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Role of Worker's Compensation Benefit in Estimating Value of Statistical Life

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ROLE OF WORKER'S COMPENSATION BENEFIT IN ESTIMATING VALUE OF STATISTICAL LIFE

Agamoni Majumder* and S Madheswaran**

Abstract

A worker's compensation benefit is an important part of the compensation package for risky jobs, and excluding it during the estimation of Value of Statistical Life (VSL) and Value of Statistical Injury (VSI) may yield biased estimates of wage-risk trade-off. Besides, many studies from developed countries indicate that there exists a negative trade-off between a worker's compensation benefit and the wage for risky jobs. Therefore, this paper uses information on a sample of 430 workers from the manufacturing industries of Ahmedabad, India to examine the influence of worker's compensation benefits on their wages and Value of Statistical Life. The results of this study show that including an interaction variable between compensation benefit and injury risk in estimation improves the VSL and VSI estimates. These results have important implications for the labour market in developing countries like India. The estimates of VSL and VSI obtained from this study will help policymakers and government agencies to evaluate the existing policies on compensation benefit and occupational safety in India as well as other developing countries.

Keywords: Value of a Statistical Life (VSL), Compensating Wage Differential, Hedonic Wage Method, Compensation benefit.

Introduction

A job comprises of many characteristics. While some of the attributes are desirable, others are not. The riskiness of a job is a major concern for industrial workers since it poses a threat to their health and safety at workplace. Therefore, workers engaged in risky jobs are provided with a wage premium in order to compensate them for unpleasant job attributes. This difference in pay is known as the Compensating Wage Differential (CWD). CWD is the amount that has to be paid to a worker so that he takes up a risky job. It also indicates the amount a worker is willing to pay out of his wage to make the workplace safer. Thus, workers indirectly engage in a trade-off between wage and job risk. Wage-risk trade-off is a key to the estimation of Value of Statistical Life (VSL) and Value of Statistical Injury (VSI). VSL refers to the amount that all the workers are jointly ready to pay for reducing the risk of death for one of them (Borjas 2013). The wage-risk trade-off is generated using the hedonic wage method and it is used to estimate VSL and VSI for the workers in the sample.

Compensation for job risk is provided by employers to workers either through an ex-ante or ex-post compensation. Ex-ante compensation refers to the compensating wage differentials paid to workers for taking up risky jobs. Ex-post compensation refers to the compensation benefit provided to the worker for a job injury (Viscusi and Moore 1987). A firm can purchase insurance scheme from any private insurance company that provides compensation to workers for job related accidents. On payment of an insurance premium, these schemes provide a certain level of coverage from accidental injuries to workers of that firm. However, due to the asymmetric information in the labour market, the

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private insurance market fails to provide optimal income protection in case of job-related disabilities. Most workers are unaware of job risks before they start working in a job and therefore employers may skimp on safety. Again, the workers may be negligent about safety leading to more accidents and more insurance claims. Under such circumstances, government social insurance schemes can correct market failures (Krueger, 1989). Therefore, the government of a country decides the rate of compensation benefit. The guidelines for providing compensation benefit vary with the nature of injury (temporary, permanent, partial, and total disablement), duration of illness due to injury, worker's wage, age, etc. In India, there are only two legislations concerning that offers compensation to factory workers for various types of occupational injury and for death. The first one is the Employees State Insurance (ESI) Scheme (1948) and the second one is the Workmen's Compensation Act (1923), which is now called Employees Compensation Act. These acts are amended from time to time by the government of India. Both the acts have separate guidelines and provisions for providing compensation, which are discussed in detail in the main text of the paper. The government decides the rate at which the compensation benefit will be provided to workers under the ESI scheme. Not only the employers but also the employees have to pay a certain portion of premium for compensation insurance under the ESI scheme. This ensures that the problem of moral hazard doesn't arise in case of compensation insurance. The other way of providing compensation in India is through a direct government mandate (i.e. through Workmen's Compensation Act), under which the employers have to bear the total cost of job-related disabilities and death by paying a lump sum amount to the workers. This paper follows the seminal work of Viscusi and Moore (1987) and utilizes the ESI scheme to examine the impact of worker's compensation benefit for temporary disablement on their wages and VSL.

In developed countries, it is observed that if workers are paid higher wages, they are ready to accept lower compensation benefit. Besides, incorporating compensation benefit in the estimation of hedonic wage equation increases the wage-risk trade-off (Viscusi and Moore, 1987). Most of the pioneering studies on this topic were undertaken in the US during the 1980's. Krueger (1988) found that as higher compensation benefits were provided, more cases of accidents were reported. The moral hazard problem was the main reason behind the reporting of higher number of accidents. On the other hand, Moore and Viscusi (1987) found that high insurance premiums offset the problem of moral hazard and closing the compensation benefit programs would increase mortality rates by 20 percent (Chelius and Smith,1 987).

