Valuing Workplace Risks in Thailand: Insights into the Value of Statistical Life and Injury

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ABSTRACT

Promoting safe working environments is crucial to achieving Sustainable Development Goal (SDG) 8. However, progress in Thailand has been hindered by persistently high rates of workplace fatalities and injuries. Estimating their economic cost is essential for designing effective policies. This study uses national labor force survey data and workplace risk information from 2014 to 2021 to estimate the Value of a Statistical Life (VSL), the Value of a Statistical Injury (VSI), and the human cost of occupational risks in Thailand. It provides the first comprehensive VSL and VSI estimates for the country, addressing endogeneity and selection bias while considering both fatal and non-fatal risks. Using a hedonic log-wage model, the 2021 VSL and VSI averaged USD 2,015,693.92 and USD 697,579.49 (PPP), respectively. The results reveal disparities: male and non-manual workers had higher values than female and manual workers, while older workers and those in Bangkok had the highest estimates. Notably, injuries imposed a greater economic burden than fatalities, as reflected in VSI values. These findings underscore the need to reassess Thailand's compensation structures and safety regulations to better reflect the true costs of occupational hazards.

Keywords: value of statistical life, value of statistical injury, fatal risks, non-fatal risks; decent workplace

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Background and Significance of the Research Problem

Promoting safe working environments is a key target of achieving Sustainable Development Goal (SDG) 8, which advocates for inclusive and sustainable economic growth, full employment, and decent work for all (United Nations, 2015). Beyond social justice, workplace safety is an economic imperative, as occupational hazards impose significant human and financial costs. Estimating these costs is essential for designing effective safety policies.

Among the methods for valuing the economic value of loss of life, the value of a statistical life (VSL) has been widely used in the economic literature (e.g., Viscusi, 1993; Freeman, 2003; Field & Field, 2008; Mardones & Riquelme, 2018; Cao et al., 2023; Silverman, 2024). Theoretically, VSL quantifies how individuals value reductions in mortality risks by assessing their willingness to pay (WTP) to lower such risks or their willingness to accept (WTA) compensation for increased mortality risk (Viscusi & Aldy, 2003; St-Amour, 2024). In addition to VSL, the value of a statistical injury (VSI) represents how much an individual is willing to pay to reduce non-fatal risks or accept as compensation for increased injury risk (e.g., Viscusi & Aldy, 2003).

Specifically, VSL and VSI provide important insights into how individuals trade off income for risk reduction, offering policymakers a robust framework for evaluating the benefits of safety regulations, compensation policies, and investments in accident prevention. Previous studies have shown that differences in VSL and VSI are influenced by factors such as gender, age, occupation, and geographical region, reflecting variations in risk perception and labor market conditions across different demographic groups (Guardado & Ziebarth, 2019).

Despite extensive research on VSL and VSI capturing both fatal and non-fatal risks in developed countries (e.g., Viscusi & Aldy, 2003; Kniesner et al., 2012), studies in developing countries remain limited. Previous studies have attempted to bridge this gap by estimating VSL in developing countries, such as Chile (Mardones & Riquelme, 2018), China (Cao et al., 2023), Malaysia (Yusof et al., 2013), and Thailand (Witvorapong & Komonpaisarn, 2019), but they do not estimate VSI capturing non-fatal risks, limiting their applicability to comprehensive workplace safety policies. Additionally, many prior studies estimating the VSL and VSI rely on the ordinary least square (OLS) estimation, which may face with selection bias and endogeneity problems in wage-risk trade-offs.

In Thailand, studies estimating VSL and VSI are very limited although Thailand has faced the problem of safe working environments resulting in the lack of information for guiding cost-benefit analyses of public policies aimed at reducing mortality and injury risks. According to the Office of the Workmen’s Compensation Fund (WCF), workplace fatalities rose from 575 cases in

2015 to 610 cases in 2023. In 2020, Thailand ranked 13th globally in occupational fatality rate (International Labour Organization [ILO], 2024). On the other hand, the number of workplace injuries slightly decreased from 95,099 cases in 2015 to 80,899 cases in 2023. The number of workplace deaths and injuries surged after the COVID-19 pandemic in 2020. According to the ILO (2024), Thailand ranked 32nd worldwide for the highest rate of non-fatal occupational injuries per 100,000 workers in 2020. Against this backdrop, this study seeks to address the following research questions: (1) What is the monetary value of reducing fatal risks, as measured by the Value of a Statistical Life (VSL), in the Thai labor market? (2) What is the value of reducing non-fatal risks, as captured by the Value of a Statistical Injury (VSI)? and (3) How can these estimates inform public policy in Thailand and other developing countries seeking to improve workplace safety?

Research Objectives

This study aims to examine both fatal and non-fatal risks by estimating VSL and VSI, using Thailand as a case study for developing countries. It also conducts detailed subgroup analyses by gender, age, occupation, and region to provide a deeper understanding of risk compensation mechanisms in Thailand's labor market. Finally, we attempted to apply estimated VSL and VSI to quantify the economic costs of work-related deaths and injuries across various subgroups.

