The Value of Reduced Risk of Injury and Deaths in Pakistan using actual and perceived risk estimates

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Abstract

This study has been designed to obtain the statistical value of life and health in Pakistan by examining the compensating wage differentials among the blue collar workers of the manufacturing sector in Lahore. This is a pioneering work in Pakistan and so far there are no estimates available for the country based on compensated wage models or contingent valuation method. The results are based on the one to one interviews of 680 workers. We have estimated VSL and VSI based on actual and perceived measures. The study has estimated the Value of Statistical Life (VSL) to be between $ 122,047 (10.4 million PKR) and $435,294 (37 million PKR) per statistical life. Moreover, the Value of Statistical Injury (VSI) is within a range of $417 (35,445 PKR) and $1654 (140,590) per statistical injury. These values are low as compared to the values of developed countries; however, our results are akin with the results of many studies conducted in several developing countries including India, South Korea and Mexico. The variations in the results are due to the use of different risk measures, that is, actual and professed or perceived risk measures in alternative regression equations. The regression models are fully robust and do not suffer from any major econometric problem. The results of the study will facilitate different public and private sector agencies in the future for a better approximation of the benefits of pollution reduction and other safety measures such as traffic safety measures and medical intercessions. Furthermore, it will also provide a breeding ground for supplementary exploration and research in this area.

1. Introduction

Different safety measures adopted by governments across the globe require the estimates of willingness to pay of the people to swap wealth for a reduction in the probability of death and injury. The approximation of these trade-offs are employed in assessing the cost-benefit analysis of environmental issues, public safety measures on highways and roads, medical treatments, and many other areas. Economists term a trade-off between money and fatality risks as the Value of a Statistical Life (VSL).

The Value of Statistical Life and Limb is generally predicted using one of the three main approaches. The first is by the compensating wage differentials that workers must be paid to take riskier jobs (Viscusi and Aldy, 2003). The second approach examines other behaviors where people weigh costs against risks (Blomquist, 2004), and the third is through contingent valuation surveys where respondents report their willingness to pay (WTP) to obtain a specified reduction in mortality risks. The VSL is then obtained by dividing the WTP by the risk reduction being valued (Alberini, 2005).

However, most of these studies are conducted in developed countries and previously no such estimates based on willingness to pay (WTP) studies were available for Pakistan. A recent World Bank publication[1] had disclosed that the annual health effect of ambient air pollution in Pakistan includes 22,000 premature deaths among adults and 700 deaths among children under five. The total health cost of air pollution is estimated to be between .62 billion PKR to Rs.65 billion PKR or approximately one percent of GDP. It places the implied VSL figures to be in the range of 58 billion to Rs.61 billion PKR or less than three million per statistical life.

[1] EPA/ World Bank (2006)

Nevertheless, these estimates are less than many regional and international studies.[2]. Besides this, these estimates are based on extrapolated values from other countries, on cost of illness approach, and human capital approaches in the absence of true willingness to pay (WTP) estimates for the country.[3] Economists term such estimates as a lower bound of the premature mortality and morbidity. The absence of true estimates of VSL poses a serious problem for the policy maker in the cost-benefit analysis of different policy options.

We estimate the value of statistical life and injury in Pakistan based on compensating wage differential among the blue-collar male workers of the manufacturing sector in Lahore. We estimate the wage-risk tradeoff based on 2-digit industry level, as well as perceived measure of risk. Perceived risks are more plausible as they reflect job and work specific risks rather than industry aggregates which simply signal same level of risks for all occupations and work in a specific industrial classification. However, workers are not typically used to compute risks, this might overestimate the results.[4] To circumvent this problem we introduce two variants of the perceived fatal risk.

This is the first study of its kind in Pakistan. The results of the study shall help different agencies and research bodies for the evaluation of different safety programs. The study will also be a springboard for further exploration and research in this area.

2. Theoretical ideas

Workers while considering the job characteristics examine many pecuniary and non-pecuniary characteristics of work, such as wages, work time career path, ease and hardship of work,

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[2] See Madheswaran for estimates of VSL in India (2004)
[3] EPA/ World Bank (2006)
[4] Hammitt and Ibarraran (2006)

pension and benefits and risk of life and health. Nonetheless, as noted by Viscusi (1978a, 1978b) that job safety is expected to be one of the most important characteristics. The theory of compensating wage differentials postulates that if a job is more riskier than the other jobs and this is known to the workers, then there must be some other more valued characteristics of that job as a compensation, but if the non-monetary aspects of all the others job are the same, then the compensation should be in the from the higher wages.