In India, there have been a few studies on the Value of Statistical Life. Some of the noteworthy Indian studies are by Shanmugam (1996, 1997), Simon *et al* (1999), Madheswaran (2007), Shanmugam and Madheswaran (2011), and Majumder and Madheswaran (2018). It has been well established through many international studies (Viscusi and Moore 1987, Krueger 1989, etc.) that a worker's wage is affected by compensation benefits and excluding it from the estimation of hedonic wage equation would yield a biased estimate of the wage-risk trade-off and hence a biased VSL estimate. However, earlier VSL studies in India had not examined this important issue in detail. Shanmugam and Madheswaran (2011) undertook a preliminary examination of the effect of compensation benefit on workers' wages and found that the wage-risk trade-off for injury risk improved but the VSI decreased on inclusion of the compensation benefit variable in their study. In this context, the present study examines the impact of compensation benefit on workers' wages, their VSL and VSI estimates. The paper begins with a discussion on the theoretical framework of the study. Section 3 briefly discusses the two existing workers' compensation schemes in India. The sources of data and information on variables used in this study are presented in section 4. Section 5 focuses on empirical analysis and explains how the VSL and VSI are estimated. The results of estimation of the hedonic wage equation are presented in section 6, and section 7 concludes the paper.

Theoretical Framework

The theory of compensating wage differential was first introduced by Adam Smith in 1776, who laid the foundation for understanding why different workers are paid differently. Smith's theory guided numerous studies, which established that any job with disagreeable attributes would require higher wages. Almost 200 years later, the modern theory of compensating wage differential was developed by Nobel laureate economist Richard Thaler and his supervisor Sherwin Rosen (1976). Their theory followed the hedonic wage approach. Under this approach, it is considered that a job has pecuniary as well as non-pecuniary attributes. While the pecuniary attribute comprises of monetary remunerations, the non-pecuniary attributes comprise of the job's risk level, the degree of its difficulty, the skill required for doing it, etc. Since job risk level is a matter of great concern for workers, they demand wage differential for taking up risky jobs. Thus, compensating wage differential indicates the level of risk associated with a job and it is crucial for the estimation of VSL and VSI of the workers.

A simple mathematical framework comprising of Von Neumann Morgenstern utility theorem can be used to obtain the compensating wage differential for job risk. In this framework, two utility functions are considered that are dependent on two states. The first utility function corresponds to utility under the good health state, which is given by "$\mathbf{U^1(x)}$". The second utility function corresponds to the utility under ill health state, which is given by "$\mathbf{U^2(x)}$". Any rational individual would prefer good health over ill health and therefore, $\mathbf{U^1\ (x) > U^2\ (x) > 0}$. Since the marginal utility of consumption under good health will be higher than that under the ill health state, therefore, $\mathbf{U_x^1\ (x)\ > U_x^2\ (x)\ > 0}$. The marginal utility of consumption is positive but diminishing, i.e. $\mathbf{(U_{xx}^1,\ U_{xx}^2 < 0)}$. The likelihood of occurrence of good health state is denoted by $\mathbf{p}$ and the likelihood of occurrence of ill health state is denoted by $\mathbf{(1-p)}$. A worker would earn a wage of $\mathbf{w_1}$ under the good health state while the compensation he would receive under the ill health or injured state is $\mathbf{w_2}$. If government levies a tax of amount $\mathbf{t}$ on the earnings, then under the good health state worker's income will be $\mathbf{(1-t)\ w_1}$. This study examines the trade-off between a worker's wage ($\mathbf{w_1}$) and the compensation benefits ($\mathbf{w_2}$) for taking up a job with risk level $\mathbf{p}$. Using the above given information, the Expected Utility (EU) function of the worker is constructed.

$$\mathbf{E = (1\text{-}p) \times U_x^1\ ((1\text{-}t)\ w_1) + p \times U_x^2\ (w_2)} \qquad \text{..................} \ \mathbf{(1)}$$

The aim of the worker is to maximize the expected utility function given the job risk level. The first order condition for this is obtained by differentiating equation (1) with respect to $\mathbf{w_1}$ and $\mathbf{w_2}$ which is given by equation (a) and (b)

$$\delta E/_{\delta w_1} = (\mathbf{1-p}) \times (\mathbf{1-t}) \times \mathbf{U}_x^1 \qquad \text{..................} \ \mathbf{(a)}$$

$$\delta E /_{\delta w_2} = p \times U_x^2 \qquad \text{.................... (b)}$$

The trade-off between worker's wage and compensation benefit is obtained as follows.

$$\frac{dw_1}{dw_2} = \frac{-\delta E/_{\delta w_2}}{\delta E/_{\delta w_1}} = \frac{-(p \times U_x^2)}{(1-p)\times(1-t)U_x^1} \qquad \text{.................... (2)}$$

The trade-off obtained in equation (2) shows the rate of substitution between $\mathbf{w_1}$ and $\mathbf{w_2}$.