Scope of Research

The analysis uses repeated cross-sectional data from nationally representative quarterly labor force survey and workplace death and injury statistics from 2014-2021. The Heckman selection model and instrumental variables (IV) estimation (Heckman, 1979) are employed to correct for selection bias and endogeneity problems in wage-risk trade-offs allowing for more robust estimation as suggested by Kniesner et al. (2012) and Sun et al. (2018).

Literature Review

Studies estimating the VSL and VSI across countries employ diverse methodologies to examine how workers trade income for risk reduction. While most existing research focuses on estimating VSL in developed countries, relatively few studies have examined VSI or provided VSL estimates for developing or emerging economies (Viscusi & Aldy, 2003). In the U.S., Kniesner et al. (2012) used hedonic wage equations and panel data (1993–2001) to address measurement error, endogeneity, and heterogeneity, estimating VSL between $7–12 million. In Southeast Asia, methods vary more widely. Cameron et al. (2010) applied OLS to interview data in Cambodia, estimating VSL at $1.47 million (PPP). Mon et al. (2019) used the structural equation modeling (SEM) in Myanmar, estimating VSL between $180,443–$339,013. In Malaysia, Yusof et al. (2013) used conjoint analysis with logistic regression to estimate VSL at $1.21–$1.42 million. Hoon and Lim (2007) used the contingent valuation method (CVM) in Singapore, estimating VSL at S$850,000–2.05 million. Nguyen et al. (2011) applied CVM in Laos and Vietnam, estimating VSL at $15,853–47,898 in Laos and $65,726–209,660 in Vietnam. Outside the Southeast Asian context, Cao et al. (2023) applied CVM in six Chinese cities, reporting VSL of $689,659.

Fewer studies in developing contexts have used the hedonic wage approach. Witvorapong and Komonpaisarn (2019) applied OLS and quantile regression on 2012–2014 data, estimating VSLs between $660,000 and $1.21 million (PPP), though their method may still suffer from endogeneity and selection bias. Mardones and Riquelme (2018) addressed these issues in Chile using 2SLS and Heckman 2SLS, estimating a VSL of $3.7 million with instruments related to household dependency and firm size composition. These studies highlight that VSL estimates vary due to both methodological and contextual differences. Yet in Thailand, research remains limited. Most studies have not addressed sample selection bias (Kniesner et al., 2012; Sun et al., 2018), and VSI remains largely neglected despite its policy relevance.

This study addresses these gaps by applying a Heckman selection model to control for sample selection bias and by estimating both VSL and VSI using quarterly repeated cross-sectional data from the Thai Labor Force Survey (2014-2021). Subgroup analyses by gender, age, occupation, and region are also conducted to capture heterogeneity in risk-income trade-offs—a critical but underexplored issue in Thailand. Unlike Witvorapong and Komonpaisarn (2019), who used only third-quarter data, this study incorporates all four quarters to reduce seasonal bias. This is particularly important in sectors such as agriculture, construction, and tourism, where risk and labor demand fluctuate seasonally, potentially distorting annualized risk valuations.

Research Methodology

The Theoretical Foundation

VSL and VSI are key economic metrics for valuing reductions in mortality and injury risks, widely used in cost-benefit analyses (Viscusi & Aldy, 2003; Viscusi & Gentry, 2015). These values are typically estimated using two approaches: the human capital method, which calculates lost future income due to death or injury (Ashenfelter, 2006), and the individual preference method, including hedonic wage analysis, which infers risk valuation from wage differences in hazardous jobs (Kaplow, 2005). This study employs data from Thailand's Labor Force Survey (2014–2021) and the Workmen's Compensation Fund, despite structural mismatches in coverage, frequency, and classification. To harmonize these datasets, TSIC-2009 industry codes from the LFS were aligned with the WCF's classifications using the ISCO framework at the most detailed level possible, enabling robust econometric analysis of individual-level mortality risk variation.

Methodology

The estimation of VSL and VSI is rooted in economic theories of compensating wage differentials and individual risk preferences. The hedonic wage method (HWM) is the most widely used approach for estimating VSL and VSI, as it assumes that workers accept a wage premium for jobs with higher risk levels (Bockstael & McConnell, 2007). This method has been extensively applied in developed countries (Viscusi & Aldy, 2003) and has been adapted to study labor markets in emerging economies (Mardones & Riquelme, 2018; Cao et al., 2023). However, its application in Thailand remains limited, necessitating further investigation into wage–risk trade-offs in the country.

This study applies the HWM to estimate VSL and VSI in Thailand, based on the theory that wage differentials compensate for job-related risks. Using the Box-Cox transformation, the optimal functional form is identified as log-linear, with a transformation parameter of -0.03. This transformation improves model accuracy by better aligning wage data with real labor market conditions. The general model is as follows:

$$\ln(w_{it}) = a + Hb + Jc + Gd + \beta_1 r_{it} + \beta_2 p_{it} + e_{it} \tag{1}$$

The dependent variable is the natural logarithm of the inflation-adjusted annual wage of individual i at time t. H_{it} corresponds to the vector of a respondent's personal characteristics (i.e., gender, age, education level, and status of as a head of household). J_{it} denotes the vector of work-related characteristics (i.e., job category, industry type, and working hours). G_{it} comprises the location and time characteristics (i.e., provinces, areas, years, and quarters) to capture spatial and temporal effects and enhance the estimation accuracy by mitigating the potential influence of omitted variables. r_{it} signifies the fatal risks faced by individual i at time t, which are derived from the occupation in which they work. These risks are calculated as the ratio of fatalities to 1,000 workers in occupation j for each quarter. Similarly, p_{it} represents the non-fatal risks encountered by individual i at time t based on their occupation, and this is calculated as the ratio of injuries to 1,000 workers in occupation j for each quarter. The coefficients of interest are β_1 and β_2, which represent the compensating wage differentials due to fatal and non-fatal risks, and they serve as the foundation for calculating the VSL and the VSI, respectively. The specification of both the dependent and independent variables follows prior literature, including Witvorapong and Komonpaisarn (2019) and Parada-Contzen, Riquelme-Won, and Vasquez-Lavin (2012), who used occupation-level risk as a proxy for individual exposure.

