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The Value of Environment Health Risks and Wage Compensation: Evidence from Selected Industries of Punjab, Pakistan

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Abstract

The study's key objective empirically examines the compensating wage and income differential for Pakistan's workers in various risky industries. This study estimates the cost of occupational health risks in Pakistan's diverse industries. The FFL quantile-decomposition method, the hedonic wage equation, and the VSL approach investigate the factors affecting wage differentials, risky job selection, and the total health risks cost in hazardous workplace settings. The wage differentials associated with perilous workplace conditions follow a quadratic trend, demonstrating that illiterate and impoverished workers are well-informed about potentially dicey settings. However, they are compelled to work as the stagnant labor market lacks alternatives. In contrast, skilled workers are compensated for occupational health risks because of the high demand. The estimated annual cost of health risks associated with potentially dangerous occupational settings is $5 million for industrial workers and $8 million for radiographers. Firms should build a framework for reducing work-related injuries, including employee self-assessment programs, accident prevention training, anti-smoking campaigns, stress management education, ergonomic management, and nutritional awareness to reduce workplace illnesses.

Keywords: FFL Quantile Decomposition, Hedonic Wage Approach, The Value Of Health Risks, Wage Differentials Caused By Environmental Riskiness.

JEL Classification: I19, J31, J33,

1. Introduction

Numerous economies expanded due to the Industrial Revolution, which significantly impacted workers' working environment and health. The International Labor Organization (ILO) estimates[5] that 1.9 million people die yearly from occupational injuries. While 50 percent of similar occurrences go unreported in

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[5] WHO Press release, 2021. Available at
https://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_819705/lang--en/index.htm

developing nations, according to a WHO report[6], the global economy loses between 4-6 percent of its GDP yearly due to workplace health hazards. Workers suffer from health problems resulting from physical, biological, chemical, and other workplace risks in the absence of safety equipment and law enforcement of occupational health and safety standards. Additionally, 12.2 million working-age people die each year in developing countries due to work-related health problems; at the same time, more than 70 percent of workers are not compensated for occupational ailments and injuries (Ezzati et al., 2004). In developing countries, the informal sector employs more workers who are not compensated for dangerous jobs[7]. Over 72 percent of Pakistan's workforce is in the informal sector[8], which prefers to work in high-risk industries. Because the literacy rate is lower in industrial cities such as Lahore, Sialkot, Faisalabad, Kasur, Multan, and Gujranwala, people prefer to work in these industries despite the inherent danger (Syed et al., 2010).

Occasionally, these health consequences manifest immediately, while others emerge after several years of exposure to contaminated workplace settings and are detrimental to the worker's health and overall environment (Ahmad et al., 2016). Similarly, according to the Environment Protection Agency[9], employees in various industries in Pakistan are exposed to hazardous chemicals and other environmental externalities daily. Workplace conditions are hazardous to workers' health due to harmful chemicals and physical pollutants like noise, heat, light, and radiation. Although Pakistan's industrial sector uses radiation barely, radiologists and technologists are at risk of developing skin cancer, breast cancer, leukemia, skin damage, blisters, radiodermatitis, and different reproductive disorders (Brown and Rzucidlo, 2011; Parikh et al., 2017).

Although several studies[10] have documented the causes and effects of physical, chemical, biological, and other hazards confronting Pakistani workers, there is death in the literature evaluating the health costs incurred by workers due to hazardous work environments, especially by radiation. This research aims to

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[6] WHO and ILO reports, available at
https://www.who.int/news-room/fact-sheets/detail/protecting-workers'-health
https://www.ilo.org/global/about-the-ilo/mission-and-objectives/features/WCMS_075615/lang--en/index.htm
[7] WHO 2017 report, available at
https://apps.who.int/iris/bitstream/handle/10665/259671/9789241550048-eng.pdf
[8] ILO report 2018, available at
https://www.ilo.org/islamabad/areasofwork/informal-economy/lang--en/index.htm
[9] EPA Pakistan report, available at
https://environment.gov.pk/SiteImage/Misc/files/Downloads/interventions/environmentalissues/EnvironmentalConcernsPakistanScenario.pdf
[10]There is a long list of studies among leather, textile, chemicals, steel, sugar, fertilizer, cutlery, and other industries in different parts of Pakistan. For example, see (Ahsan et al., 2006) (Rehman et al., 2008) (Khan et al., 2008), (Afridiet al., 2013), (Kamal et al., 2012), (Asad et al., 2013). (Ahmad et al., 2016), (Muhammad et al., 2021) (Rai et al., 2021).

close this gap by evaluating the health costs associated with workplace pollution in Pakistan's various industries. The EPA-classified Pakistan's industries are analyzed for this purpose, whereas analysis is conducted using a well-structured and designed questionnaire due to the unavailability of data. Additionally, this research examines the factors that affect risky job selection and wage differentials caused by workplace hazards and differences in education, age, gender, experience, and other factors among Pakistan's blue, white, grey, and gold-collar workers. This study represents ground-breaking efforts to investigate the cost of radiation-related health hazards in radiographers.

The remainder of this paper is organized in the following manner. Section II discusses the theoretical foundations and conducts a literature review. Sections III and IV discuss the data and methodology used to examine the factors influencing risky job selection, wage differentials, and estimating the total health costs associated with hazardous settings. Section V summarises and clarifies the estimation findings. Finally, Section VI concludes the paper.

2. Review of Literature

The literature includes why companies endanger worker health and cause work-related diseases and injuries. In addition, the different challenges associated with work-related accidents and health hazards and the consequences of compromising worker health are discussed. The middle section of the literature review contains some econometric estimations. The conclusion provides literature-based recommendations to prevent work-related diseases and injuries and a framework for wage compensation against health hazards.

While the ILO promotes workplace safety and health, inadequate and hazardous working conditions are frequently reported, especially in developing nations. Encouraging workplace safety and health is a sound economic strategy and a fundamental human right. The critical question is why firms have been unable to establish a safe and healthy workplace. Increased competition as a result of free trade, migration, globalization, the transformation of economies into service-oriented sectors, labor market flexibility, demographic changes in the labor force, and job insecurity are the primary threats to health and safety in the workplace (Pouliakas and Theodossiou, 2013; Lavetti, 2020). The preceding logic implies that firms reduce costs, offer low wages, use outdated technologies, and provide an unhealthy work environment to keep more profit. For instance, small blue-collar firms compete with outmoded machines that generate additional noise and vibrations (Adem and Dağdeviren, 2021).

Similarly, workers in the pharmaceutical industry confront the same issue due to the indiscriminate use of chemicals and pesticides impacting agricultural labor's health. Workers in the manufacturing sector experience musculoskeletal difficulties due to repetitive physical motions, but employees in the service industry experience mental illness due to workplace bullying and harassment (Cassitto et al., 2003). On the other hand, employees' risk tolerance varies for various reasons, including economic and demographic factors and individual preferences. Within a firm, hierarchical relationships and workload both stimulate and exacerbate psychological syndromes in employees (Baeriswyl et al., 2017).

Additionally, some governments concentrate on the non-trivial costs of individual and societal wellness by establishing social security frameworks that protect employees' health and safety. According to a recent report by ILO[11], over 2.3 million workers die globally each year due to work-related accidents or illnesses; this equates to more than 6,000 fatalities daily. Approximately 340 million employees are affected by workplace accidents annually, and 160 million workers are afflicted with work-related diseases. Compared to the ILO's percent estimate, (Takala et al., 2014) evaluated the economic cost of work-related injury and accidents up to 6 percent of the world GDP.

Workers' safety and health are regulated by a complex collection of regulations that reflect multiple cost-benefit evaluations of investing in work-related health issues, assuming rational workers demand a wage premium to compensate for the risk (Viscusi, 1993; Shapiro, 1999; Caskey and Ozel, 2017). Wage-risk trade-offs are primarily evaluated using compensating wage differential (CWD) theory and hedonistic pricing. According to an early study on CWD theory, workers are compensated for working in hazardous settings (Rosen, 1986). Smith, (1776) is credited with coining the *concept of "compensating wage differential."* According to this hypothesis, market forces will ensure that industries with dangerous working conditions pay a wage premium. Sufficient studies have been conducted recently to investigate the hypothesis of compensating wage differentials for occupational risks (Lavetti, 2020; Viscusi and Masterman, 2017; Ehrenberg et al,, 2021; Guardado and Ziebarth, 2019; Strawiński and Celińska-Kopczyńska, 2019).