The theory was originally formed by Adam Smith who explicated that "The wages of laborers vary with the ease or hardship, the cleanliness or dirtiness, the honorableness or dishonorableness of the employment." Economists have developed statistical models to realize the difference in workers' productivity and different component of job by unraveling wage-risk trade-off from other factors affecting wages. Griliches (1971), Rosen (1974, 1986), and Thaler and Rosen (1975) have reorganized this concept. The critique has been termed as the Hedonic (quality adjusted) Wage Model which tries to determine the variability in wages pertaining to different factors including job related fatal and non-fatal risks.

While considering the Hedonic Wage Model, the demand for labor is a decreasing function of the cost of employing laborers. These costs include wage, compensation, training and development, rest days, provision of safety measures, etc. Firms are willing to pay less to their workers as the cost of safety for a given level of profit increases. Given the wage risk offers, workers choose a wage- risk combination in the market offering highest wages. The supply of labor is fractionally influenced by their wage, risk preferences, besides numerous pecuniary and non pecuniary job characteristics.

The hedonic wage model can be explained with state-dependent utility functions. Let $U(w)$ represent the utility of a worker in good health earning wage w and let (w) represent the utility of an injured worker at wage *w*. More routinely workers' are paid compensation for an injury depending upon wage one was receiving. Suppose that the compensation received by the worker and its association with the wage is symbolized by the functional form of *V*(*w*), and beside this it is also supposed . beside this it is also supposed that workers favor healthy state over an injured one, that is, U (w) > V(w). Moreover, the marginal utility of income is positive. Symbolically, U´(w) > 0 V`(w) > 0. Let p be the probability of risky event. Labors select the wage-risk deal from the available alternatives. Then the expected utility of the worker can be expressed as:

$$Z = (1 - p) U (w) + pV (w). \qquad (1)$$

And the wage-risk swapping can be expressed as:

$$dw/dp = - Z_{p} / Z_{w} = U (w) - V (w)/ (1 - p) U'(w)+ p V'(w) > 0, \qquad (2)$$

Therefore, wage must increase with the increase in the degree of risk. As a result the wage-risk swap is equated to the differentiation in the utility levels of the two states by the expected marginal utility of income. We need the observed market data to study equality between these two, and for many workers, observations of a range of workers are the combination of workers' wage and risk trade-offs. Hedonic wage models trace these loci of point by workers which is determined by the demand and supply in the market. Precisely, the coefficients match to the employee's marginal willingness to accept risk, on the other hand his demand for more safety and the firm's incremental cost for the provision of increased safety demand plus the decrease in the marginal cost faced by the firm owing to more risk faced by the worker.[5]

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[5] This section is based on the meta analysis of Viscusi and Aldy (2003).

Data and Variables

For estimation of the hedonic wage equation, take home hourly wages have been used as a dependent variable. This was obtained directly from the respondents.[6] The independent variables include risk variables such as annual average fatalities per 10,000, nonfatal accident per 100 workers, human capital variables such as age, education, experience, and job characteristics such as type of permanent or temporary jobs, job related trainings compensation provided by the company in case of industrial accident etc. industrial dummy variables to obtain difference in the wage among different industrial classifications, and professional dummy variables to control for differences in the wages among different professions such as supervisor, motor operators, electricians and foreman etc.

The data pertaining to worker's fatal accident for the year 2006-2007 was compiled from the records of the Punjab Employees Social Security Institute (PESSI). The institute does not regularly publish these incidents, so the record had to be compiled manually by looking into the registers which were maintained in their main and sub offices across different parts of Lahore.[7] Ironically, even the Federal Bureau of Statistics and Punjab Bureau of Statistics do not publishes details of industrial fatal accidents.

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[6] The respondents had reported monthly wages which were annualized and then were divided by 2000 hours to obtain hourly wages. The 2000 hours is a standard annual work time and many studies including Viscusi and Aldy (2003) and Madesh (2004) had used similar wage estimates in their respective studies. The same is more or less true for Pakistan.