However, OLS estimates from Equation (1) may be biased due to two main issues: 1) missing data on annual income, leading to a selection bias, and 2) an endogeneity from unobservable individual or employer-level factors that influence both risk and wages. For instance, risk-aware workers may negotiate higher wages or avoid risky jobs, while safety-conscious firms may invest in risk reduction without adjusting wages. These unobservable factors distort the estimated relationship between wages and risks, potentially biasing VSL/VSI—e.g., risk-seeking workers accepting low pay for dangerous jobs can lead to downward-biased VSL.

This current study uses the Heckman two-stage least squares (Heckman 2SLS) to address these issues. This approach combines Heckman's two-step model (Heckman, 1979) to correct for sample selection bias and the 2SLS method to mitigate endogeneity arising from unobservables. Instrumental variables reflecting perceived occupational risks are used to satisfy identification conditions. The Heckman 2SLS involves two stages as follows:

Step 1: Estimation of the probit model and calculation of the Mills ratio.

In the first step, we estimate a probit model with robust standard errors to account for heteroskedasticity and address both selection bias from missing income data and the endogeneity of fatal and non-fatal risk variables. Observations are weighted to reflect the survey design. The binary dependent variable (bi_lnwage) indicates whether an individual reports wages/an annual income $[\ln(w_{it})]$. The probit model is specified as follows:

$$P(\text{b\_lnwage} = 1) = \Phi(a + Hb + Jc + Gd + \beta_1 r_{it} + \beta_2 p_{it} + S\alpha + T\eta) + \varepsilon_{it} \tag{2}$$

where $P(\text{b\_lnwage} = 1)$ is the probability of an individual reporting a wage;

$\Phi(\cdot)$ denotes the cumulative distribution function of the standard normal distribution;

r_{it} and P_{it} are key endogenous variables of interest (i.e., fatality risk and non-fatality risk);

H_{it}, J_{it}, and G_{it} represent vectors of control variables capturing a respondent's personal characteristics, work-related characteristics, and location and time characteristics, respectively, as stated previously.

S denotes a vector of instrumental variables used to address endogeneity in fatal and non-fatal risk estimates. This study uses marital status and firm size (number of employees) as instruments, following Angrist & Krueger (2001), Viscusi & Aldy (2003), and St-Amour (2024). These variables are associated with perceived workplace risk but are not directly related to wages. Marital status influences individual risk preferences, while firm size correlates with accident rates and reflects bargaining power in smaller firms, which may offer limited wage flexibility.

T represents variables influencing the probability that wages are observed. Consistent with prior literature, the number of household members is used to address sample selection bias. Larger households often face higher living costs, encouraging labor force participation, and benefit from broader social networks that improve employment access—a phenomenon referred to as the social capital effect.

Following the estimation of the probit, we then generate the linear prediction ($\widehat{P}$) and calculate the inverse Mills ratio (λ) to correct the selection bias. The inverse Mills ratio is computed as follows:

$$\lambda = \frac{\phi(\widehat{P})}{\Phi(\widehat{P})} \tag{3}$$

$\phi(\cdot)$ denotes the probability density function of the standard normal distribution; $\Phi(\cdot)$ is the cumulative distribution function of the standard normal distribution; $\widehat{P}$ is the predicted value from the probit model.

Step 2: Estimation of the 2SLS with the inverse Mills ratio.

In the second step, we employ a 2SLS regression to address the endogeneity problem of the fatal and non-fatal risk variables (r_{it} and P_{it}). At the same time, we add the estimated inverse Mills ratio (λ) in this step to correct for selection bias from the unobserved wage problem. The 2SLS regression model is specified as follows:

$$\ln(w_{it}) = a + Hb + Jc + Gd + \beta_1\hat{r}_{it} + \beta_2\hat{p}_{it} + \delta\lambda + e_{it} \tag{4}$$

where $\ln(w_{it})$ is a dependent variable representing the natural logarithm of wages; $\hat{r}_{it}$ and $\hat{p}_{it}$ are the predicted endogenous fatal risk and non-fatal risk; H_{it}, J_{it}, and G_{it} represent vectors of control variables, as in the probit model; λ is the inverse Mills ratio from the first step.