Empirically, the estimation of compensating wage differentials is not a novel development. Butler (1983) and Viscusi and Moore (1987) estimated the wage premium required by a worker to tolerate an additional unit of work-related

[11] ILO report 2021, *The enormous burden of poor working conditions*, available at https://www.ilo.org/moscow/areas-of-work/occupational-safety-and-health/WCMS_249278/lang--en/index.htm

risk. Although the literature supports positive compensating wage differentials for non-fatal diseases (Viscusi and Aldy, 2003; Verhaest and Adriaenssens, 2022), the premium wage against risk does not continuously transpire (Siebert and Wei, 1994; Sandy and Elliott, 2005; Wei, 2007). Cousineau et al. (1992) pioneered the estimation of compensating wage differentials for fatal and non-fatal work-related injuries separately.

Even though hedonic wage functions are the most frequently employed estimation technique for compensating wage differentials (Liu and Hammitt, 1999; Liu et al., 1997; Kim and Fishback, 1999; Siebert and Wei, 1998; Madheswaran, 2007; Akarcay and Polat, 2019). This methodology has several shortcomings. The most recognized error measures in risk factors and endogeneity between hazardous occupations and wages (Moore and Viscusi, 2014; Herrera-Araujo and Rochaix, 2020). The second is believed to be caused by aggregation bias (Lalive, 2003; Tsai et al., 2011; Lavetti and Schmutte, 2018), that if occupations or jobs vary within an industry, the aggregation problem identifies inconsistency in compensating wage differentials. *'Selectivity bias'* is another measurement error, as many workers make occupational or job preferences based on their anticipated exposure to a risk factor (Arabsheibani and Marin, 2000; Doucouliagos et al., 2012; Viscusi, 2018a). Finally, many occupational diseases are under-reported in public records (Karnon et al., 2005; Alfonso et al., 2017). Workers in blue-collar jobs confront more health hazards than white-collar workers (Viscusi, 2004; Dėdelė et al., 2019).

Thaler and Rosen (1976), Olson (1981), McNabb (1989), Viscusi (1993) and Viscusi and Aldy (2003) estimated rational workers' ceteris paribus demand for higher wages in hazardous working settings. Age differences are the primary determinant of a Worker's willingness to accept riskier occupations (Thaler and Rosen, 1976; Aldy and Viscusi, 2020). Usually, unionization creates a barrier to risk compensating wage demand due to collective bargaining (Marin and Psacharopoulos, 1982; Siebert and Wei, 1994). On the other hand, if the union has sufficient clout, it could increase the pressure for fair compensation (Knepper, 2020). The gender discrepancies in wage premium demand are murky, owing to women's preference for safe white-collar occupations (Neely, 2020).

Firms should establish a framework for reducing work-related injuries by encouraging ergonomics programs (Burgess-Limerick, 2018). Targeted prevention techniques, such as employee self-assessment and frequent monitoring of job satisfaction, can also help improve workers' health (Dembe et al., 2004; Capodaglio, 2020). However, firms should prioritize anti-smoking campaigns, education on stress, ergonomics, and nutritional awareness to prevent workplace illnesses (Cooklin et al., 2017). Training employees in accident prevention and improving the workplace environment also reduces health risks—a good training program relies on its frequency, group size, trainer credentials, and communication (Cohen et al., 1998; Hofmann et al., 2017). The institutional framework, workforce engagement, comprehensive understanding of safety hazards, organizational philosophy regarding occupational health risk, top management goals, and level of training contribute significantly to a lower accident rate and reduced health risk (Shannon et al., 1997).

In conclusion, rising competition and job insecurity are the greatest dangers to workplace health and safety. Over 2.3 million workers die annually due to work-related accidents or diseases; this translates to over 6,000 casualties daily. The economic cost of work-related injuries and accidents is around 6 percent of the global GDP. The compensatory wage difference (CWD) theory and hedonistic pricing examine wage-risk trade-offs.

3. Data Collection and Descriptive Analysis

The present research attempts to evaluate the health risks that workers exposed to hazardous working environments face. Inadequate reporting of workplace injuries, diseases, and fatalities, as well as a dearth of data on health risks, are reasons for collecting primary data from various industries using well-designed and comprehensive questionnaires from 273 workers. Data is collected from five distinct industries in Lahore, Qasoor, and Sialkot. The sample size was collected through purposeful random and stratified sampling. The current study employs the most frequently used purposeful stratified and random sampling method within a minimalist framework, enabling an investigator to generate credible results with a small sample size (30 to 50). These techniques are typically used to increase the reliability of large samples; thus, combining two or more sampling methods produces more accurate results (Nastasi et al., 2010). The sample size used in the underlying techniques is between 30 and 50; thus, data is collected from at least 50 respondents from each industry.

Due to widespread illiteracy among industrial workers, the questionnaire is translated into local languages (Urdu and Punjabi). Respondents must have at least one year of experience in their current job. Radiographers from various public hospitals are surveyed[12]. One person out of every seven is chosen randomly to minimize sample bias. Cronbach Alpha (0.749) reliability test of the questionnaire assures that the conclusions obtained through analysis and data collection

[12] Jinnah hospital, Mayo hospital, Inmol hospital, Sir Ganga raam hospital, Services hospital, Sheikh zaid hospital, Gulab devi hospital, Children hospital, General hospital, Punjab Institute of Cardiology and Social Security Hospitals.

methodologies are consistent. According to previous research Hersch (1998), Shanmugam (2001), Aldy and Viscussi (2003), Black and Kniesner (2003), Madheshwaran (2004), Hammitt and Ibarraran (2006), Kniesner et al. (2010), Viscusi (2014), Parada-Contzen (2019), the hedonic wage model incorporates variables such as human capital, job characteristics, working conditions, and perceptions of various environmental health risks.

The definition of each variable is given in Table A1 Annexure-1.

Because this analysis includes skilled and unskilled workers, the minimum monthly wage is $31.37, and the maximum is $701.45. Additionally, wages are classified into a low, a median, and a high wage quantile. Workers have an average of 8.7 years of experience. In contrast, the sample's most experienced respondent is 33 years old. According to the designation variable, 175 of the sample's 273 workers are employed temporarily. Additionally, 45.5 percent of respondents worked more than 48 to 50 hours each week, which is worrisome. A worker is not permitted to work for more than 48 hours per week, according to the Factory Act 1934[13]. This pitiful state of affairs is risky for workers, as excessive work endangers their mental and physical health. Over 45 percent of respondents reported being exposed to workplace health hazards.

3. Methodology

3.1. Probit-Type Risk-Selection Function

To what end do workers put their lives in occupational jeopardy? Is there any evidence of industry-specific differences in the selection of high-risk jobs? Do firms compensate employees for taking on riskier jobs? The probit-type risk selection function is used in this study to dig deeper into these issues. The following is the ML-estimated probit model for risk selection:

$$J_{i\theta} = a_{\theta} + \beta_{1\theta} X_{i_\theta} + \beta_{2\theta} N_{i_\theta} + \beta_{3\theta} F_{i_\theta} + \varepsilon_{i\theta} \quad (1)$$

The i^{th} worker and the θ^{th} quantile are denoted by the subscripts i and θ, respectively. Dummy variable J is an unobserved or latent continuous variable used to indicate whether a worker is involved in a dangerous job or not. X is a vector of personal and professional traits that includes information on age, gender, education levels, employment type, designation, and work experience. While various factors can impact a worker's wage, their decision to accept a dangerous job is mainly determined by their non-wage income and degree of risk aversion (Garen, 1988;

[13] For details see Pakistan Factory Act,1934 available at:
www.ilo.org/dyn/natlex/docs/WEBTEXT/35384/64903/E97PAK01.htm

Wang et al., 2016). Non-wage income from the firm is represented by vector *N*, which includes risk compensation, medical, injuries, other allowances, and life insurance. Finally, vector *F* indicates a firm's risk level, including a type of industry, hygienic workplace conditions, availability of safety protocols, equipment and training, number of accidents, work-related health risks, number of fatalities, and public perception about diseases. These factors are frequently employed as proxy measures of occupational risk (Lanoie et al., 1995; Viscusi, 2004; Viscusi and Aldy, 2007).