[7] We are especially thankful to Mr Safdar Raja and his team for helping us with the compilation of fatality data

The data pertaining to non-fatal accidents per 100 workers was compiled from the data set of the Labor Force Survey (LFS)[8] (2006). Non-fatal risks have also been used as one of the explanatory variable in this study. However, we have employed two different types of non-fatal risks. Both have been obtained from the LFS.[9] This has been done to analyze the difference in the respective Values of Life and limb. The two measures of injuries have been used in separate equations. One of such measures is the Punjab non-fatal industrial accidents among the manufacturing sector workers for the year 2006, whereas the other is the, country wise industrial non-fatal accidents for the same year.

But these fatal and non-fatal risk data are two digit[10] industrial risk averages. However, perceived fatal and non-fatal risks were elicited using Likert scales. Separate scales were used for the risk of death and the risk of injuries. These scale ranged from 1-5, where 1 represent minimal and 5 a maximal risk of receiving fatal and non-fatal accidents.[11]

However, following the work of Hammitt and Ibarraran (2006) and others, beside these two measures of perceived risks, another measure was also developed for obtaining the perceived fatal risk. A scale which ranged from 0-10 out of 10,000 was used.[12] As an example, 0/10,000

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[8] I am especially thankful to Mr.Masood Ashfaq and Mr. Tayab at PIDE, Islamabad for helping me in obtaining the LFS data set

[9] LFS is annually conducted by the Federal Beau rue of Statistics(FBS)

[10] 2-digits refers to main industrial classifications, for example 31 represent food, beverages and tobacco industries

[11] The questions were "please tick the appropriate box below indicating your perception of receiving a job related injury/ fatality in your present job in comparison to any other job you can do.

[12] The spearman's correlation between the two perceived risk measures is found to be .51 and is statistically significant result. The relationship is not too high, but the relationship is positive and significant. This shows the consistency of the workers response.

chances means no chance of risk and 10/10,000 refers to .001 chances of receiving job related fatal accidents. Verbal analogies were used in order to help the respondent answer the question.

We tried two analogies including an explanation such as numbers of hours in fourteen month which are approximately 10,000 and secondly a scenario describing the chances of receiving job related fatal injuries out of 10,000 of people doing the same job as you are doing. We only used second analogy when we realized that the first one is not helping them answer the question and the majority of them could only understand it with the second analogy.

Sampling and Primary data Collection

Multi stage sampling technique was used for data collection. At the outset, Lahore was selected as the study area because it is the second largest industrial city and is also a nearest study destination. For the interview, the blue collar male workers of the manufacturing sector who had also served in Lahore for at least a year were selected[13]. The survey was also limited to the workers of the factories registered under industrial act 1934. By this means the survey was confined to the formal sector. It was also important to confine the survey to the formal sector because of the fact that the formal sector's labor market is not distorted and the wages were determined by demand and supply.[14] Further stratified random sampling technique was adopted to draw out the representative sample. The stratification was done based on the National Industrial Codes (NIC) which has classified the industrial group in to nine industrial categories.

For determining the sample size precedent was used as many other regional and international studies have employed a sample size of more than a 1000 workers[15], hence it was

[13] This was done to ensure that interviewee knew the labor market situation and were aware of the job related risk.
[14] There was no sample selection bias because the informal markets are not fully functioning and the market is really distorted. Moreover, in the formal sector though there are minmum wage laws however, those are hard to implement and the role of unions is minimal.
[15] See madesh (2004) and Viscusi and Aldy (2003)

taken as a precedent and the sample size was set down as 1000 blue collar male workers. Interestingly, the sample size also turned out to be ten percent of the manufacturing workers in Lahore.

The factories and respondents were randomly picked up; as an example any seven to ten workers were interviewed from the concerned industrial classification. However the number of industrial unit per industrial classification and the number of respondents per factory was based on the risk categories. The reason for including more workers and factories from high risk categories was to allow the variation in the data. The risk categories were obtained from the Labor Force Survey for the year 2006.[16]

A survey was designed to collect data from the workers of the manufacturing sector. In person interviews were conducted from the blue-collar male workers. The questionnaire was pretested in a pilot study of fifty workers. The results of the pilot study were used to strategize the data collection procedure. During the said study it was observed that the industrialists were hesitant to allow their workers to be interviewed. Beside this, it was also observed on few occasions that the workers were instructed not to answer few questions. Therefore, for the final survey a three prong approach was adopted for interviewing the respondents, Firstly, by contacting the employers, secondly, by visiting the cafeterias inside industrial zones during lunch or tea time, and a third, by going to the residential compounds/villages on off days.