After the model estimation, we conducted various diagnostic tests to validate our instruments and check for the robustness of our results. These diagnostics included tests for the relevance of the instruments and the overall fit of the model. After estimating the parameters in a regression, it was possible to estimate the VSL and VSI for Thailand with the following equations:

$$\mathrm{VSL} = \beta_1 \times \text{annual wage} \times 1{,}000 \tag{5}$$

$$\mathrm{VSI} = \beta_2 \times \text{annual wage} \times 1{,}000 \tag{6}$$

To quantify the VSL and VSI per worker, we multiplied the estimates in equations (5) and (6) by 1,000, since the coefficients β_1 and β_2 in equations (1) and (2) represent the effects of fatal and non-fatal risks, respectively, which were expressed as the number of fatalities and injuries per 1,000 workers. This convention is consistent with previous studies such as Witvorapong and Komonpaisarn (2019).

Instrumental Variables and Identification Strategy

For an instrument to be valid, it must satisfy two key conditions: 1) Relevance – The instrument must be strongly correlated with the endogenous variables. Firm size affects job risk exposure as larger firms generally have better safety protocols and offer different compensation structures. Marital status influences risk preferences, as married individuals may choose safer jobs or require higher risk premiums; and 2) Exogeneity – The instrument must not be correlated with the error term in the wage equation. Firm size and marital status are unlikely to directly determine wages except through their influence on job risk exposure, making them suitable IV candidates. To verify the strength and validity of these IVs, we conduct standard diagnostic tests including the underidentification test, weak instrument test, and overidentification test (Kleibergen and Paap, 2006; Stock and Yogo, 2005). The following section presents the IV estimation results.

Results

Descriptive Statistics

Table 1 presents population-weighted descriptive statistics from 2014 to 2021. The average annual wage during this period was 191,764.91 THB, equivalent to $15,617.05 (PPP) in 2021 based on World Bank conversion factors.

Fatal job-related risks averaged 0.016 cases per 1,000 workers, remaining stable through 2020 before rising to 0.020 cases per 1,000 workers in 2021. Non-fatal injuries averaged 2.340 cases per 1,000 workers, peaking at 2.753 cases per 1,000 workers in 2014, declining thereafter, then rebounding to 2.615 cases per 1,000 workers in 2021—nearly matching the 2014 level. These patterns highlight limited progress in achieving SDG 8 targets for workplace safety.

Table 1 Descriptive Statistics of Variables Used in the Model

Variable	2014-2021	2014	2015	2016	2017	2018	2019	2020	2021
Total Annual Wage	15,617.05	14,618.34	14,521.48	19,888.76	14,901.36	14,977.16	15,146.33	15,370.07	15,402.85
(USD, PPP)	(29,164.70)	(17,772.32)	(15,174.97)	(54,646.84)	(14,550.58)	(14,261.76)	(15,004.82)	(15,170.23)	(13,488.29)
Fatality risks	0.016	0.017	0.015	0.015	0.015	0.015	0.017	0.015	0.020
(per 1,000 people)	(0.026)	(0.026)	(0.023)	(0.025)	(0.024)	(0.024)	(0.028)	(0.025)	(0.031)
Non-fatality risks	2.340	2.753	2.500	2.355	1.565	2.263	2.505	2.237	2.615
(per 1,000 people)	(4.518)	(5.495)	(4.654)	(4.501)	(3.033)	(4.320)	(4.729)	(4.241)	(4.792)
Male	0.517	0.516	0.517	0.517	0.517	0.517	0.517	0.518	0.517
	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)
Married	0.580	0.628	0.624	0.618	0.613	0.610	0.605	0.541	0.361
	(0.494)	(0.483)	(0.484)	(0.486)	(0.487)	(0.488)	(0.489)	(0.498)	(0.480)
Age (year)	44	43	43	43	44	44	44	45	45
	(18)	(17)	(17)	(18)	(18)	(18)	(18)	(18)	(18)
Head of Households	0.397	0.391	0.395	0.391	0.391	0.397	0.404	0.401	0.408
	(0.489)	(0.488)	(0.489)	(0.488)	(0.488)	(0.489)	(0.491)	(0.490)	(0.492)
Working hours	1,767.224	2,322.534	2,282.180	2,280.889	1,505.365	1,481.499	1,483.309	1,410.854	2,147.584
(per year)	(1,090.578)	(672.788)	(670.368)	(648.815)	(1,194.424)	(1,187.400)	(1,174.378)	(1,158.577)	(677.845)
Municipal area	0.455	0.454	0.454	0.454	0.455	0.455	0.455	0.456	0.461
	(0.498)	(0.498)	(0.498)	(0.498)	(0.498)	(0.498)	(0.498)	(0.498)	(0.498)
Number of economically	4	4	4	4	4	4	4	4	3
dependent persons per household	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Observations	5,462,789	683,222	709,842	712,192	707,648	697,138	686,810	695,278	570,659

Note: Standard deviations are in parentheses. To save space, descriptive statistics by year for Education, Occupation, Industries, Number of workers by sector, Province, Year, and Quarter are not presented here and are provided in Table A1 of the Supplementary Materials.

Source: Authors' Analysis from Labor Force Survey (2014-2021) from Thailand's National Statistical Office and the Office of the Workmen's Compensation Fund (WCF).