This research estimates the factors associated with dicey job selection at an aggregate level and then gauges the same effects for different wage quantiles. While the estimation methods developed by Blinder (1973) and Oaxaca (1973) have been widely used to investigate wage differentials, Elder et al. (2010) concluded that this technique exaggerates the role of observable characteristics. This study uses the wage-quantile approach (Firpo et al., 2009) to investigate risky jobs at different wage levels.

3.2. Firpo Fortin Leuimax's Decomposition Method Using Hedonic Wage Model

Human capital theory's early literature demonstrates that heterogeneity in productivity-related competence explains wage differentials between individuals (Schultz, 1961). While Section 3.1 enables estimation of the factors influencing the choice of a risky job, the extent to which risk premium and productivity capacities contribute to wage differentials is fairly ambiguous. Disentanglement of these components is accomplished using the "recentered influence function (RIF) and decomposition techniques" proposed by S. Firpo et al. (2018) and referred to as FFL estimations. This is an enhanced version of the Oaxaca-Blinder decomposition technique that allows for greater wage flexibility at the quantile level (Wang et al., 2016; Yokoyama et al., 2016; Alam et al., 2021).

The FFL decomposition method partitions total variation into compositional and structural effects, subdivided into the contributions of the variable(s) of interest. The FFL decomposition method uses the recentered influence function (RIF) of the dependent variable, enabling a comprehensive analysis of distributional changes. This influence function quantifies the effect of relatively minor changes on distributional statistics (S. Firpo et al., 2009; Wang et al., 2016). Estimations of the RIF regression decompose wages enable the analysis to determine whether wage differentials exist between workers or whether they receive a risk premium for riskier jobs (S. Firpo et al., 2009; Heckley et al., 2016). It is abundantly clear that the labor market in the majority of developing countries is based on non-market valuation (Solow, 1990); in such a scenario, the hedonic wage model is most appropriate (Taylor, 2003), which is

$$ln\, W_{i\theta} = a_{\theta} + \beta_{1\theta} X_{i_{\theta}} + \beta_{2\theta} N_{i_{\theta}} + \beta_{3\theta} F_{i_{\theta}} + \beta_{4\theta} \lambda_{i_{\theta}} + + \mu_{i\theta} \quad (2)$$

The vectors *X, N, and F* denote personal and professional characteristics, non-wage compensation from the firm, and the firm's risk level, respectively. In contrast, λ is the inverse mills ratio and was introduced early (Heckman, 1977). It is computed by the estimated value of the dependent variable of the *Probit-Type Risk-Selection Function* and given as

$$\lambda_{i_{\theta}} = \frac{\phi(J^*_{i\,\theta})}{1-\varphi\left(J^*_{i\,\theta}\right)} \quad (3)$$

Φ(.) and *φ(.)* are the standard normal distribution's density and cumulative density functions. The inverse Mills ratio is added to the hedonic wage model to verify robust results (see (Heim, 2007) (Dal et al., 2020).

3.3. Calculation of Value of Health Risks

While sections 3.1 and 3.2 enable us to analyze the factors influencing job selection and wage differentials associated with human capital and a risky environment, the study's ultimate goal is to estimate the total monetary value of health risks. Because the value of statistical life (VSL) technique is frequently used to determine the monetary value of health hazards, it is also used by US government policymakers (OECD, 2012; Sunstein, 2014; Viscusi, 2018b). The total value of health risks is calculated using the estimated median quantile of the variable *"exposure risks."* This variable includes a hazardous workplace environment's effect and is widely regarded as the best proxy for exposure risks (Viscusi and Aldy, 2003; Madheswaran, 2004; San and Polat, 2012; Alberini and Ščasný, 2021). The VSL equation of this research is given as

$$\Omega_i = \left(\hat{\beta}_{i(exposure\ risks)} \times \overline{W_i}\right) \times (\bar{h} \times \tau_i) \quad (4)$$

Whereas Ω_i, $\overline{W_i}$, and τ_i are the total value of health risks, mean hourly wage rate, and the number of workers in the *i*th industry, respectively. The $\bar{h}$ is the typical average annual working hours and $\bar{h} = h = 2000$.

Although the VLS approach has many econometric issues because of individual heterogeneity, estimations using revealed preference-type data are also frequently found in the literature (Kniesner and Viscusi, 2019). However, the extensive controls applied to other methodologies produce results comparable and consistent with VLS (Kniesner and Viscusi, 2019; Kniesner et al., 2012).

4. Empirical Results

4.2. Estimations from Probit-Type Risk-Selection Function

Maximum likelihood is used to estimate the parameters of the probit-type risk-selection function, as illustrated in Table 2, where the dependent variable represents a selection of risky jobs. Findings suggest that males are more likely to work in potentially hazardous workplaces than females. Radiographers contact fatal and nonfatal diseases (Boice Jr et al., 2006; Lee et al., 2015). The significance of industrial dummies reveals that radiologists face a greater risk of occupational illness than workers in the leather tannery, textile, steel, and chemical industries. Young workers are more committed to their careers and are more likely to undertake job health risks (Breslin et al., 2007). Thus, estimates indicate that young, male, and new entrants to the workforce are more likely to work in hazardous jobs. Human capital is a fundamental factor in occupational selection (Saks and Shore, 2005; Caner and Okten, 2010). The findings indicate that education levels have negative and statistically significant relationships with choosing hazardous jobs. Another proxy for human capital is being skilled, regardless of education level; the effect is incorporated in this study by the variable *"designation."* According to estimates, unskilled workers can work more environmentally hazardous jobs than skilled laborers. While permanent provides a greater sense of job security (Clark and Postel-Vinay, 2009), results demonstrate that temporarily hired workers are engaged in riskier jobs than permanent ones. Additionally, their weekly working hours exceed the minimum requirements set by the International Labor Organization.

Satisfaction with hygienic conditions and safety procedures at the workplace are proxies of risk aversion (Wang et al., 2016), and estimates indicate that workers are demotivated by inadequate safety equipment and training, resulting in workplace accidents (Madheswaran, 2007; Viscusi and Aldy, 2003). Additionally, the accident rate, the availability of firm-provided compensation, and medical benefits all play a significant role in taking on riskier work. Finally, findings predict that firms legitimately employ illiterate and unskilled workers in hazardous and temporary jobs; they do not compensate for working in a potentially dangerous environment (Viscusi, 2004).

Table 2. Probit Model Estimates

Variables	Coefficients	Standard Error	P-Value
Risky Job (Dependent Variable)			
Age	-.0380163	.0421843	0.367
Gender (Reference: Male)	-.1006897	.4411067	0.819
Level of education	-.4583672	0.1976421	0.020**
Experience	.0644092	.0539852	0.233
Industry (Reference: Radiology)			
Ind1 (leather)	-2.687589	1.006476	0.008***
Ind2 (textile)	-3.019929	0.8586019	0.000***
Ind3 (steel)	-1.896066	0. 8476151	0.025**
Ind4 (chemical)	-1.541662	0.4720811	0.010**
Salary Basis Reference			
Salary basis 1	1.007744	.4868666	0.038**
Salary basis 2	-.6472119	1.096662	0.555
Designation Reference			
Desg 1	.8038985	.2013665	0.030**
Desg 2	-.5353003	. 2775112	0.054*
Workplace Hygienic Conditions			
Reference	.1750346	0. 4208146	0.677
Hyg2	.4230148	0. 339339	0.213
Hyg3			
Safety procedures Reference			
Sp2	-.4720286	.600181	0.432
Sp3	.7409278	.3573501	0.038**
Equipment & training Reference			
ET2	-.5412895	.3241906	0.095
ET3	-.3810161	.5602999	0.496
Life insurance Reference	-.1160925	.7266588	0.873
Compensation from firm	-.8976943	.3780429	0.018**
Accidents occur in the firm	.7380133	.4262485	0.083*
weekly working hours	.059953	.0785726	0.445
Working Days Reference			
WD2 Reference WD1	.2406702	.9313572	0.796
Job Nature Reference	-1.223507	0.184442	0.000***
Medical/injury/other allowances	1.074436	0. 238732	0.025**
Constant	6.643817	4.254461	0.118
No of observations		273	
Log-likelihood		-76.333625	
LR chi2 (25)		132.32	
Prob > chi2		0.000	
Pseudo R2		0.4643	
Model correctly classified		87.55%	

Note: *, **, *** are statistically different from zero at 10%, 5%, and 1 %.