The survey started in April 2009, and was extended to all the parts of Lahore including industrial zones, housing colonies and the villages on the peripheries. The main industrial zones are situated on Ferozpur road, Multan roads, Quaid-e Azam industrial estate, Sundas industrial

[16] See annexure-3 for further details

estate, industries situated on Rai Wind road. Moreover, approximately, fifty five villages on the fringes of Lahore were also expedited for interviewing the workers.

But, due to deteriorating law and order situation the survey was discontinued in October, 2009. Because of this reason, six hundred and eighty respondents were interviewed which is still more than the required number, as per the sampling formula. Table 2 shows the actual number of respondent as against the target in each industrial group.

Econometric Model

The data is analyzed through the estimation of hedonic wage equations by regressing log of hourly wages on human capital variables, industrial dummy variables and occupational dummies. The hedonic wage equation is given as follows:

$$\mathbf{LnW_i = a + H_i\, ß1 + X_i ß2 + p_i\, ß3 + q_i\, ß4 + e_i} \qquad \textbf{(4)}$$

Where, LnWi is the worker i*'s* hourly wage rate in logarithmic term, *a* is a constant term, H is a vector of personal characteristic variables for the worker i*.* This include education measured as years of education, age and experience, *X* is a vector of job characteristic which comprises, training and compensation variables, six industries dummy, three profession dummy variables, a variable to denote whether the job is permanent or temporary. Di is the fatality risk associated with worker i*'s* job per 10,000 workers, and Ni is the nonfatal injury risk associated with worker i*'s* job per 100 workers, and *ei* is the random error.

The dependent variable has been measured as hourly wage rates; evidently many other studies have also used hourly wage rates. However, the choice of the functional form is an unanswered question. Different researchers have used either linear or log-linear form. Subsequent upon the Meta analysis of Viscusi and Aldy (2003), present study has made use of Box-Cox transformation to decide about the dependent variable. We estimated both the linear form and the log form of wages in the resilient Box-Cox transformation, yet it reinforced both the functional form when a log form was used and it supported none when linear form was employed.[17]

Value of Statistical Life and Value of Statistical Injury were computed using the following equations:

$$VSL = ß`3 * \bar{W} * 2000 * 10000$$

&

$$VSI = ß`4 * \bar{W} * 2000 * 100 \quad (5)$$

Where,

ß`s are the respective risk coefficients, $\bar{W}$ is the mean hourly wage rate which is multiplied with the 2000[18] annual hours of work to annualize the Value and is multiplied with the scale of the variable which is per 10,000 workers for the fatality risk variables and per 100 worker for the non-fatal risk variable.

[17] Evidently, many other researchers, for example Moore and Viscusi (1988a), and Madeshwaran (2004) have employed the same technique. Gunatilake (2003) have also suggested making use of Box-Cox technique for selecting the functional form for such studies. The theta values = 0 was accepted when we used hrwge as dependent, however, when I used lhrwge the hypotheses that theta =1 was accepted. It would be good to present the estimated parameters for Box-Cox transformation. That will make things easier to understand. .

[18] This has been done to follow a standard practice. However, there is no change in the results if we use the log of monthly wages.

Results and Discussion

The descriptive statistics along with the definition of the variables which have been used for the present analysis are in Table-3. The average hourly wage rate in log form is 3.705 (anti-log= 42PKR[19]). Average education is six years of schooling and average age is 27 years. Average experience in the present occupation is 5 years.

The 2-digit industry level fatality rate and the perceived fatality rate are almost similar with a slight variation that is 1.17 and 1.36 per 10,000 per annum. The professed fatality and non-fatality statistics measured on Likert scale reflect mean risks as perceived by workers is below average level of risk (mean risk= 3). The industry level injury averages for both Pakistan as a whole and Punjab-wise are modestly close that is, 4.14 and 3.9 per 100 workers per year respectively

The estimation results of the alternative hedonic wage models are presented in Table-4. Column 1 and 2 of the Table show the regression results based on 2- digit industry level fatal and non-fatal risk variables, whereas, column 3 and 4 are explicating the regression estimates using the perceived risk measures.

The coefficient of fatal risk in all the five models using either industry level actual risk data, or individual level perceived risk measure, is positive and statistically significant. This clearly authenticates the compensating wage differentials theory and establishes that labor markets in Pakistan do pay wage premium for higher risk. However, non-fatal risk coefficient is significant when actual risk data is used.