The average age of respondents was 44 years. Most were male (51.7%), married (58.0%), heads of households (39.7%), and residing in municipal areas (45.5%), primarily in Bangkok (13.5%). Approximately 23.7% had less than primary education, 29.0% worked in skilled agriculture, forestry, and fishery, and 33.0% were employed in the agriculture, forestry, and fishing industries. Average annual working hours totaled 1,767.22 (or 6.77 hours per day). Most businesses had 1-4 workers (72.7%), and household averaged 4 members. Full descriptive statistics are provided in Table 1 (Supplementary Materials).

Regression results from the full-sample analysis: Marginal impacts of explanatory variables on annual income

Table 2 displays estimated coefficients and their corresponding standard errors from OLS that did not address the problems of selection bias and endogeneity, and those from Heckit 2SLS that addressed both problems. Most of the estimated coefficients exhibited significance at the 1 percent level, indicating strong statistical relevance.

Table 2 Estimated Coefficients from OLS and the Heckit 2SLS obtained through Repeated Cross-sectional Sampling in 2014–2021

Variables	OLS		Heckit 2SLS	
	Coef.	SE.	Coef.	SE.
Fatal risk (per 1,000 people)	1.192***	0.027	0.131***	0.020
Non-fatal risk (per 1,000 people)	0.003***	1.46E-04	0.045***	3.82E-05
Male	0.102***	0.001	0.121***	2.24E-04
Age (years)	0.007***	6.10E-05	0.010***	2.55E-06
Head of household	0.041***	0.001	0.030***	5.30E-05
Working hours	1.058E-04***	0.000	7.390E-05***	5.91E-08
Professionals	0.070***	0.005	0.050***	2.45E-04
Technicians and associate professionals	-0.118***	0.005	-0.161***	1.41E-04
Clerical support workers	-0.299***	0.005	-0.347***	1.96E-04
Service and sales workers	-0.352***	0.005	-0.335***	1.40E-04
Skilled agriculture, forestry, and fishery workers	-0.732***	0.005	-0.657***	2.13E-04
Craft and related trade workers	-0.427***	0.005	-0.611***	4.96E-04
Plant and mach. operators and assemblers	-0.358***	0.005	-0.621***	0.001
Elementary occupations	-0.608***	0.005	-0.861***	0.001
Municipal area	0.046***	0.001	0.041***	5.77E-05
Observation	**1,099,671**		**2,638,406**	

Note: (1) *** = 1% level of significance. (2) For the OLS and Heckit 2SLS regression, linearized standard errors are in parentheses. (3) Population weights were accounted for in all regressions. To save space, estimated coefficients for *Education, Industries, Province, Year*, and *Quarter* are not presented here and are provided in Table A2 of the Supplementary Materials.

Source: Authors' Estimate

Fatal risk had a positive and significant effect on annual wages under both models, consistent with the risk–return tradeoff. However, the magnitude decreased after correction. Specifically, each unit increase in fatal risk raised the real annual wage by approximately 13.1%. Similarly, non-fatal risk also showed a positive effect, with its magnitude increasing after correction-each unit increase in non-fatal risk raised wages by about 4.5%. These results align with Parada-Contzen, Riquelme-Won, & Vasquez-Lavin (2012) and Mardones & Riquelme (2018), further supporting the interplay between risk factors and wages within economic frameworks.

Instrument validity was confirmed through robustness checks. The underidentification test (Kleibergen-Paap LM statistic) yielded 433.19 (p-value = 0.000), ruling out underidentification. The weak instrument test (F = 216.74) exceeded the critical value (7.03), indicating strong instruments. Finally, the overidentification test (Hansen J test) resulted in a J-statistic of 0.000, confirming that the model is exactly identified and that the instruments do not introduce overidentification bias.

Additional findings indicate that male and household-head workers earned higher real annual wages than their counterparts, consistent with Witvorapong & Komonpaisarn (2019). Age was positively associated with income, and education had a strong, positive effect—workers with higher education levels consistently earned more than those with less than primary education. Moreover, workers in professional occupations earned higher annual wages than those in other unspecified roles. Increased working hours had a minimal impact on income, suggesting limited returns from extended hours. Geographically, municipal residents reported the highest average wages, underscoring regional disparities in income within the sample.

The VSL in Thailand

Based on the coefficients addressing endogeneity and selection bias (Table 2), the VSL and the VSI for Thai workers were estimated, as illustrated in Figure 1. Averaged over 2014-2021, the VSL and VSI were approximately 2,015,693.92 and 697,579.49 (2021 USD, PPP), respectively. These values imply that Thai workers are, on average, willing to collectively pay $2,015,693.92 to reduce one statistical death and $697,579.49 to reduce one statistical injury in the population.

An unusual spike in both VSL and VSI occurred in 2016, driven by increased real household income due to government stimulus measures, farmer relief programs, export sector recovery, and low inflation. For example, key initiatives included the “Shop to Help the Nation” program and financial assistance to farmers impacted by falling crop prices (Royal Thai Government, 2017). The export sector also rebounded from a 2015 slowdown, while global oil price declines kept inflation low, thereby boosting real income in 2016 relative to other years.