Table 3. Estimates of Hedonic Wage Equation (Dependent variable: *Log wage*)

Independent variables	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
Age	0.00782	0.01003	0.0053	0.0077	0.00481	-0.00595	-0.0045	0.02737	0.07304**
Gender	0.1639***	-0.1665***	-0.1507**	-0.1897***	-0.1943**	-0.0427	-0.12716	0.46873	0.93196**
Level of education	0.06137	0.05027	0.07059	0.0885*	0.12524**	0.11208*	0.44128***	0.61050**	0.64134**
Experience	0.02599*	0.01748	0.02732**	0.02442*	0.0229**	0.0267**	0.01264	-0.00741	-0.06321**
Industry Reference									
Ind1 (leather)	-0.10508	-0.0044	0.06123	-0.36931*	-0.19675	-0.5513**	-0.717595	-1.3908**	0.50736
Ind2 (textile)	-0.43436*	-0.2917	-0.1977	-0.29804	0.00691	-0.2734	-0.9713*	-1.4669**	0.57267
Ind3 (steel)	-0.40525*	-0.3843**	-0.2264	-0.30964	-0.1076	-0.38993	-0.4652	-1.18367*	0.47886
Ind4 (chemical)	0.03066	0.11421	0.24197	-0.00048	0.04701	-0.5764**	-1.12804**	-1.6266**	0.20189*
Salary Basis Reference									
Salary basis 1	0.04662	-0.0306	-0.0611	0.1046	-0.0986	-0.3815**	-0.9369**	-0.31767	-0.18185
Salary basis 2	0.2415	-0.4748	-0.28692	0.09362	0.061342	-0.6803**	-0.6069	0.12673	-0.0191
Designation Reference									
Desg 1	2.0389**	1.4672*	1.54728**	0.72373	-0.58583	-1.7349**	-4.05549**	-3.272434	-3.3659
Desg 2	2.12153**	1.5839**	1.74471**	1.09214*	-0.15843	-1.06504	-3.77609**	-3.697535	-3.8619
Environment Health Risk Ref (ENHR 3)									
ENHR1	0.33521**	0.29704***	0.20126	-0.0773	-0.09872	-0.0192	0.4175**	0.42191**	0.38239
ENHR2	0.07247	-0.0326	0.02414	0.03882	-0.0147	-0.0394	0.0905	-0.28173	0.05149
Occupational Risk Ref (OCR3)									
OCR1	0.02754	-0.0273	0.00334	-0.07088	0.070235	0.00911	0.078343	-0.03898	-0.05334
OCR2	-0.02436	-0.0273	-0.03974	-0.04137	0.03307	-0.03834	-0.12002*	0.33118**	0.00644
exposure-Risks	-0.0196	-0.0005	0.01884	0.02183	0.02532	-0.0138	-0.2484**	-0.08290	-0.20002
life insurance	-0.1836	-0.2156	-0.2318	0.00441	-0.08174	0.10695	-1.0368**	-0.37151	-0.6815**
Risk compensation	-0.11861*	-0.0764	-0.07146	-0.03396	0.076869	0.1302**	0.2927**	0.14310**	0.4994**
Accidents occur in firms.	0.1127671	0.08341	-0.03783	0.01454	-0.05458	0.18109**	-0.319331	-0.25399	-0.10045
Fatalities	0.00396	0.05533	0.13438	0.17566	0.33652**	0.42579**	0.30128	0.03672	-0.0427
Perception about Diseases Reference (PADR3)									
PADR1	-0.05005	-0.0214	-0.12334	0.0585	0.1602**	0.0619	0.06001	0.11140	-0.0532
PADR2	-0.03769	-0.0694	-0.03271	-0.01128	0.020545*	-0.0608**	-0.11426**	-0.0855098	-0.092872
WD2 Reference WD1	0.04099	16644	0.27315**	0.35052*	0.6783**	0.6678**	0.33641**	0.22847	0.62296
Lambda	0.34642*	0.25483*	0.29724**	0.20257	-0.04419	-0.1776	-0.5095**	-0.68893*	-0.7861*
Constant	1.2275	2.07234**	2.0375**	2.75064***	4.1702***	6.1286***	10.0141***	8.02496**	5.6998*
Observations	273	273	273	273	273	273	273	273	273
F(25, 247)	1.92	4.82	10.98	29.67	81.04	214.34	273.22	28.63	2.06
Prob > F	0.0067	0	0	0	0	0	0	0	0.0029
R Squared	0.2549	0.3646	0.4729	0.6007	0.7218	0.7933	0.8711	0.6832	0.3596

Note: *, **, *** are statistically different from zero at 10%, 5%, and 1 %. Standard errors are not given due to space limitations.

4.3. Hedonic Wage Model Estimates

The outcome of RIF regression from Equation 2 is shown in Table 3. The estimated lambda coefficient is significant in the total distribution of the hedonic wage equation, indicating that the results are robust and that selection bias exists in choosing environmentally hazardous and health-safe jobs for employees. Wages are significantly affected by the industry in which they work (Krueger and Summers, 1988; Bachmann and Frings, 2017). The findings indicate that radiographers earn more than industrial workers and perceive more significant health concerns from radiation exposure. In most estimated quantiles, environmental health risk significantly affects wages. Workers in all industries recognized that workplace hazards threatened their health. Quantile distribution estimation demonstrates that workers at both extremes of the wage scale (low and high) face hazardous working conditions. The logic underlying this phenomenon is relatively self-evident**.** Educated people gain additional financial benefits through compensatory risk allowances, but illiterate workers are compelled to labor in hazardous settings for low pay; as a result, high-wage workers in the 0.7 and 0.8 quantiles confront environmental health risks.

This investigation examines wage differentials between workers exposed to various hazards during work hours, including offensive odors, dust, heat, radiation, noise, and various chemicals. The '*occupational risk'* variable is positive and significant at 0.8 quantiles, revealing that, on average, these workers receive 33 percent more wages. The underlying reality is the same as discussed previously. The skewed sample demonstrates that a high wage compensates for occupational risk (Lavetti, 2020; R. S. Smith, 1979). Life insurance negatively and insignificantly affects workers' wages at all quantiles except 0.7 to 0.9. It demonstrates that low- and moderate-wage workers are not covered by life insurance by their employers or the government. Risk compensation significantly affects wages only for workers in the lowest most and highest four quantiles. It demonstrates that only high-wage workers receive risk compensation (Bender et al., 2006; Viscusi, 2018b). On average, female workers earn less than male workers at most quantiles. These findings are subject to selection bias in data collection, as most female workers are reluctant to respond to the questionnaire. However, the negative sign of the gender dummy at the low and middle-wage quantiles indicates that male workers prefer jobs despite their riskier and safer nature, even at low wages, to fulfill family needs (Lazear, 1998). In the local context, females are risk-averse and prefer to work in significantly safer working conditions than males (Rafiq and Shah, 2012; Shah et al., 2015; Husain et al., 2019). It is pretty self-explaining that educated workers can earn more. Hence, the estimated level of education is positive across all quantiles and enormously significant in medium to high-wage quantiles.

The results indicate that the coefficient of experience level is positive and significant at most quantiles and negative at the upper quantile. Moreover, dummies for specific industries demonstrate that leather, textile, steel, and chemical industrial workers earn less than radiology technicians. This is because of labor-intensive manufacturing industries in most developing countries.

Wages can be explained by designation. This research indicates that the designation has a significant and positive effect on wages in the first two quantiles but has a negative effect on wages in the sixth and seventh quantiles. It demonstrates that unskilled workers earn more among the low-income groups than accountants, administration officers, managers, and skilled professionals. The situation is reversed at the sixth and seventh wage quantiles and is noticeable. Managerial workers earn more than unskilled workers, given that both belong to the high-wage category. Similarly, technicians, supervisors, and skilled laborers, at the 0.7 quantiles, earn 377 percent less than white-collar and gold-collar workers. With the exogenous wage increase, the marginality between wages and designation level diminishes (Wang et al., 2016); see Table 4.