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[19] This was calculated at the prevailing exchange rate which was 1 US$=85PKR

The coefficients of fatal and non-fatal variables and subsequently the VSL and VSI in column one, is substantially higher as compared to the estimates in column two. Both the models include the same fatal risk variables, however, the former incorporates the country level non-fatal risks statistics, whereas the latter has used province wise risk data. But in our opinion the results of both the models are not directly comparable owing to different model specification. Nonetheless, this does points out the variation in VSL and VSI to the use of different risk measures and right hand side variable. The choice of the right hand side variables is based on the Likelihood Ratio (LR) test.

Similar variations are observed when the two variant of the perceived fatal risk variable along with the same non-fatal risk data are used. The VSL in column 4 which is based on the workers' perception measured on a scale 0-10/10,000 is considerably high not only as compared to the VSL estimates from alternative perceived fatal risk estimate in column 3, but is also higher than any other model. However, the model is also differently specified. The choice of the covariates in the entire estimated regression models is based on the LR test.

However, to check the robustness of our results, we have also estimated a model which includes all the industrial dummies except one. Column 5 is showing the results of such a regression. The regression model includes objective measure of fatal risk variable, but it does not include the injury variable. The coefficient of the risk variable is the same as in column 1.

The coefficients of the human capital variables are not sensitive to the choice of the other explanatory variables in the model. Both the age and education are showing positive and significant relationship with the hourly wage in all the estimated regression models, however, the result of the work experience is insignificant in all the estimated regression models. The results of the professional dummy variables are also robust and are showing little sign of variations. The outcome of these two variables shows that supervisors and foreman on the average earn 36% and 41% more than all other professional categories.

One of the industrial dummy variables, that is textile, has shown consistent results and it shows evidence of higher earnings of this group as compared to the base category. The results of other industrial classification are mixed and the coefficients are also changing signs in different specifications. This may be due to the multicollinerity problem, however, the results of the partial correlation do not show any sign of it.

Evidently, within one of the specified model, the coefficient results elucidate that workers of permanent status earns more on the average, whereas, workers who had received compensation for job related non-fatal accidents in the past receive low wage. Both the coefficients are statistically significant.

We have confirmed the structural stability of our regression models by restricting the estimations to 384[20] respondents as was set by the sampling formula. The results are quiet robust and there has been no considerable changes in the results of the estimated coefficient.[21]

The Value of Statistical Life and Value of Statistical Injury are shown in the Table-4. VSL based on actual risks is between $ 122,047 and $313,411. Whereas, VSL based on perceived risks is between $122,811 and $435,294. The VSL based on actual risk in column 2 and that in column 3 based on perceived risks are akin. The Value of Statistical Injury based on actual risks is within a range of $417 and $1654.

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[20] These 384 observations were randomly generated in SPSS
[21] See annexure 1 and 2 for results.

These values are smaller as compared to the VSL of many developed countries which is in the range of $4 million and $9 million, however our results are comparable with the estimates of many developing countries, including Mexico, India, South Korea, and Hong Kong.[22] Table-5 shows the comparison of the VSL and VSI for the developing countries.

Calculating VSL for Pakistan based on Prediction equation

In order to reinforce the validity of our estimates, we have also computed the Value of Statistical Life for Pakistan based on the Bowland and Beghin (2001) prediction equation which can be used to estimate the VSL for the developing countries. The equation is based on the Meta Analysis of the industrialized countries and it takes in to account the difference in risk, human capital and income between the developed and developing countries. The income elasticity estimated by the ranges from 1.52 to 2.269.[23] However, we have used the income elasticties estimated by different studies to compute Value of Life for Pakistan. Table-6[24] present the VSL based on the prediction equation. The equation provides us a range of VSL from $0.17 million to $1.2 million, nevertheless, Miller's estimated range of elasticities gives a close approximation of our reported results.

Conclusion

This is the first study of its kind in Pakistan. Previously there have been no estimates available for the country based on either compensated wage models or contingent valuation method.

[22] See Viscusi and Aldy (2003)
[23] See Brajer and Rehmatian study "From Diye to Value of Statistical Life: A Case Study of Islamic Republic of Iran".
[24] For developing this table we have taken help from e Meta Analysis of Viscusi and Aldy (2003), USEPA and World Development Indicators(WDI).