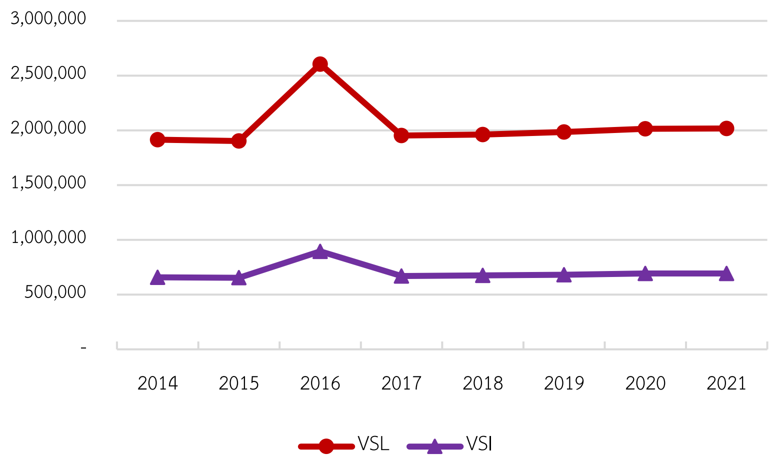

Figure 1 VSL and VSI in Thailand from 2014-2021 in 2021 USD, PPP

Source: Authors' Estimate

Regression Results from the Subsample Analysis

As suggested by Viscusi and Aldy (2003), this study disaggregated the full sample into subsamples to examine variations in VSL and VSI based on worker characteristics. The analysis explores wage differences by gender, age groups, occupations, and regions, offering insights into how demographic and labor market factors influence wage–risk trade-offs. Occupational differences revealed varying impacts on wages and fatality risks, while regional subsamples captured disparities in labor market conditions across the country.

Table 3 presents the average VSL and VSI estimates (2014–2021) across subsamples, derived using the Heckit 2SLS method. Several interesting findings were observed:

1. Male workers had higher VSL estimates than females, reflecting the trade-off between fatal risks and higher average male wages. This aligns with findings from Stergiou-Kita et al. (2015) and DeVore (2018), which highlight male concentration in high-risk sectors such as construction, manufacturing, and transportation. In contrast, female workers exhibited higher VSI estimates. This is consistent with Sheu & Hedegaard (2016) and Schram et al. (2022), who found that women are more likely to work in service, healthcare, and education—fields with greater non-fatal injury risks and work-related stress. These occupational exposures contribute to higher injury risk valuations among women, underscoring gender-based disparities in workplace safety.

2. Workers aged 45–59 exhibited the highest VSL and VSI among all age groups. While wage–risk trade-offs were not at their peak in this range, their higher annual wages contributed

to elevated valuations. This aligns with WHO (2021) reporting the rise in mortality of this group—42% from heart disease and 19% from stroke—due to long working hours (over 55 hours/week).

3. Non-manual workers consistently had higher VSL and VSI than manual workers. This reflects income disparities: non-manual workers generally earn more due to higher-skill tasks, while manual workers perform physically intensive, low-skilled jobs. Despite facing greater fatal and non-fatal risks, manual workers' lower incomes yield lower VSL and VSI estimates. Thus, income plays a central role in risk valuation, with non-manual workers' higher earnings translating into higher economic valuations of life and injury.

Table 3 Estimated Average VSL and VSI during 2014-2021 in USD (PPP) 2021 for subsamples

Item	Number of Observation	Coef. Of Fatal Risk	Coef. Of Non-Fatal Risk	Real Income	VSL	VSI
Gender						
Male	1,384,168	0.147	0.024	1,301.771	2,298,175.162	375,845.761
Female	1,253,985	0.120	0.038	1,300.999	1,877,453.963	591,556.960
Age range						
Early working age (15-29 years old)	253,391	0.148	0.013	1,000.479	1,781,799.473	159,455.543
Middle working age (30-44 years old)	1,049,845	0.159	0.041	1,354.158	2,580,108.112	663,208.630
Late working age (45-59 years old)	1,219,597	0.155	0.044	1,588.589	2,947,947.149	842,930.741
Senior (60 years old and above)	372,795	0.111	0.056	932.511	1,242,286.918	626,781.606
Regions						
Bangkok	230,180	0.176	0.043	1,844.720	3,889,578.100	958,560.785
Central	1,429,270	0.160	0.041	1,318.214	2,529,721.213	640,732.679
Northeast	1,387,309	0.151	0.027	1,054.109	1,912,262.932	337,871.871
North	1,045,717	0.150	0.042	1,012.968	1,820,337.532	514,265.215
South	721,332	0.155	0.031	1,013.293	1,882,076.637	375,246.312
Occupation						
Manual workers	710,293	0.144	0.050	853.624	1,478,841.095	507,761.505
Non-manual workers	750,124	0.120	0.046	1,817.487	2,618,993.678	997,281.289

Source: Authors' Estimate

4. Regional disparities were evident, with Bangkok showing the highest VSL and VSI, driven by higher real income and greater trade-offs with occupational risks. As Thailand's economic hub, Bangkok had the highest income levels and accounted for 23.57% of national work-related injuries and fatalities during 2018–2022 (Workmen's Compensation Fund Office, 2023), particularly in the construction sector—Bangkok's largest industry.

Tables 4 and 5 illustrate VSL and VSI trends across subsamples from 2014 to 2021, highlighting the significance of income and risk factors affecting the predictions of the VSL and

VSI. Higher income leads to increased VSL and VSI, as workers require greater compensation to tolerate risks associated with death or injury. The differences between the VSL and VSI reflect the varying impacts of mortality and injury on life and economic outcomes.