At the 6th quantile, the rate of accidents in firms has a positive and significant relationship with wages. It suggests that workers are compensated financially for the high probability of risk of an accident (Olson, 1981; Siebert and Wei, 1994; Strawiński and Celińska-Kopczyńska, 2019). In the local labor market, low-wage workers are mostly illiterate and lack protective measures; consequently, minor and severe accidents occur in firms that reduce their wages (Rafique, 2011; Khan and Haider, 2016). Similarly, the positive and significant relationship between fatalities and the average wage at the 0.5 and 0.6 quantiles indicates that risk premium wages are paid to compensate for fatalities in middle-income workers. According to estimated results, workers earned 33–42 percent more in the local labor market due to the fatal risk premium, consistent with Rafique (2011) and Shah (2016).

Workers' wages are significantly affected by their perceptions of developing diseases in their current jobs. Low perception of diseases *(PADR1)* positively and significantly affects workers' wages at the 0.5 quantiles. Simultaneously, the average perception group *(PADR2)* has a strong and significant positive relationship with wages at the 0.5 quantiles and a negative with wages at the 0.6 and 0.7 quantiles. As a result, workers earn between 6% and 11% less. It means that by working in their present jobs, they understand that they are working in extremely hazardous conditions, especially the lower-income quantile workers, who are well aware of the situation. At the same time, the middle-income level group also has a strong idea of being involved in hazardous jobs; on the other hand, the highest-income level group thinks they are already involved in the riskiest jobs. Despite the knowledge, the lower and middle-level groups are getting wages/salaries less as compared to the higher risk involved.

At the 0.3 to 0.7 quantiles, working days significantly and positively affect wages. Workers who work more than six days per week earn between 27 and 66 percent more than workers who work less than six days per week. It establishes that industrial workers in the local market work more than the ILO-mandated 40 hours per week. Local market workers in the low and medium quantiles work extra hours to increase their earnings, which is detrimental to their health (Wang et al., 2016; Majumder and Madheswaran, 2020). F-test results indicate a significant difference in wage determinants at most quantiles. Additionally, the R-squared value for each quantile is included.

Table 4. FFL Decomposition for Wage Differentials for Environmental Risks (Dependent variable: Log wage)

Independent Variables	1	2	3	4	5	6	7	8	9
Risky job	3.680	3.876	4.017	3.994	4.079	4.197	4.295	4.812	5.259
Safe Job	3.830	4.049	4.215	4.303	4.537	4.949	5.963	5.692	5.953
Composition Effect									
Personal [14]	0.122	0.201	-0.017	0.059	0.063	0.084	0.848	1.991	2.436
Employment[15]	0.590	0.283	0.874	0.535	0.572	0.787	0.969	-1.755	-1.640
Lambda (inverse mills ratio)	-0.226	-0.168	-0.335	-0.336	-0.359	-0.478	-0.312	0.567	0 .5972
Total	**0.486**	**0.316**	**0.521**	**0.258**	**0.276**	**0.393**	**1.504**	**0.802**	**1.395**
Wage structure Effect									
Personal	0.587	1.134	0.490	0.216	0.272	0.359	-0.432	3.362	4.940
Employment	-0.337	0.257	0.184	0.731	1.016	1.265	1.436	2.934	-3.765
Lambda	-0.016	0.010	-0.037	-0.026	-0.021	-0.051	-0.033	0.203	0.124
constant	-0.571	-1.544	-0.961	-0.869	-1.085	-1.214	-0.807	-6.422	-1.999
Total	**-0.336**	**-0.143**	**-0.323**	**0.051**	**0.182**	**0.359**	**0.163**	**0.077**	**-0.699**

4.4. FFL Decomposition for Wage Differentials for Environmental Risks

Table 4 illustrates the FFL decomposition of wage differentials between hazardous and safer jobs. According to past studies, workers in dangerous jobs in developing nations are either low-level wage workers who cannot negotiate with their employer for wage premiums because they have no other choice but to work in a better and safer place (Madheswaran, 2004; Rafiq et al., 2010). With the theory

[14] age, gender, education
[15] Experience, designation final, job nature, Life Insurance, Exposure to risks, working days

mentioned earlier, our estimated results indicate that low-income workers in high-risk jobs face negative wage premiums between the 0.1 and 0.3 quantiles.

Positive wage premiums for workers in safe jobs are observed between the 0.4 and 0.7 quantiles. The wage disparity follows an inverted U-shaped pattern with the wage level increment, reaching its minimum and maximum values at the 0.6 and 0.8 quantiles, respectively. A wage premium compensates workers in the highest quantile for their riskiness. The wage premium at the highest income level may be due to increased education and experience and the ability to negotiate a higher wage with an employer (Gerhart and Rynes, 1991; Donovan and Bradley, 2019).

4.5. Value of Health Risks

Equation 4 estimates the total cost of occupational health risks by setting the *'exposure risks'* variable to the median quantile. According to the Bureau of Statistics[16], Punjab's leather, textile, chemical, and steel industries employ 217,812 workers. It includes 14,064 leather, 161,306 textile, 25,875 chemical, and 16567 steel industry workers. Apart from manufacturing industries, the value of radiographers' health risks is also estimated. The estimated mean hourly wage rate for manufacturing workers is $0.46, compared to $1.30 for radiographers. The annual estimated cost of occupational health risks is $5 million for underlying manufacturing industries. Similarly, Punjab employs 122,765 radiographers[17], with an estimated annual cost of approximately $8 million for health risks to these workers.

5. Conclusions

This study significantly contributed to environmental health risk assessment in Pakistan's diverse industries. It attempts to estimate the total value of the health risks confronting blue, white, grey, and gold-collar workers, notably radiographers. While wage differentials are evaluated using the FFL decomposition model, the value of a worker's health risk is estimated using the VSL technique. Industrial employees are more susceptible to various ailments than radiologists. Most unskilled, uneducated, or lower-level workers are temporarily hired in the leather, textile, chemical, and steel industries. Additionally, it demonstrates that unskilled workers are more inclined than skilled professionals to engage in risky jobs. On the

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[16]Punjab monthly survey of industrial Production and employment , available at https://bos.gop.pk/system/files/October%20-%2021.pdf

[17] Pujab Health Statistics report 2020, available at https://bos.gop.pk/system/files/Punjab%20Health%20Statistics%202019-2020.pdf

other hand, industrial workers' job hours are the most challenging, as they work more than the ILO-required number of hours.

Occupational health risk has a significant effect on wages. While workers are informed of potential health risks during work hours, the positive relationship between potential health risks and wages is estimated. Simultaneously, the risk exposure analysis reveals that most workers confront unhealthy working conditions and deficient workplace safety measures and precautions. Both theoretically and empirically, wages are positively correlated with education and experience. Additionally, the labor market compensates industrial workers, particularly radiographers, for their riskier jobs.

The decomposition of wage differentials according to health risks reveals a quadratic trend. We estimated a negative wage premium associated with occupational health risk for low-wage group workers, but a positive wage premium is estimated for higher-wage earners. The situation demonstrates that illiterate and impoverished workers are well-informed about potentially hazardous settings. However, they are compelled to work in hazardous conditions as the labor market is stagnant and there is a lack of alternatives. In comparison, educated workers are compensated for the occupational health risks because of the high demand relatively and good negotiating skills. The estimated annual cost of health risks to industrial workers due to hazardous working conditions is $5 million, and $8 million for radiographers.

To conclude, we advocate providing safety precautions and equipment to Pakistani workers. Several training sessions and seminars should be conducted to alleviate health risks and increase awareness and proficiency with safety equipment. The government ought to give priority to regulating the informal sector. Finally, workplace safety and health legislation and EPA regulations must be implemented. There should be introductory courses for illiterate workers about the use of chemicals; chemical bottles should be labeled by their name, while cautions should be mentioned in native languages. Radiology workers should be sent on vacation, and their physical examination should be done. They should be provided lead glasses, lead aprons, lead shields, lead gloves, and thyroid protectors to avoid radiation effects.

Statement/ Declaration of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Ethics Approval

The Institutional Review Board of Forman Christian College (A Chartered University), Lahore, Pakistan, approved the study. The approval certificate reference is IRB-37/05-2017 dated 04-05-2017. The board was Chaired by Dr. Kauser Abdulla Malik, Professor and Dean of Postgraduate Studies.