If there is no risk associated with a job, then the trade-off between $\mathbf{w_1}$ and $\mathbf{w_2}$ will be zero. Thus, the trade-off between wage and compensation benefits exists only if the level of risk associated with a job is positive. If no taxes are levied on workers' earnings, then their compensation will be actuarially fair and a perfect market for compensation insurance will prevail. Besides, workers' earnings will be allocated smoothly over the two states so that the utility under each state will be same. In a perfect market for compensation insurance, the trade-off between wage and compensation benefit will be of the following form

$$\frac{dw_1}{dw_2} = \frac{-p}{(1-p)} \qquad \text{.................... (3)}$$

Equation (3) shows that there is an inverse relation between workers' wage and compensation benefits. For example, if the trade-off value is -0.03, then workers will be ready to forego 3 paisa from their wage in good health state in order to obtain a compensation benefit of 1 rupee in the ill health or injured state. The average injury risk (p) for this study is 0.00197 (see table 2). Thus, using equation 3, the trade-off between wage and compensation is calculated to be -0.0019. This trade-off can be considered as the optimal rate of substitution between wage and compensation benefit for the workers in the sample. Thus, a worker is willing to forego 0.19 paisa out of his income in the healthy state in order to get an extra 1 rupee as compensation benefit in the ill health state. However, this trade-off will take place only if the market for compensation insurance is perfect and there are no taxes on workers' earnings. For Viscusi and Moore's study (1987) the rate of substitution was found to be -0.04 and it was considered to be sub-optimal given the income levels that were being insured. However, a perfect market for insurance compensation doesn't exist. There are administrative costs (**a**) associated with the insurance schemes. Besides, workers have to pay taxes on their income. Consequently, a worker has to forego **(1+a)** dollars in good health state so as to obtain 1 dollar as compensation in ill health state. Thus, a worker has to ultimately pay more out of his income in the good health state. The wage-compensation trade-off under such a scenario is represented by equation (4).

$$\frac{dw_1}{dw_2} = \frac{-p\,(1+a)}{(1-p)} \qquad \text{.................... (4)}$$

If the compensation is high, then a situation may arise where workers may become negligent about safety, and a higher number of accidents may be reported to obtain compensation benefits. Thus, the problem of moral hazard may arise. In order to avoid this kind of situation, the efficient level of insurance should be lower.

Compensation Schemes in India

As discussed earlier in the introduction section, there are two schemes in India that provide compensation to workers for on-the-job injury and death. The first one is the ESI scheme. This scheme was initially introduced in 1948 and it is amended from time to time. This study uses the 2010 amendment of this scheme. Under the ESI scheme, any factory worker who has an average monthly income less than INR 15,000 can register for it. This scheme is financed by contributions from employees, employers and state governments. Thus, a worker has to make contributions towards this scheme at the rate of 1.75 percent of his wages. The employers make contribution at the rate of 4.75 percent of a worker's wage and the state governments make contributions at the rate of 12.5 percent as provision towards Medical Care. This scheme provides medical benefits to the workers as well as to their family members. The worker is entitled to receive disablement benefits for temporary and permanent disablement caused by injuries at his workplace. However, the amount of compensation depends on the type and severity of injury, work days lost, contributions made towards the scheme, etc. Under this scheme, the government has listed the standard daily benefit rates that correspond to their average daily wage. The workers are given compensation on the basis of these standard benefit rates (see table 4 in Appendix for the benefit rates). In case of temporary disablement due to sickness, the worker is compensated at the rate of 60 percent of mean daily wage if the sickness lasts for a maximum of 91 days in any two consequent periods. On the other hand, compensation for temporary disablement caused due to injury at workplace is given at the rate of 75 percent of the mean daily wage till the incapacity lasts. The compensation for permanent disablement depends on the loss of earning capacity of workers, which is determined by a Medical Board. The dependents benefit is given at the rate of 75 percent of the mean daily wage to the wife and children if the insured worker dies because of any accidents associated with his job. Since this study mainly focuses on temporary disablement and death, the ESI scheme has been selected to examine the effect of compensation benefit on workers' wage and VSL. Therefore, the compensation replacement ratio used in this study represents the compensation for temporary disablement and death.

The second one is the Employees Compensation Act (2009 amendment) under which the employer needs to pay lump sum compensation to workers if any severe outcome like permanent disablement or death occurs at work. This act has provisions for lump sum compensation for permanent total disability, permanent partial disability, temporary disability (both partial and total) and death of workers. Any worker engaged in factory work is entitled to lump sum compensation under this regulation. Unlike the ESI scheme, the workers do not have to make any monetary contribution to avail this compensation. However, workers who have registered themselves under the ESI scheme cannot avail compensation benefit under the Employees Compensation Act. The lump sum compensation depends on the nature of disablement, a worker's monthly wage and age specific factors listed by this Act (refer to Table 5 in Appendix). The compensation amount for permanent total disability is obtained by multiplying 60 percent of a worker's monthly wage with the corresponding age specific factor. Lump sum compensation for death is provided at 50 percent of the worker's monthly wage multiplied by the age specific factor. However, the maximum wage limit for lump sum death compensation is Rs. 8,000.