Subsequent upon the results of the estimations, the study concludes that the Compensating- wage differential does exists in the formal private sector in Pakistan and the market does compensate the workers for taking risk. Moreover, since these compensating differentials are the consequence of labor demand and supply, therefore the hypothesis that the workers are rational and they do consider risk while accepting jobs, is therefore fully validated. The study has estimated the Value of Statistical Life (VSL) to be between $ 122,047 and $435,294 per statistical life. Moreover, the Value of Statistical Injury (VSI) is within a range of $417 and $1654 per statistical injury. The variations in the results are due to the use of different risk measures, that is, actual and professed or perceived risk measures in alternative regression equations. The regression models are fully robust and do not suffer from any econometric problem. The usual econometric problems, such as Hetroscedsticity, and specifications biases have been fully taken care off. In addition to this it is also concluded that the models are structurally stable model and the results based on a sample size of 384 respondents and that of 680 respondents do not vary dramatically. These values are robust and can be used for the cost-benefit analysis (CBA) of the safety projects in Pakistan pertaining to abatement of pollution, medical intercession and highway safety measure etc. It can be also be used for settling claims on insurance companies and other court settlement cases etc. Moreover, in the context of ongoing war on terrorism, policy maker can use it for evaluating the impact assessment of different policy options. The results of the study provide a breeding ground for supplementary exploration and research in this area.

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Tables

Table 1: Sampling Frame

Details	*No of Respondents*	*Max per factory*
31Food Group	125	10
32 Textile Group	83	7
33 Wood and Furniture	125	10
34 Paper andpublishing	83	7
35 Chemical Group	83	7
36 Non Metallic	125	10
37 Metal Group	125	10
38 Fabricated Metal	125	10
39 Other	125	10

Table 2: Sample target versus the actual numbers of respondents

NIC	Type of manufacturing	Target	Per factory	Actual numbers
31	Manu.of food, beverages and tobacco	125	10 max	121
32	Manuf. Of Textile, wool and hosiery etc	83	7 max	82
33	Manuf. Of wood or wood product or furniture	125 respondents	10 max	31
34	Manuf. Of paper, paper prod. Printing publishing	83 respondents	7 max	74
35	Manuf of Chemical petroleum, coal rubber and plastic prod.	83 respondents	7 max	93
36	manuf. Non-metallic product except petroleum and coal	125 respondents	10 max	41
37	Basic metal industries	125 respondents	Do	91
38	Manuf. Fabricated metal product machinary and equipment	125 respondents	Do	116
39	Other manuf. Industries and handicraft	125 respondents	Do	30
	Total Respondents	1000		680

Table 3: Variable definitions and descriptive Statistics

Variable	*Variable Definition*	*Mean*	*Std. Dev.*
PRMNT	1 if the worker's job is permanent, 0 otherwise	0.35	0.48
LHRWG	hourly wage in PKR (in logarithm)	3.705	0.304
EDUCN	years of schooling	6.037	4.129
AAAGE	age of the respondent	27.38	7.983
FAMLZ	family size	6.544	2.791
DEPEN	No of dependents	4.46	2.275
SPEDY	1 if the worker job requires speedy work, 0 otherwise	0.73	0.44
EMPFM	Employed family members	2.11	1.201
RGRHR	Regular hours of work	8.697	1.612
EXPER	experience in years	4.842	5.893
DSTNC	Distance from the work place in minutes	31.36	20.78
UNION	1 if union member, 0 otherwise	0.0265	0.16
DCNMK	1 if the worker has to make decision, 0 therwise	0.43	0.50
TRNNG	1 if the worker is provided any kind of training, 0 otherwise	0.84	0.36
PESFAT	2-digit fatality rate compiled from the office of Punjab Employees Social Security Institute per 10,000 workers	1.17	1.27
LFSPK	2-digit injury rate of Pakistan's manufacturing worker computed from the labor force survey (LFS,2006) per 100 workers	4.14	2.3
LFSPN	Injury rate of Punjab based manufacturing worker computed from the labor force survey (LFS,2006)per 100 workers	3.9	1.88
PRFNJ	Professed/perceived injuries proportion measured on a likert scale 1-5 scale	2.26	1.14
PRFT1	Professed/perceived fatalities proportions measured on a likert scale 1-5	1.27	0.68
PRFT2	Professed/perceived fatalities rate 0-10 per 10000	1.36	2.138
TOTMP	Total no of employees	501	1108
LFINS	1 if the worker life is insured, 0 otherwise	0.08	0.29
COMPS	1 if the worker is provided compensation by the employers , 0 otherwise	0.52	0.51