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References

Adem, A., & Dağdeviren, M. (2021). A job rotation-scheduling model for blue-collar employees' hand–arm vibration levels in manufacturing firms. *Human Factors and Ergonomics in Manufacturing & Service Industries*, 31(2), 174-190.

Afridi, A. A. K., Kumar, A., & Sayani, R. (2013). Needle stick injuries–risk and preventive factors: A study among health care workers in tertiary care hospitals in Pakistan. *Global Journal of Health Science*, 5(4), 85-92.

Ahmad, I., Sattar, A., & Nawaz, A. (2016). Occupational health and safety in industries in developing world. *Gomal Journal of Medical Sciences*, 14(4), 1-6.

Ahsan, M. M., Shakoori, F. R., & Shakoori, A. R. (2006). Biochemical and hematological abnormalities in factory workers exposed to hexavalent chromium in tanneries of Kasur district. *Pakistan Journal of Zoology*, 38(3), 239-253.

AKARÇAY, A., & POLAT, S. (2019). Occupational injuries and wage differentials in Turkey. *Marmara Üniversitesi İktisadi ve İdari Bilimler Dergisi,* 41(2), 473-492.

Alam, M. J., Kloepfer, T., & Kaneko, S. (2021). Wage inequality in Bangladesh, 2000–2010: An unconditional quantile regression decomposition. *Asia-Pacific Journal of Accounting & Economics*, 28(4), 507-524.

Alberini, A., & Ščasný, M. (2021). On the validity of the estimates of the VSL from contingent valuation: Evidence from the Czech Republic. *Journal of Risk and Uncertainty*, 62(1), 55-87.

Aldy, J. E., & Viscusi, W. K. (2020). Age differences in the value of statistical life: revealed preference evidence. *Review of Environmental Economics and Policy*, 1(2), 1-16.

Alfonso, J., Bauer, A., Bensefa-Colas, L., Boman, A., Bubas, M., Constandt, L., Mahler, V., Rodilla, J.M. R., Rustemeyer, P. T., Spring, S.M., John, W. U., Wilkinson, A.M., & Giménez-Arnau. (2017). Minimum standards on prevention, diagnosis and treatment of occupational and work-related skin diseases in Europe–position paper of the COST Action StanDerm (TD 1206). *Journal of the European Academy of Dermatology and Venereology*, 31, 31-43.

Arabsheibani, G. R., & Marin, A. (2000). Stability of estimates of the compensation for Danger. *Journal of Risk and Uncertainty*, 20(3), 247-269.

Asad, R., Jubeen, S., & Iqbal, S. (2013). Effects of industrial environment on health status of workers. A case of Noon Sugar Mill Bhalwal. *Academic Research International*, 4(1), 215-223.

Bachmann, R., & Frings, H. (2017). Monopsonistic competition, low-wage labour markets, and minimum wages–An empirical analysis. *Applied Economics*, 49(51), 5268-5286.

Baeriswyl, S., Krause, A., Elfering, A., & Berset, M. (2017). How workload and coworker support relate to emotional exhaustion: The mediating role of sickness presenteeism. *International journal of stress management, 24*(S1), 52-73.

Bender, K. A., Mridha, H. A., & Peoples, J. (2006). Risk compensation for hospital workers: Evidence from relative wages of janitors. *ILR Review*, 59(2), 226-242.

Black, D. A., & Kniesner, T. J. (2003). On the measurement of job risk in hedonic wage models. *Journal of Risk and Uncertainty,* 27(3), 205-220.

Blinder, A. S. (1973). Wage discrimination: reduced form and structural estimates. *Journal of Human Resources*, 8(4), 436-455.

Boice Jr, J. D., Cohen, S. S., Mumma, M. T., Dupree Ellis, E., Eckerman, K. F., Leggett, R. W., Henderson, B. E. (2006). Mortality among radiation workers at Rocketdyne (Atomics International), 1948–1999. *Radiation Research,* 166(1), 98-115.

Breslin, F. C., Polzer, J., MacEachen, E., Morrongiello, B., & Shannon, H. (2007). Workplace injury or "part of the job"?: Towards a gendered understanding of injuries and complaints among young workers. *Social Science & Medicine*, 64(4), 782-793.

Brown, K. R., & Rzucidlo, E. (2011). Acute and chronic radiation injury. *Journal of Vascular Surgery*,53(15), 115-155.

Burgess-Limerick, R. (2018). Participatory ergonomics: evidence and implementation lessons. *Applied Ergonomics, 68,* 289–293.

Butler, R. J. (1983). *Wage and Injury Rate Response to Shifting Levels of Workers' Compensation*. ILR Press.

Caner, A., & Okten, C. (2010). Risk and career choice: Evidence from Turkey. *Economics of Education Review,* 29(6), 1060-1075.

Capodaglio, E. M. (2020). Participatory ergonomics for the reduction of musculoskeletal exposure of maintenance workers. *International Journal of Occupational Safety and Ergonomics*, 28(1), 1-11.

Caskey, J., & Ozel, N. B. (2017). Earnings expectations and employee safety. *Journal of Accounting and Economics,* 63(1), 121–141.

Cassitto, M. G., Fattorini, E., Gilioli, R., Gonik, V., Fingerhut, M. A., Kortum-Margot, E. G., & Organization, W. H. (2003). *Raising Awareness of Psychological Harassment at Work*. World Health Organization.

Clark, A., & Postel-Vinay, F. (2009). Job security and job protection. *Oxford Economic Papers,* 61(2), 207-239.

Cohen, A., & Colligan, M. J. (1998). *Assessing Occupational Safety and Health Training*. National Institute for Occupational Safety and Health.

Cooklin, A., Joss, N., Husser, E., & Oldenburg, B. (2017). Integrated approaches to occupational health and safety: A systematic review. *American Journal of Health Promotion,* 31(5), 401-412.

Cousineau, J.-M., Lacroix, R., & Girard, A. M. (1992). Occupational hazard and wage compensating differentials. *The Review of Economics and Statistics*, 74(1), 166-169.

Dal Maso, L., Basco, R., Bassetti, T., & Lattanzi, N. (2020). Family ownership and environmental performance: The mediation effect of human resource practices. *Business Strategy and the Environment*, 29(3), 1548-1562.

Dėdelė, A., Miškinytė, A., Andrušaitytė, S., & Bartkutė, Ž. (2019). Perceived stress among different occupational groups and the interaction with sedentary behaviour. *International Journal of Environmental Research and Public Health*, 16(23), 4595-4610.

Dembe, A. E., Erickson, J. B., & Delbos, R. (2004). Predictors of work-related injuries and illnesses: National survey findings. *Journal of Occupational and Environmental Hygiene,* 1(8), 542-550.

Donovan, S. A., & Bradley, D. H. (2019). Real Wage Trends, 1979 to 2018. Washington DC: Congressional Research Service.

Doucouliagos, C., Stanley, T. D., & Giles, M. (2012). Are estimates of the value of a statistical life exaggerated? *Journal of Health Economics*, 31(1), 197-206.

Ehrenberg, R. G., Smith, R. S., & Hallock, K. F. (2021). *Modern Labor Economics: Theory and Public Policy*. Routledge.

Elder, T. E., Goddeeris, J. H., & Haider, S. J. (2010). Unexplained gaps and Oaxaca–Blinder decompositions. *Labour Economics,* 17(1), 284-290.

Ezzati, M., Lopez, A. D., Rodgers, A. A., & Murray, C. J. (2004). *Comparative Quantification of Health Risks: Global and Regional Burden of Disease Attributable to Selected Major Risk Factors*. World Health Organization.

Firpo, S., Fortin, N. M., & Lemieux, T. (2009). Unconditional quantile regressions. *Econometrica,* 77(3), 953-973.

Firpo, S. P., Fortin, N. M., & Lemieux, T. (2018). Decomposing wage distributions using recentered influence function regressions. *Econometrics,* 6(2), 28.

Garen, J. (1988). Compensating wage differentials and the endogeneity of job riskiness. *The Review of Economics and Statistics,* 70(1), 9-16.

Gerhart, B., & Rynes, S. (1991). Determinants and consequences of salary negotiations by male and female MBA graduates. *Journal of Applied Psychology,* 76(2), 256-260.