Over the period, VSL and VSI for male workers increased more than for females. VSL growth was higher among early- and middle-working-age groups. Manual workers saw rising VSL, while non-manual workers' VSL remained stable. Regionally, the North experienced the largest VSL increase, whereas Bangkok showed a decline. Robustness checks confirmed model reliability. Instrument validity was reassessed, alternative variables were used to reduce multicollinearity, and estimation consistency was verified using Probit and Logit models. Most VIF values were below 5, and no correlation coefficients exceeded 0.8.

Table 4 Variations in the yearly trends of the VSL (USD, PPP 2021) based on subsamples

Item	2014	2015	2016	2017	2018	2019	2020	2021
Gender								
Male	2,095,794	2,106,468	2,911,748	2,197,809	2,215,101	2,249,762	2,291,377	2,292,044
Female	1,794,420	1,766,527	2,401,410	1,788,222	1,793,168	1,806,741	1,827,702	1,834,317
Age range								
Early working age (15-29 years old)	1,668,753	1,678,556	2,287,765	1,697,879	1,704,014	1,712,253	1,722,670	1,766,202
Middle working age (30-44 years old)	2,377,420	2,415,429	3,323,363	2,443,845	2,490,466	2,506,898	2,539,437	2,523,160
Late working age (45-59 years old)	2,835,056	2,739,145	3,705,821	2,847,051	2,810,224	2,852,909	2,898,144	2,869,857
Senior (60 years old and above)	1,276,725	1,084,841	1,466,941	1,198,139	1,206,583	1,230,886	1,240,643	1,279,052
Occupation								
Manual	1,369,266	1,396,848	1,770,079	1,412,174	1,435,138	1,476,293	1,444,713	1,532,502
Non-manual	2,494,386	2,478,476	3,316,373	2,495,621	2,506,785	2,502,158	2,553,336	2,485,928
Regions								
Bangkok	3,581,127	3,635,102	5,316,947	3,632,317	3,700,712	3,802,508	3,864,527	3,479,858
Central	2,385,456	2,287,383	3,373,494	2,396,259	2,416,898	2,407,708	2,451,708	2,509,780
North	1,665,819	1,717,424	1,984,655	1,815,942	1,793,600	1,796,231	1,828,243	2,018,568
Northeast	1,836,013	1,827,942	2,045,725	1,890,167	1,884,977	1,916,169	1,962,588	1,946,522
South	1,817,141	1,807,319	2,387,681	1,841,635	1,800,456	1,794,425	1,764,450	1,834,592

Source: Authors' Estimate

Table 5 Variations in the yearly trends of the VSI (USD, PPP 2021) based on subsamples

	2014	2015	2016	2017	2018	2019	2020	2021
Gender								
Male	342,748.193	344,493.787	476,189.980	359,431.808	362,259.809	367,928.225	374,733.905	374,843.041
Female	565,394.299	556,605.511	756,647.402	563,441.386	564,999.624	569,276.479	575,880.916	577,965.235
Age range								
Early working age (15-29 years old)	149,338.900	150,216.139	204,735.014	151,945.403	152,494.449	153,231.737	154,163.930	158,059.668
Middle working age (30-44 years old)	611,108.260	620,878.426	854,259.976	628,182.665	640,166.534	644,390.200	652,754.273	648,570.277
Late working age (45-59 years old)	810,650.716	783,226.359	1,059,635.907	814,080.618	803,550.544	815,755.773	828,690.069	820,601.889
Senior (60 years old and above)	644,156.730	547,343.932	740,128.005	604,507.090	608,767.811	621,029.398	625,952.382	645,330.832
Occupation								
Manual	470,138.661	479,609.015	607,758.444	484,871.182	492,756.016	506,886.569	496,043.465	526,186.199
Non-manual	949,832.308	943,773.953	1,262,834.915	950,302.557	954,553.447	952,791.525	972,279.666	946,611.355
Regions								
Bangkok	882,544.990	895,846.845	1,310,326.488	895,160.422	912,015.985	937,102.912	952,387.133	857,587.969
Central	604,193.028	579,352.870	854,445.039	606,929.066	612,156.655	609,828.908	620,973.319	635,682.017
North	470,612.060	485,191.051	560,686.605	513,023.426	506,711.471	507,454.819	516,498.506	570,267.572
Northeast	324,399.421	322,973.391	361,452.825	333,967.835	333,050.804	338,561.969	346,763.650	343,925.050
South	362,299.428	360,341.268	476,053.210	367,183.034	358,972.922	357,770.519	351,794.014	365,778.841

Source: Authors' Estimate

Discussion

This section compares the VSL and VSI estimates with prior studies and applies these values to quantify the economic costs of work-related fatalities and injuries across subgroups. The estimated VSL of \$2.02 million (PPP, 2021) exceeds the mean and median VSLs from Witvorapong and Komonpaisarn (2019)—\$1.38 million and \$0.75 million, respectively—based on OLS. However, it remains below their 90th percentile estimate of \$3.41 million (PPP, 2021).