WTHDM	Wealth dummy= value of the house in PKR	885126	1159938
NMSTK	1 if the worker job requires no mistake, 0 otherwise	0.15	0.37
JBNOS	1 if the worker job is very noisy, 0 otherwise	0.8	0.4
EXPOS	1 if the worker is exposed to smoke or dust, 0 otherwise	0.63	0.48
TXTDM	1 if the worker is from the Textile group, 0 otherwise	0.12	0.32
BSCMT	1 if the worker is from Basic metal group, 0 otherwise	0.13	0.34
SPORT	1 if the worker is from Sport and others group, 0 otherwise	0.04	0.2
WOOD	1 if the worker is from wood and furniture group, 0 otherwise	0.04	0.2
FOOD	1 if the worker is from the food group, 0 otherwise	0.17	0.38
PAPER	1 if the worker is from the paper group, 0 otherwise	0.10	0.31
CHEME	1 if the worker is from the chemical group, 0 otherwise	0.13	0.34
FABRI	1 if the worker is from the fabricated metal group, 0 otherwise	0.17	0.37
DSTRT	1 if the worker is from district Lahore, 0 otherwise	0.71	0.45
SUPER	1 if the worker is a supervisor, 0 otherwise	0.036	0.18
MACOP	1 if the worker is a machine operator, 0 otherwise	0.23	0.42
FORMN	1 if the worker is a foreman, 0 otherwise	0.04	0.2

Table 4: Regression results of the alternative hedonic wage equations

Variables	(1)	(2)	(3)	(4)	*(5)*
PRMNT	----	0.063***	-----	-----	------
		(0.02)			
EDUCN	0.013***	0.011***	0.015***	0.013***	0.01***
	(0.003)	(0.003)	(0.003)	(0.0028)	
AAAGE	0.009***	0.007***	0.008***	0.008***	0.03***
	(0.002)	(0.001)	(0.002)	(0.0018)	
EXPER	0.003	0.003	0.002	0.003	0.004
	(0.003)	(0.002)	(0.002)	(0.0026)	
TRNNG	0.02	-----	-----	------	-------
	(0.03)				
PESFAT	0.361***	0.141***	----	----	0.36**
	(0.105)	(0.03)			
LFSPK	0.19***	------	----	----	------
	(0.068)				
LFSPN	----	0.054***	----	----	------
		(0.02)			
PRFNJ	---	----	0.06	0.049	-------
			(0.08)	(0.0901)	
PRFT1	----	----	0.156***	------	------
			(0.06)		
PRFT2	----	----	----	0.542**	-------
				0.2408	
COMPS	----	0.08***	----	------	------
		(0.02)			
TXTDM	0.949***	0.449***	0.119***	0.169***	-------
	(0.295)	(0.095)	(0.044)	0.0504	
BSCMT	-0.39***	--	0.165***	0.22	-1.1*
	(0.13)		(0.042)	0.0558	
SPORT	---	--	--	0.219	-1.04*
				0.056	
WOOD	-----	0.062	------	----	-0.006
		(0.064)			
FOOD		0.112***	------	----	-0.15***
	------	(0.04)			
PAPER	0.11	--	0.016	0.072	-0.9**
	(0.11)		(0.041)	0.054	
CHEME	1.069***	0.338***	-0.02	0.052	0.02
	(0.37)	(0.105)	(0.03)	0.0449	
FABRI	-0.185***	0.07*	-------	0.094**	-0.2***
	(0.067)	(0.04)		0.0481	
NONMETL	--------	-------	-------	---------	-0.03
SUPER	0.401***	0.356***	0.366***	0.369***	0.35***
	(0.098)	(0.07)	(0.104)	0.0981	
MACOP	---------	---------	---------	----------	-0.01
FORMN	0.41***	0.385***	0.443***	0.427***	0.4***
	(0.084)	(0.06)	(0.08)	0.0834	
EXPERSQ	---------	---------	---------	----------	-0.00004

R^2	0.25	0.25	0.21	0.22	0.24
F	11.5	15.84	12.44	11.15	
VSL (PKR)	26,640,000	10,374,000	11,554,000	37,000,000	
VSL@85PKR/$	$313,411	$122,047	$135,811	$435,294	
VSI@85PKR/$	$1654	$470	$523	$427	

Note: The parentheses are showing robust standard errors of the estimates except for the second model. This is due to the fact that hetroscedsticity test for the second model was insignificant.