Guardado, J. R., & Ziebarth, N. R. (2019). Worker investments in safety, workplace accidents, and compensating wage differentials. *International Economic Review,* 60(1), 133-155.

Hammitt, J. K., & Ibarraran, M. E. (2006). The economic value of fatal and non-fatal occupational risks in Mexico City using actuarial-and perceived-risk estimates. *Health Economics,* 15(12), 1329-1335.

Heckley, G., Gerdtham, U.-G., & Kjellsson, G. (2016). A general method for decomposing the causes of socioeconomic inequality in health. *Journal of Health Economics,* 48, 89-106.

Heckman, J. J. (1977). *Sample selection bias as a specification error*. *Econometrica,* 47(1),153-161.

Heim, B. T. (2007). The incredible shrinking elasticities married female labor supply, 1978–2002. *Journal of Human Resources,* 42(4), 881–918.

Herrera-Araujo, D., & Rochaix, L. (2020). Does the Value per Statistical Life vary with age or baseline health? Evidence from a compensating wage study in

France. *Journal of Environmental Economics and Management, 103*, 102338-102353.

Hersch, J. (1998). Compensating differentials for gender-specific job injury risks. *The American Economic Review*, 88(3), 598-607.

Hofmann, D. A., Burke, M. J., & Zohar, D. (2017). 100 years of occupational safety research: From basic protections and work analysis to a multilevel view of workplace safety and risk. *Journal of Applied Psychology,* 102(3), 375-388.

Husain Tahir, S., Shoukat, A., Mehmood, K., Latif, K., & Ateeq, A. (2019). Do women risk averse in ownership behavior: Myth or reality? *European Online Journal of Natural and Social Sciences: Proceedings,* 8(3), 24-33.

Kamal, A., Malik, R. N., Fatima, N., & Rashid, A. (2012). Chemical exposure in occupational settings and related health risks: a neglected area of research in Pakistan. *Environmental Toxicology and Pharmacology,* 34(1), 46-58.

Karnon, J., Tsuchiya, A., & Dolan, P. (2005). Developing a relativities approach to valuing the prevention of non-fatal work-related accidents and ill health. *Health Economics,* 14(11), 1103-1115.

Khan, D., Qayyum, S., Saleem, S., & Khan, F. (2008). Lead-induced oxidative stress adversely affects health of the occupational workers. *Toxicology and Industrial Health,* 24(9), 611-618.

Kim, S.-W., & Fishback, P. V. (1999). The impact of institutional change on compensating wage differentials for accident risk: South Korea, 1984–1990. *Journal of Risk and Uncertainty*, 18(3), 231–248.

Knepper, M. (2020). From the fringe to the fore: Labor unions and employee compensation. *Review of Economics and Statistics,* 102(1), 98–112.

Hofmann, D. A., Burke, M. J., & Zohar, D. (2017). 100 years of occupational safety research: From basic protections and work analysis to a multilevel view of workplace safety and risk. *Journal of Applied Psychology*, 102(3), 375.

Kniesner, T. J., Viscusi, W. K., Woock, C., & Ziliak, J. P. (2012). The value of a statistical life: Evidence from panel data. *Review of Economics and Statistics,* 94(1), 74-87.

Kniesner, T. J., Viscusi, W. K., & Ziliak, J. P. (2010). Policy relevant heterogeneity in the value of statistical life: New evidence from panel data quantile regressions. *Journal of Risk and Uncertainty,* 40(1), 15-31.

Krueger, A. B., & Summers, L. H. (1988). Efficiency wages and the inter-industry wage structure. *Econometrica: Journal of the Econometric Society*, 56(2), 259-293.

Lalive, R. (2003). Did we overestimate the value of health? *Journal of Risk and Uncertainty*, 27(2), 171–193.

Lanoie, P., Pedro, C., & Latour, R. (1995). The value of a statistical life: A comparison of two approaches. *Journal of Risk and Uncertainty,* 10(3), 235-257.

Lavetti, K. (2020). The estimation of compensating wage differentials: Lessons from the Deadliest Catch. *Journal of Business & Economic Statistics,* 38(1), 165–182.

Lazear, E. P. (1998). *Hiring Risky Workers. In Internal Labour Markets, Incentives and Employment.* Springer.

Lee, W. J., Ha, M., Hwang, S.-s., Lee, K.-M., Jin, Y.-W., Jeong, M., & Choi, K.-H. (2015). The radiologic technologists' health study in South Korea: Study design and baseline results. *International Archives of Occupational and Environmental Health*, 88(6), 759-768.

Liu, J.T., & Hammitt, J. K. (1999). Perceived risk and value of workplace safety in a developing country. *Journal of Risk Research*, 2(3), 263-275.

Liu, J.T., Hammitt, J. K., & Liu, J.L. (1997). Estimated hedonic wage function and value of life in a developing country. *Economics Letters*, 57(3), 353-358.

Madheswaran, S. (2007). Measuring the value of statistical life: estimating compensating wage differentials among workers in India. *Social Indicators Research*, 84(1), 83–96.

Majumder, A., & Madheswaran, S. (2020). Compensation for Occupational Risk and Valuation of Statistical Life. *Social Indicators Research,* 149(3), 967–989.

Marin, A., & Psacharopoulos, G. (1982). The reward for risk in the labor market: Evidence from the United Kingdom and a reconciliation with other studies. *Journal of Political Economy,* 90(4), 827-853.

McNabb, R. (1989). Compensating wage differentials: Some evidence for Britain. *Oxford Economic Papers,* 41(1), 327-338.

Moore, M. J., & Viscusi, W. K. (2014). *Compensation Mechanisms for Job Risks*. Princeton University Press.

Muhammad, N., Nafees, M., Ge, L., Khan, M. H., Bilal, M., Chan, W. P., & Lisak, G. (2021). Assessment of industrial wastewater for potentially toxic elements, human health (dermal) risks, and pollution sources: A case study of Gadoon Amazai industrial estate, Swabi, Pakistan. *Journal of Hazardous Materials,* 419, 126450-126465.

Nastasi, B. K., Hitchcock, J. H., & Brown, L. M. (2010). An inclusive framework for conceptualizing mixed methods design typologies: Moving toward fully integrated synergistic research models. *Handbook of Mixed Methods in Social & Behavioral Research,*2, 305-338.

Neely, M. T. (2020). The portfolio ideal worker: Insecurity and inequality in the new economy. *Qualitative Sociology,* 43(2), 271-296.

Olson, C. A. (1981). An analysis of wage differentials received by workers on dangerous jobs. *Journal of Human Resources,* 16(2),167-185.

Parada-Contzen, M. V. (2019). The value of a statistical life for risk-averse and risk-seeking individuals. *Risk Analysis,* 39(11), 2369-2390.

Parikh, J. R., Geise, R. A., Bluth, E. I., Bender, C. E., Sze, G., Jones, A. K., & Radiology, H. R. (2017). Potential radiation-related effects on radiologists. *American Journal of Roentgenology,* 208(3), 595-602.

Pouliakas, K., & Theodossiou, I. (2013). The economics of health and safety at work: An interdisciplinary review of the theory and policy. *Journal of Economic Surveys,* 27(1), 167-208.

Rafiq, M., & Shah, M. K. (2012). Does compensating wage differentials exist in the formal sector in Pakistan? *Sarhad Journal of Agriculture,* 28(1), 137-141.

Rafiq, M., Shah, M. K., & Nasir, M. (2010). The Value of Reduced Risk of Injury and Deaths in Pakistan—Using Actual and Perceived Risk Estimates. *The Pakistan Development Review,* 49(4), 823-837.

Rai, R., El-Zaemey, S., Dorji, N., Rai, B. D., & Fritschi, L. (2021). Exposure to occupational hazards among health care workers in low-and middle-income countries: A scoping review. *International Journal of Environmental Research and Public Health,* 18(5), 2603-2615.

Rehman, W., Zeb, A., Noor, N., & Nawaz, M. (2008). Heavy metal pollution assessment in various industries of Pakistan. *Environmental Geology,* 55(2), 353-358.

Rosen, S. (1986). The theory of equalizing differences. *Handbook of Labor Economics*, 1, 641-692.

Saks, R. E., & Shore, S. H. (2005). Risk and career choice. *The BE Journal of Economic Analysis & Policy,* 5(1), 1-15.