Data and Variables

In developed countries like the US, information on job risk measures is available by industry as well as occupation. However, in India, this information is available at only industry level and by a two-digit National Industrial Classification (NIC) code. For this study, the information on job risk measures has been obtained from secondary as well as primary sources. The secondary information on the fatalities and injuries in various manufacturing industries of Ahmedabad has been collected from the Industrial Safety & Health office, Ahmedabad for a period of five years, i.e. from 2010 to 2014. This is done to smoothen any kind of sudden fluctuations in the number of deaths and injury. The two job risk variables, namely FATAL and INJURY, are estimated using information on the average number of deaths and injuries occurring in 13 types of manufacturing industries of Ahmedabad and the average employment in factories during the five-year period. The variable FATAL corresponds to fatality rate per one lakh workers while INJURY corresponds to the injury rate per one thousand workers. The estimated fatality and injury rates are presented in table 1.

Table 1: Fatality Rate and Injury Rate for Male Blue Collar Workers in Manufacturing Industries of Ahmedabad

Sr. No.	NIC (2004)	Industry	Fatality rate (p)	Injury rate (q)	No. in sample
1	15	Mfg. of Food Products and Beverages	7.49	0.74	35
2	17	Mfg. of Textile	9.17	2.29	56
3	20	Mfg. of Wood and Wood Products and Cork	22.96	0.37	19
4	21	Mfg. of Paper and Paper Products	43.71	0.95	32
5	23	Mfg. of Cock Refined Petro Products and N. Fuel	19.62	9.47	29
6	24	Mfg. of Chemicals and Chemical Products	15.4	2.69	41
7	25	Mfg. of Rubber and Plastics Products	10.21	0.91	17
8	26	Mfg. of Other Non-Metallic Mineral Products	18.31	0.47	29
9	27	Mfg. of Basic Metals	16.51	0.82	43
10	28	Mfg. of Fabricated Metal Products	12.91	0.48	37
11	29	Mfg. of Machinery and Equipment	34.41	1.4	50
12	31	Mfg. of Electrical Machinery and Apparatus	17.01	1.48	16
13	35	Mfg. of Transport Equipment	22.38	3.55	26
For the full sample			19.23	1.97	**430**

Source: Author's own calculation using secondary information from the Industrial Safety & Health office, Ahmedabad.

The manufacturing of paper and paper products (NIC 21) has the highest fatality rate while the manufacturing of food and food products (NIC 15) has the lowest rate of fatal occurrences. But injury rate is highest for manufacturing of coke and refined petroleum products (NIC 23) and lowest for manufacturing of wood and wood products (NIC 20). The average fatality rate for the selected industries is 19.23 per one lakh workers while the injury rate is 1.97 per one thousand workers. The job risk measures are matched with the workers using the two-digit NIC code. However, in this type of studies, a measurement issue may arise while matching the workers to the risk measures because all the workers in a particular industry do not face the same level of risk. For white collar workers, this problem is more serious since they have much safer work conditions and they face completely different types of risks (Garen, 1988). Since this study includes only blue collar workers in the sample, this measurement problem may not be as serious as in other studies.

This study adopts the multi-staged stratified random sampling technique. Ahmedabad district has been selected for conducting the primary survey since it has the highest number of registered factories. Male blue collar workers have been selected. According to information provided by Industrial Health and Safety office, no female worker faced any severe accident or death during the five-year period, i.e. between 2010 and 2014. Therefore, female workers are not included in the sample. The blue collar male workers are then matched with 13 selected manufacturing industries for which information was available. Roughly, one percent sample from each manufacturing industry has been chosen. The interview method has been used to collect information from the workers, who have been randomly selected from factories spread across four industrial divisions of Ahmedabad. The final sample size of this study is 430. The information on the dependent and independent variables other than the job risk measures have been obtained through primary data collection. Table 2 provides the descriptive statistics on all the variables.

Table 2: Descriptive Statistics of Variables Obtained from Primary Data

Variable	Description	Mean & Standard Deviation	Expected sign
Dependent variable			
HOURLY WAGE	After-tax hourly wage of workers	42.96 (12.72)	NA
Independent variables			
• **Risk variables**			
FATAL	Fatality rate per one lakh workers	19.26 (10.30)	Positive
INJURY	Injury rate per one thousand workers	1.97 (2.21)	Positive
• **Variables on worker's compensation**			
JOB TYPE	1= if worker's job is contractual/ temporary, 0= if work is permanent	0.739 (0.43)	Positive
TRAINING	1= if worker obtained job training in the factory where he works, 0= if worker completed job training elsewhere	0.425 (0.49)	Positive
R_i	Compensation replacement rate, $[\boldsymbol{R_i} = \frac{\boldsymbol{Benefit\ Level}}{\boldsymbol{after\ tax\ daily\ wage}}]$	0.46 (0.06)	Negative
• **Personal characteristics of worker**			
EXPERIENCE	Work experience in years	17.85 (11.15)	Positive
PRIMARY	1= If the worker has completed primary education, 0 = otherwise	0.22 (0.41)	Positive
SECONDARY	1 = If the worker has completed secondary education, 0 = otherwise	0.29 (0.45)	Positive
HS	1 = If the worker has completed higher secondary education, 0 = otherwise	0.31 (0.46)	Positive