Table 5: Comparative Statistics of VSL and VSI of Developing Countries[25]

Study	**Country**	**Average income (2000 US $)**	**Average Fatal risk (per10000)**	**VSL (2000 US $)**	**VSI (2000 US $)**
Hammitt and Ibarraran	Mexico	4100	3.0	230000-310000	3000-10,000
Kim and Fishback	South Korea	8100	4.9	800,000	
Liu et al.	Taiwan	5000-6100	2.3-3.8	200,000-900,000	
Liu et al.	Taiwan	18500	5.1	700,000	50,000
Shanmugun	India	780	1.0	1,200,000-1,500,000	
Shanmugun	India	780	1.0	1,000,000-1,400,000	150,000-560,000
Shanmugun	India	780	1.0	4,100,000	350,000
Madesh	India	780	1.13	305,000-318,000	
Siebert and Wei	Hong Kong	11700	1.4	1,700,000	

25 The table has been partly developed from the study of Hammitt and Ibarraran (2006)

Table-6 VSL for Pakistan based on prediction equation using different income elasticities

Study	**Income Elasticity (a)**	**US GNI per capita (2008)**	**Pakistan per capita (2008)**	**US VSL**	**VSLpk= VSLus(GNIpk/GNIus)^{a}**
Miller	0.85	$47930	$950	$7,400,000	$264107
Miller	0.96	$47930	$950	$7,400,000	$171578
Morzek and Taylor	0.46	$47930	$950	$7,400,000	$1218723
Morzek and Taylor	0.49	$47930	$950	$7,400,000	$1083474
Viscusi and Aldy	0.52	$47930	$950	$7,400,000	$963234
Viscusi and Aldy	0.61	$47930	$950	$7,400,000	$676819

Annexure-1

Model 1 with 384 observations

Variables	Coefficients	Standard Errors
(Constant)	2.1209063	0.4838981
EDN	0.0132498	0.0034306
AGE	0.0082742	0.0019007
EXP	0.0016632	0.002618
PESFAT	**0.3477484**	**0.1046184**
LFSPK	**0.159142**	**0.0679601**
TXTDM	0.778388	0.2942034
CHME	0.943315	0.3756681
SUPR	0.3948349	0.0793876
FORMN	0.4114461	0.0822118
BSCMT	-0.4526293	0.1427629
FABRI	-0.1282835	0.0764491
TRN	0.0346173	0.0367577
PAPR	0.0440898	0.1243513

Annexure-2

Model 2 with 384 observations

Variables	Unstandardized Coefficients
(Constant)	3.034075
EDN	0.0099013
AGE	0.0065526
EXP	0.0051569
PESFAT	**0.1364673**
TXTDM	0.4804214
CHME	0.3161378
SUPR	0.2786012
FORMN	0.4301871
FABR	0.0609588
PRMNT	0.0698664
LFSPN	0.0557972
FOOD	0.1103081
WOOD	0.0825739
COMP	-0.0963853

Annexure -3 sampling frame

Details	Manuf. Of food beverage and tobacco	*Manuf. Of textile wearing apparel and leather ind.*	*Manuf. Of wood or wood product or furniture*	*Manuf. Of paper, paper prod. Printing publishing*	*Manuf of Chemical petroleum, coal rubber and plastic prod.*	*manuf. Non-metallic product except petroleum and coal*	*Basic metal industrie*
no.of injury once	20	62	26	3	3	31	1
Do	2	1	0	0	1	3	0
respondent with no injury	362	3008	364	146	185	429	39
Total respondents	384	3071	390	149	189	463	40
2+3=	22	63	26	3	4	34	1
2+3/5	0.057291667	0.02051449	0.066666667	0.020134228	0.021164021	0.073434125	0.025
7*100=	**5.7**	**2.1**	**6.7**	**2.0**	**2.1**	**7.3**	**2.5**

Explanatory note: the injury rates such as 5 and above 5 were considered as mediun high and high risk categories, whereas below it was considered as medium low and low risk categories. It was decided that 125 max respondent shall be interviewed from medium high and high risk categories and 83 respondent from medium low and low categories.