By subsample, our VSLs estimates for male and female workers are \$2.30 million and \$1.88 million, respectively, both higher than the earlier study's estimates of \$1.21 million and \$1.80 million. Regional VSLs from our study also surpass prior figures: Bangkok (\$3.89 million), Central (\$2.53 million), Northeast (\$1.91 million), North (\$1.82 million), and South (\$1.88 million), compared to \$1.61 million, \$1.20 million, \$1.44 million, \$1.46 million, and \$0.84 million, respectively, in the previous study.

Several factors help explain the differences between this study and earlier work. First, the current analysis utilizes a longer and more recent dataset covering the period from 2014 to 2021, compared to the 2012–2014 timeframe used in previous research. Second, our study incorporates full-year data across all four quarters, thereby reducing potential seasonal bias inherent in the earlier study, which relied solely on third-quarter data. Third, and most importantly, this study explicitly addresses issues of selection bias and endogeneity, which enhances the reliability and accuracy of the VSL and VSI estimates.

Although both studies in Thailand employ the hedonic wage method, VSL estimates for Thailand remain substantially lower than those reported for the United States (Kniesner et al., 2012). Conversely, estimates for Thailand are generally higher than those reported in Cambodia (Cameron et al., 2010), Myanmar (Mon et al., 2019), China (Cao et al., 2023), and Malaysia (Yusof et al., 2013). These cross-country differences likely reflect not only variations in estimation techniques but also differences in labor market structures, perceived occupational risks, compensation mechanisms, and broader institutional, cultural, and economic contexts. As such, the VSL and VSI estimates derived from this study should not be generalized to other developing countries without careful consideration of these contextual differences.

The COVID-19 pandemic during 2020–2021 may have had a modest impact on the estimated VSL and VSI values, primarily through its effects on labor market dynamics and occupational risk profiles. Fatal and non-fatal risks appeared to decline slightly in 2020, likely due to reduced labor-force participation, nationwide lockdowns, and the rise of telecommuting. Nonetheless, certain high-risk sectors remained operational, and many vulnerable workers faced layoffs. Concurrently, average wages increased slightly as the economy began to recover. As a result, only minor changes in VSL and VSI were observed during this period.

Finally, although this study employs robust methodologies and utilizes reliable national data, several important limitations remain. First, it excludes informal workers, who represent a large share of Thailand's labor force and may face different risks not reflected in the data. Second, labor and injury data come from different sources—worker characteristics from the labor force survey and injury rates from the Workmen's Compensation Fund. Since they are not linked at the individual level, the assigned risk may not fully reflect each worker's actual exposure. Third, risk is measured at the occupation level, giving the same value to all individuals in the same job, despite potential differences in their working conditions. These limitations may affect the accuracy and generalizability of the VSL and VSI estimates and should be considered in policy applications.

Recommendations

This study proposes policy recommendations, categorized into overall recommendations and those based on subsample analysis for Thailand. To some extent, these recommendations may also apply to other developing countries facing similar challenges.

Overall recommendations

Although Thailand has adopted national plans and regulations related to workplace safety, the country continues to face persistently high fatality rates and only modest declines in injury cases. To mitigate the economic impact of work-related incidents, policymakers should strengthen law enforcement by increasing inspection budgets and personnel, and by tightening penalties to ensure compliance. Fostering a stronger safety culture is equally essential, through incentives for low-accident firms, mandatory annual safety training, and a national safety rating system. Additionally, leveraging data and technology is crucial—by promoting workplace use of IoT and AI, developing a centralized accident database, and encouraging ISO 45001 adoption for more effective occupational health and safety management.

For instance, in 2020, the Thai government spent approximately $2.04 million USD (PPP)—including $863,607 on a transport-led project and $1.22 million on personnel—for alcohol enforcement initiatives. That same year, drunk driving caused over 6,000 injuries and 2,000 deaths, with estimated economic losses of $4.07 million and $3.99 million USD (PPP), respectively—nearly four times the prevention budget. This indicates underinvestment relative to the cost burden. We recommend allocating more funding toward enforcement, prevention, and public education to reduce alcohol-related casualties effectively.

Recommendations based on subsample analysis

1. Reducing risks for manual workers: Although manual workers have lower VSL and VSI, they face higher fatality and injury rates, leading to greater total economic losses. Risk mitigation should prioritize: 1) Enforcing Personal Protective Equipment (PPE) use in high-risk sectors (e.g., construction, manufacturing, logistics) with tax incentives or subsidies for safety investments; 2) Raising wages and benefits to match risk levels and expanding subsidies for healthcare and accident insurance.

2. Supporting age-vulnerable workers (30–59): Both middle-aged and older workers contribute significantly to the economic cost of occupational risks—through either volume of incidents or higher VSL/VSI. Interventions should include customized safety training, age-friendly workplaces, and upskilling pathways for supervisory roles.

3. Reducing regional disparities: The Central region and Bangkok show the highest losses. Priorities include establishing safety zones in high-risk provinces, boosting inspections, and funding safety tech (e.g., fatigue sensors). In urban areas like Bangkok, addressing office injuries and promoting wellness and remote work to reduce commuting risks.

4. Integrating VSL/VSI in policy decisions: VSL and VSI are vital for evaluating transport, environmental, and public health policies. Policymakers should incorporate them in cost-benefit analyses—e.g., using VSL for prioritizing road safety investments, and VSI for allocating healthcare resources for injury prevention and rehabilitation.

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