GRADUATE	1 = If the worker is a graduate or has a college degree, 0 = otherwise	0.06 (0.23)	Positive
SC	1= if the worker belongs to the SC (Schedule Caste) Category, 0= if the worker belongs to other social class.	0.16 (0.37)	NA
MIGRANT	1= if the worker is a migrant, 0= if the worker's native is Gujarat.	0.56 (0.49)	NA
• **Job characteristics**			
WSIZE	Total number of workers in the factory where the worker is employed.	699 (1245.19)	NA
UNION	1 =If worker is a union member, 0= if he is not union member	0.07 (0.26)	Positive
PHW	1= If worker's job requires physical hard work, 0= doesn't require hard work	0.45 (0.49)	Negative
OT	1= If the worker's job requires him to work overtime, 0= otherwise	0.77 (0.41)	Positive
PHCOND	1= if the working condition is pleasant, 0= if working condition is poor	0.89 (30)	Negative
MENT	1= If worker's job requires mental work, 0= doesn't require mental work	0.47 (0.50)	Positive
DEC	1= If decision making is a part of worker's job, 0= worker doesn't need to make any decision	0.51 (0.50)	Positive
FAST	1= If worker's job requires him to work fast, 0= otherwise	0.23 (0.42)	Negative
CONTRACTOR	1 = If worker is a job contractor, 0 = otherwise	0.034 (0.18)	Positive
SUPER	1 =If the worker is a supervisor, 0= otherwise	0.07 (0.26)	Positive
FITTER	1= If the worker does fitter work, 0= otherwise	0.14 (0.35)	Positive
TECH	1= If the worker does technical work, 0= otherwise	0.06 (0.24)	Positive
ASSIST	1= If the worker is an assistant/Helper, 0= otherwise	0.12 (0.33)	Negative
DIV 1	1= If the worker belongs to a factory located in Division 1 of Ahmedabad district, 0 = otherwise	0.26 (0.44)	NA
DIV 2	1= If the worker belongs to a factory located in Division 2 of Ahmedabad district, 0 =otherwise	0.20 (0.40)	
DIV 3	1= If the worker belongs to a factory located in Division 3 of Ahmedabad district, 0 =otherwise	0.33 (0.47)	

Source: Author's calculation based on primary data collected from factory workers at Ahmedabad

The hourly wage is calculated using monthly and daily wages reported by workers in the sample. The reported wages are cross-checked with the salary record of factories. The after-tax average hourly wage of the workers in the sample is Rs 42.96. In this study, the logarithm of hourly wage is taken as the dependent variable. The independent variables comprise of the worker's personal and work characteristics. Other than this, there is another key variable, which is a measure of workers' compensation. The compensation variable is named as the compensation replacement ratio denoted as "$\mathbf{R_i}$". It is generated using the disablement benefits rates listed under the ESI Scheme (2010). Viscusi and Moore (1987) used two variables, i.e. the worker's marital status and the number of children, to adjust the benefit rates and finally obtained the replacement ratio relevant for their study. For this study, the daily benefit rates given by the ESI scheme ($\mathbf{b_i}$) and the corresponding average daily wage of workers (benefit rates are given in Table 4 in Appendix) are used to construct the compensation variable. Equation 5 shows how the replacement ratio **(R_i)** is calculated using the mean after-tax daily wage rate **w_i(1-t)** and the daily benefit rates, **b_i.**

$$R_i = \frac{b_i}{w_i\,(1-t_i)} \qquad \text{.................... (5)}$$

The replacement ratio is used as an independent variable while estimating the hedonic wage equation. Since **R_i** is derived using a worker's wage, using it directly in the hedonic wage equation (in which wage is the dependent variable) leads to the problem of endogeneity. In order to correct the endogeneity issue, the replacement ratio is first regressed on all independent variables and the predicted value of the replacement ratio, i.e. $\widehat{R_i}$obtained from it, is used as an exogenous measure of the replacement ratio.

Empirical Model

Given the information on sources of data and variables used in this study, this section lays down the empirical model of the study. The simple hedonic wage function is given by equation 6, which shows that a worker's wage is a function of his individual characteristics and other non-pecuniary job attributes.

$$LOG\,WAGE = \alpha + \beta_1 FATAL + \beta_2 INJURY + \textstyle\sum_k \gamma_k X_{ki} + \epsilon_i \qquad \text{.................... (6)}$$

X_{ki}**,** includes variables on personal characteristics like the worker's age, social class, level of education, and work characteristics like level of difficulty of a job, overtime, conditions of work, etc. The basic semi-logarithmic hedonic wage equation is estimated using the ordinary least squares (OLS) technique. However, equation (6) doesn't include the worker's compensation benefit variables. The compensation variables can be included in the basic hedonic equation either in an additive form or in an interactive form. Since including compensation variables in additive format produced insignificant results, the results of interactive terms are presented in the paper. The modified hedonic wage equation with an interactive compensation benefit variable is given by equation 7.

$$LOG\,WAGE = \alpha + \beta_1 FATAL + \beta_2 INJURY + \beta_3 INJURY \times \widehat{R_i} + \textstyle\sum_k \gamma_k X_{ki} + \epsilon_i \qquad \text{.................... (7)}$$

Estimation of the modified equation yields the compensation adjusted VSL and VSI estimates for the workers in the sample. However, the weighted least squares (WLS) method is used to estimate equation 7. A study by Ruser (1985) found that safety incentives should be greater in larger firms because of their experience rating. Therefore, the inverse of the firm size is used as a weight in the estimation of the modified hedonic wage equation.