San, S., & Polat, Ö. (2012). Estimation of public–private wage differentials in Turkey with sample correction. *The Developing Economies*, 50(3), 285-298.

Sandy, R., & Elliott, R. F. (2005). Long-term illness and wages the impact of the risk of occupationally related long-term illness on earnings. *Journal of Human Resources*, 40(3), 744-768.

Schultz, T. W. (1961). Investment in human capital. *The American Economic Review,* 51(1), 1-17.

Shah, N., Abbas, F., Abbas, Y., Haider, S. A., Khan, Q., & Asghar, N., Ali, A. (2015). Assessment of the workplace conditions and health and safety situation in chemical and textile industries of Pakistan. *Science*, 3(6), 862-869.

Shanmugam, K. (2001). Self-selection bias in the estimates of compensating differentials for job risks in India. *Journal of Risk and Uncertainty,* 22(3), 263-275.

Shannon, H. S., Mayr, J., & Haines, T. (1997). Overview of the relationship between organizational and workplace factors and injury rates. *Safety Science*, 26(3), 201-217.

Shapiro, S. A. (1999). Occupational safety and health regulation. *Encyclopedia of Law and Economics*. Edward Elgar Publishing Limited.

Siebert, W. S., & Wei, X. (1994). Compensating wage differentials for workplace accidents: Evidence for union and nonunion workers in the UK. *Journal of Risk and Uncertainty,* 9(1), 61-76.

Siebert, W. S., & Wei, X. (1998). Wage compensation for job risks: The case of Hong Kong. *Asian Economic Journal,* 12(2), 171-181.

Smith, A. (1776). *An Inquiry Into The Nature And Causes Of The Wealth Of Nations*. W. Strahan and T. Cadell.

Smith, R. S. (1979). Compensating wage differentials and public policy: A review. *ILR Review*, 32(3), 339-352.

Solow, R. M. (1990). *The Labor Market As A Social Institution*. Blackwell.

Strawiński, P., & Celińska-Kopczyńska, D. (2019). Occupational injury risk wage premium. *Safety Science,* 118, 337-344.

Sunstein, C. R. (2014). *Valuing life*. University of Chicago Press.

Syed, M., Saleem, T., Shuja-ur-Rehman, Iqbal, M. A., Javed, F., Khan, M. B. S., & Sadiq, K. (2010). Effects of leather industry on health and recommendations for improving the situation in Pakistan. *Archives of Environmental & Occupational Health,* 65(3), 163-172.

Takala, J., Hämäläinen, P., Saarela, K. L., Yun, L. Y., Manickam, K., Jin, T. W., & Lim, S. (2014). Global estimates of the burden of injury and illness at work in 2012. *Journal of Occupational and Environmental Hygiene,* 11(5), 326-337.

Taylor, L. O. (2003). The Hedonic Method. *A Primer on Nonmarket Valuation*, 3, 331-393.

Thaler, R., & Rosen, S. (1976). The value of saving a life: Evidence from the labor market. *NBER Working Paper*, 265-302.

Tsai, W.J., Liu, J.T., & Hammitt, J. K. (2011). Aggregation biases in estimates of the value per statistical life: Evidence from longitudinal matched worker-firm data in Taiwan. *Environmental and Resource Economics,* 49(3), 425-443.

Verhaest, D., & Adriaenssens, S. (2022). Compensating wage differentials in formal and informal jobs. *Kyklos,* 75(1), 106-126.

Viscusi, W. K. (1993). The value of risks to life and health. *Journal of Economic Literature,* 31(4), 1912-1946.

Viscusi, W. K. (2004). The value of life: estimates with risks by occupation and industry. *Economic Inquiry,* 42(1), 29-48.

Viscusi, W. K. (2014). The value of individual and societal risks to life and health. *Handbook of The Economics of Risk and Uncertainty,* 1, 385-452.

Viscusi, W. K. (2018). Best estimate selection bias in the value of a statistical life. *Journal of Benefit-Cost Analysis*, 9(2), 205-246.

Viscusi, W. K. (2018). *Pricing Lives.* Princeton University Press.

Viscusi, W. K., & Aldy, J. E. (2003). The value of a statistical life: A critical review of market estimates throughout the world. *Journal of Risk and Uncertainty*, 27(1), 5-76.

Viscusi, W. K., & Aldy, J. E. (2007). Labor market estimates of the senior discount for the value of statistical life. *Journal of Environmental Economics and Management,* 53(3), 377-392.

Viscusi, W. K., & Masterman, C. (2017). Anchoring biases in international estimates of the value of a statistical life. *Journal of Risk and Uncertainty*, 54(2), 103-128.

Viscusi, W. K., & Moore, M. J. (1987). Workers' compensation: Wage effects, benefit inadequacies, and the value of health losses. *The Review of Economics and Statistics*, 69(2), 249-261.

Wang, H., Cheng, Z., & Smyth, R. (2016). Are Chinese workers compensated for occupational risk? *Journal of Industrial Relations*, 58(1), 111-130.

Wei, X. (2007). Wage compensation for job-related illness: Evidence from a matched employer and employee survey in the UK. *Journal of Risk and Uncertainty*, 34(1), 85-98.

Yokoyama, I., Kodama, N., & Higuchi, Y. (2016). *What Happened to Wage Inequality in Japan During the Last 25 Years?: Evidence from the FFL Decomposition Method*. RIETI.

Annexture-1

Table A1. Description of Variables

Variables	Description of Variables	Mean	Std. Dev
Hourly wage rate wage (PKR)	The hourly wage rate of workers. It is a continuous variable. It is also taken as the dependent variable.	109. 025	95.56
Education	It is a rank variable. it is assigned as 0= illiterate 1= less than primary 2= primary 3= less than middle 4= middle 5= less than matric 6= matric 7= FA/Fsc 8=B.A/B.Sc., 9=BS/M. A/MSc/ 10= highly educated(MS/MPhil, PhD)	3.74	3.527
Employer/ Firm name	1=leather tanneries 2=textile 3 =steel 4= chemical 5= radiology worker group 6= others	2.85	1.464
Experience	This variable shows the respondent's years in his current job.	8.733	5.9313
Nature of job	1 =full time, 2 =permanent, 3= temporary, 4= both full time and permanent.	3.53	1.036
Designation	workers' skill is labeled 1= unskilled labor 2= skilled labor 3=technician 4=skilled 5=professional clerks, account officers, Administration 6= supervisor 7=manager	2.21	1.660
Compensation from firm	This variable is ranked as 1=none 2= sometime 3=often 4= always.	1.75	1.189
ENV health risk	A rank variable.t is labeled as 1 = no risk 2 = low level of risk 3= medium risk 4= high risk 5= extreme risk	2.49	.955
Occupational risk	It is ranked as 1 = no risk 2 = low level of risk 3= medium risk 4= high risk 5= extreme risk	2.80	1.010
Exposure to odors	It is a dummy variable 1=yes, 0= no	.77	.424
Exposure to dust	A dummy variable 1=yes, 0= no	.86	.343
Exposure to heat	A dummy variable 1=yes, 0= no	.83	.378
Exposed to chemicals	A dummy variable 1=yes, 0= no	.59	.493
Exposed to noise	A dummy variable 1=yes, 0= no	.73	.445
They are exposed to X-rays/ radiations.	A dummy variable 1=yes, 0= no	.19	.390
Provision of safety equipment training.	It provides special training before workers for their safety at the workplace 1=strongly agrees 2= agree 3= none 4= disagree 5= strongly disagree.	3.19	1.091
Life insurance	A dummy variable. It was asked whether they have life insurance against the riskier job. 1=yes, 0= no	.15	.361
Compensation	It is about the provision of compensation to workers. A dummy variable. 1= yes, 0= no	.25	.435
Number of fatalities	This is about information about fatalities during working hours gathered from respondents.	.01	.120

Diseases/illness variable Respondent	This variable contained information about respondents' illnesses during a year due to workplace conditions from a given list of diseases in the table. Dummy variables used for all diseases	.90	.305
Diseases/illness variable coworkers	This variable concerns co-workers' illness during a year due to workplace conditions gathered from respondents from a list of diseases in the table. Dummy variables used for all diseases	.62	.487
Risk Perception of injuries & disease.	It is ranked as 1=much less risky 2= less than average risky 3= Average risky 4=high risk 5= much more risky	2.97	1.104