., and S. Rosen. 1975. "The Value of Saving a Life: Evidence from the Labor Market." in Nestor Therleckyi, ed., Household Production and Consumption. Bureau of Economic Research.

6. Violette, Daniel M., and Lauraine G. Chestnut. 1983. "Valuing Reductions in Risk: A Review of the Empirical Estimates." Environmental Benefits Analysis Series. EPA-230-05-83-003.

7. Viscusi, W.K., and M.J. Moore. 1987. "Workers' Compensation: Wage Effects, Benefit Inadequacies, and the Value of Health Losses." The Review of Economics and Statistics 69(2):249-61.

8. Wu, Hui-lin. 1987. "Taiwan's Labor Market and Economic Development." Proceedings of the Conference on Current Economic Issues. Taipei (in Chinese).