Estimating VSL and VSI

This study assumes that on an average the workers in the sample work for 2,160 hours annually. The Factories Act (1948) says that a worker can work for 9 hours per day. They should get 12 paid holidays in the subsequent year if they work for 240 days in the current year. Therefore, the total annual work hours of 2,160 is obtained by multiplying 240 days with 9 hours per day.

The basic wage-risk trade-off for fatal risk is obtained by differentiating equation 6 with respect to fatal risk,

$$\boldsymbol{LOG\,WAGE = \alpha + \beta_1 FATAL + \beta_2 INJURY + \sum_k \gamma_k X_{ki} + \epsilon_i}$$

$$\frac{\partial w}{\partial fatal} \times \frac{1}{w} = \beta_1$$

$$or, \frac{\partial w}{\partial fatal} = \beta_1 \times w$$

Therefore,

VSL = $co - efficient\ of\ fatal\ risk\ variable \times mean\ wage \times annual\ work\ hours \times scale\ of\ fatality\ rate$

The estimated co-efficient of job risk ($\widehat{\boldsymbol{\beta_1}}$) is obtained from equation 6. This risk co-efficient is multiplied by the average hourly wage to yield the wage-risk trade-off of the workers. The trade-off is annualized by multiplying it by 2,160. The annualized trade-off corresponding to fatal risk is multiplied by one lakh to reflect the scale of fatal risk. Thus, the Value of Statistical Life is obtained as follows.

$$\boldsymbol{VSL = \widehat{\beta_1} \times (\overline{w}) \times 2160 \times 100,000}$$

In the same way, the annualized trade-off corresponding to injury risk is multiplied by 1,000 to obtain the Value of Statistical Injury (VSI).

$$\boldsymbol{VSI = \widehat{\beta_2} \times (\overline{w}) \times 2160 \times 1000}$$

Since this study has considered only the compensation for temporary job injury, the relevant compensation adjusted wage-risk trade-off for injury risk is obtained by partially differentiating equation 7 with respect to injury risk.

$$\boldsymbol{LOG\,WAGE = \alpha + \beta_1 FATAL + \beta_2 INJURY + \beta_3 INJURY \times COMP + \sum_k \gamma_k X_{ki} + \epsilon_i}$$

$$\frac{\partial w}{\partial injury} \times \frac{1}{w} = \beta_2 + \beta_{3\times} Comp$$

$$or, \frac{\partial w}{\partial injury} = (\beta_2 + \beta_{3\times} Comp) \times w$$

The annualized compensation adjusted wage-risk trade-off corresponding to injury risk is multiplied by 1,000 to obtain the Value of Statistical Injury (VSI). Therefore,

Adjusted VSI = $[(\beta_2 + \beta_{3\times} Comp) \times \overline{w}] \times 2160 \times 1000$

= [(co-efficient of injury variable + co-efficient of compensation variable × mean compensation benefit) × mean wage of the sample] × annual work hours × scale of injury rate

Estimates of Hedonic Wage Equation

Table 3 presents the results of estimation of the hedonic wage equations. In the first specification, basic VSL and VSI estimates are obtained using OLS method. The second and third specification shows the WLS estimate of hedonic wage equation that accounts for compensation for temporary disablement.

Table 3: Results of Estimation of Hedonic Wage Equation

Variables	OLS estimates	WLS estimates	
	(1)	(2)	(3)
Constant	3.195* (50.25)	3.2024 * (56.81)	3.2120* (55.97)
FATAL	0.0048 * (4.84)	0.0071 * (7.49)	0.0072* (7.53)
INJURY	0.0180 * (3.76)	0.0255 * (5.12)	0.0232* (4.41)
FATAL × $\widehat{R}_\iota$		-0.0084** (1.90)	
INJURY × $\widehat{R}_\iota$			-0.0050** (1.86)
EXP	0.0119 * (3.75)	0.0179 * (6.11)	0.0177* (6.05)
EXP^2	-0.0001* (2.23)	-0.0002* (4.51)	-0.0002* (4.42)
PRIMARY	0.1316* (3.51)	0.1078 * (3.25)	0.1058* (3.19)
SECONDARY	0.1115* (3.08)	0.0781 * (2.54)	0.0776* (2.52)
HS	0.1658* (4.65)	0.1212 * (3.83)	0.1229* (3.88)
GRADUATE	0.1629* (3.16)	0.2288 * (5.04)	0 .2279* (5.02)
SC	-0.0623* (2.36)	-0.0693 * (2.90)	-0.0695* (2.91)
MIGRANT	-0.0616* (2.86)	-0.0450 * (2.20)	-0.0463* (2.26)
UNION	0.0622*** (1.58)	0.1488 (1.51)	0.1465 (1.49)
JOBTYPE	-0.0614* (2.56)	-0.1113 * (4.38)	-0.1106* (4.35)
TRAINING	-0.0284 (1.34)	-0.0434 * (2.09)	-0.0438* (2.10)
PHW	-0.0421* (1.99)	-0.0729 * (3.53)	-0.0801* (3.88)
OT	0.0221 (0.89)	0.0567* (2.31)	0.0576* (2.35)
PHCOND	0.0253 (0.78)	-0.0663* (2.10)	-0.0716* (2.26)
MENT	0.0377** (1.85)	0.0785 * (3.99)	0.0760* (3.85)
DEC	0.0241 (1.13)	0.0578* (2.85)	0.0577* (2.85)
FAST	-0.0562* (2.42)	-0.0266 (1.16)	-0.0261 (1.14)
CONTRACTOR	0.2937* (4.99)	0.3239 * (3.86)	0.3105* (3.68)
SUPERVISOR	0.1265* (3.27)	0.1024* (2.98)	0.1050* (3.05)
FITTER	0.0984* (3.39)	0.0974 * (3.51)	0.1018* (3.64)
TECH	0.0813** (2.01)	-0.0284 (0.76)	-0.0347 (0.91)
ASSIST	-0.0991* (3.13)	-0.0847 * (2.87)	-0.0779* (2.65)
DIV 1	0.2470* (8.05)	0.2884 * (10.73)	0.2915* (10.81)
DIV 2	0.1295* (4.05)	0.1076 * (3.43)	0.1107* (3.53)
DIV 3	0.1976* (6.52)	0.1295 * (4.57)	0.1315* (4.64)
N	426	426	426
R- squared	0.5592	0.6879	0.6877
F-Statistics	18.70	31.24	31.23
VSL (in INR)	45,230,384 (45.23 million)		66,829,023 (66.82 million)
VSL obtained after inclusion of worker's compensation		30,270,943 (30.27 million)	
VSI (in INR)	1,673,542 (1.67 million)	2,369,568 (2.36 million)	
Compensation adjusted VSI			1,941,426 (1.94million)

* 1 % level of significance, ** 5 % level of significance, *** 10 % level of significance

Note: Absolute t values are given in parentheses

Source: Author's estimation based on primary data collected from factory workers at Ahmedabad.

For all the specifications, job risk variables have significant and positive association with wage, which implies that as job risk level rises, wage should rise. The basic values of statistical life and injury estimated from the first specification are INR 45.23 million and INR 1.67 million respectively. This implies that an average worker has to pay INR 452 annually from his earnings to avoid the fatal risk of 1/100,000 and INR 1,673 in order to avoid an injury risk of 1/1000. As expected, inclusion of the compensation benefit variables in hedonic wage equation significantly improves the co-efficient of fatal risk from 0.0048 in the first specification to 0.0071 in the second specification and to 0.0072 in the third specification. Similarly, it is observed that the co-efficient of injury risk increased from 0.0180 in the first specification to 0.0255 in the second and to 0.0232 in the third.

For the second specification, the co-efficient of the interaction term between compensation benefit and fatality rate indicates that in order to obtain one rupee worth of death compensation, a worker has to forego 84 paisa out of his wage. The net effect of compensation benefit for death on a worker's wage is given by the co-efficient $[0.0071-(0.0084 \times 0.46)] =0.0032$ and this is used to estimate VSL. The values of statistical life and injury estimated from second specification are INR 30.27 million and INR 2.36 million respectively. This value of statistical life is smaller compared to the basic VSL estimate because it is calculated using the co-efficient indicating the net effect of death compensation on the worker's wage. Therefore, on inclusion of an interactive term between worker's compensation and fatality rate the VSL estimate decreases while the VSI estimate increases, for the second specification. Shanmugam and Madheswaran (2011) found that their VSI estimate decreased from INR 4,876 to INR 3,286 on inclusion of an interaction term between compensation benefit and injury risk variable since their estimates are based on net effect of compensation for injury risk on wage. Therefore, a decrease in VSL estimate for specification 2 in this study can be justified on similar grounds.

For the third specification, inclusion of interactive term between compensation and injury rate improved the VSL estimate to INR 66.82 million and the VSI estimate to INR 1.94 million. The interaction variable in the third specification is significant at 5 percent level. It indicates that if the worker is provided an additional one rupee worth of injury compensation, then it leads to a 50-paisa decrease in wages. This is much higher than the estimated optimal rate of substitution between a worker's compensation benefit and his wage, which is 0.19 paisa. Thus, it can be said that the compensation levels provided to the workers in the sample are sub-optimal given the insured income levels. If high compensation benefit is provided, then it may lead to the problem of moral hazard whereby workers become less careful at work, leading to more accidents and more compensation claims. In order to avoid the moral hazard problem, the compensation benefits are kept at sub-optimal levels. The goodness of fit improved from 0.55 for the basic specification to 0.68 for the compensation adjusted specifications. Thus, 68 percent of the variations in a worker's wage can be explained by the independent variables in the compensation adjusted model.

Other variables used in the study have expected signs. Independent variables on personal characteristics, like a worker's experience and education, have significant positive influence on wage. This means that workers who are more experienced and those who have higher levels of education are paid significantly more wage compared to others. A migrant worker as well as a worker belonging to the socially backward class earns significantly lower than other workers in the sample. A union member is expected to earn more than a non-union worker. However, the result indicates that union members do not have significant influence on their wage. This may be due to the fact that only 7 percent of the workers in the sample are union members. Besides, it was observed during the primary survey that labour unions are inactive or absent in most of the factories. Workers engaged in secure jobs are observed to earn significantly higher than contractual workers. For the compensation adjusted specifications, it is observed that prior job training has a negative influence on earnings. This result is contrary to expectations since a trained worker should receive higher wage. Most of the variables on work characteristics have a significant influence on wage. Workers in the sample who have to do hard physical work are mainly engaged in loading and unloading of raw materials and finished products. The skill level required for this type of jobs is very low and therefore, these workers earn significantly less compared to the others in the sample. Pleasant conditions at work improve the productivity of workers and lead to better safety at workplace. Therefore, if the employers make the workplace safer and pleasant, they will pay lower wages in order to keep the firm's profit level same. A worker is paid significantly more for working overtime. If a worker has to take on job-related decisions and engage in mental work, he is paid higher wage compared to others. Contractors and supervisors are observed to earn more compared to assistants. Workers in all the industrial divisions earn significantly more than those in division 4.

Conclusion

For workers engaged in risky jobs, it is necessary to pay not only a wage premium but also compensation benefits if any injury or fatality occurs. Even though compensation benefits have significant influence on wages for risky jobs, it is most often excluded from the estimation of hedonic wage equation. Incorporating compensation benefit improves the trade-off between job risk variables and wage. Besides, it also yields better estimates of VSL and VSI. This study calculates the compensation benefit on the basis of the standard benefit rates provided by the Employees State Insurance Scheme (ESI), 2010 and it incorporates it in the hedonic wage equation. The results of this study show that inclusion of compensation variable raised the wage-risk trade-off for risky jobs. While the basic VSL is estimated to be INR 45.23 million, the compensation adjusted equations yielded VSL estimates of INR 30.27 million and INR 65.90 million for two specifications. On the other hand, the basic VSI estimate is INR 1.67 million while the compensation adjusted equations yielded improved VSI estimates of INR 1.94 million and INR 2.36 million respectively. It is observed from the results that if workers are provided higher compensation benefit, then they are paid lower wages. Therefore, a negative trade-off exists between these two variables. This study further examines whether the compensation levels are adequate. The results indicate that the compensation scheme for temporary disablement is sub-optimal from the insurance perspective for the workers in the sample. However, sub-optimal levels of compensation are desirable because high compensation may lead to the problem of moral hazard. This study yields many interesting results that provide an insight into the existing government schemes on workers' compensation in India. However, the results of this study can't be generalized for all the workers in India. There are many issues that could not be addressed due to paucity of information on job risks. Therefore, there is scope for improving the estimates of this study.

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Appendix

Table 4: Benefit Rates Provided under the ESI Scheme (Amendment) 2010

Sr. No	Worker's average daily wage (in Rs.)	Daily standard benefit rates (in Rs.)		Sr. No	Worker's average daily wage (in Rs.)	Daily standard benefit rates (in Rs.)
1	≤ 27	14		22	176 - 185	93
2	28 - 31	16		23	186 - 195	98
3	32 - 35	18		24	196 - 205	103
4	36- 39	20		25	206 - 215	108
5	40 - 47	24		26	216 - 225	113
6	48 - 55	28		27	226 - 235	118
7	56 - 59	30		28	236 - 249	125
8	60 - 63	32		29	250 - 259	130
9	64 - 71	36		30	260 - 269	135
10	72 - 75	38		31	270 - 279	140
11	76 - 79	40		32	280 - 289	145
12	80 - 87	44		33	290 - 299	150
13	88 - 95	48		34	300 - 309	155
14	96 - 105	53		35	310 - 319	160
15	106 - 115	58		36	320 - 329	165
16	116 - 125	63		37	330 - 339	170
17	126 - 135	68		38	340 - 349	175
18	136 - 145	73		39	350 - 359	180
19	146 - 155	78		40	360 - 369	185
20	156 - 165	83		41	370 - 379	190
21	166 - 175	88		42	380 - 389	195

Source: Employee's State Insurance (ESI) Scheme, 2010

Table 5: Age and Factors for Calculation of Compensation under Employees Compensation Act (2009 amendment)

Age	Factor	Age	Factor	Age	Factor	Age	Factor
16	228.54	29	209.92	42	178.49	55	135.56
17	227.49	30	207.98	43	175.54	56	131.95
18	226.38	31	205.95	44	172.52	57	128.33
19	225.22	32	203.85	45	169.44	58	124.7
20	224	33	201.66	46	166.29	59	121.05
21	222.71	34	199.4	47	163.07	60	117.41
22	221.37	35	197.06	48	159.8	61	113.77
23	219.95	36	194.64	49	156.47	62	110.14
24	218.47	37	192.14	50	153.09	63	106.52
25	216.91	38	189.56	51	149.67	64	102.93
26	215.28	39	186.9	52	146.2	>65	99.37
27	213.57	40	184.17	53	142.68		
28	211.79	41	181.37	54	139.13		

Source: Employees Compensation Act (2009 amendment)

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