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ECONOMICS

Estimation of the Value of Statistical Life in Chile and Extrapolation to Other Latin American Countries

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This study uses the hedonic wage method to estimate the value of statistical life (VSL) in Chile and then extrapolates this value to different Latin American countries. The data are obtained from the National Socioeconomic Characterization Survey (Encuesta de Caracterización Socioeconómica Nacional, CASEN 2013), which includes information on socioeconomic and labor variables at the individual level. Records of fatal and nonfatal occupational risk in each economic sector are obtained from the Superintendency of Social Security (Superintendencia de Seguridad Social). The results of the best hedonic wage estimate for the Chilean case (which corrects for endogeneity and selection bias) show that the VSL is US$3.7 million, with a confidence interval of 95 percent ranging between US$3.4 million and US$4.0 million. A meta-analysis that relates the VSL to GDP per capita is conducted to extrapolate the findings to other Latin American countries, with average values ranging from US$0.01 million for Haiti to US$5.2 million for Puerto Rico.

Este estudio utiliza el método de salarios hedónicos para estimar el valor estadístico de la vida (VEV) en Chile, y luego extrapola este valor a diferentes países latinoamericanos. Los datos son obtenidos de la Encuesta de Caracterización Socioeconómica Nacional CASEN 2013 que incluye información sobre variables socioeconómicas y laborales a nivel individual, mientras que los registros de riesgo laboral fatal y no fatal en cada sector económico se obtienen de la Superintendencia de Seguridad Social. Los resultados de la mejor estimación de salarios hedónicos para el caso chileno (que corrige por endogeneidad y sesgo de selección) muestran que el VEV es US$ 3.7 millones, con un intervalo de confianza al 95 por ciento que varía entre US$3.4 millones y US$4.0 millones. Para la extrapolación a otros países latinoamericanos se realiza un meta-análisis que relaciona el VEV con el PIB per cápita, obteniendo valores promedio que varían entre US$0.01 millones para Haití y US$5.2 millones para Puerto Rico.

Introduction

The value of statistical life (VSL) is the marginal willingness to pay for (or the marginal willingness to accept) marginal risk reductions in a given context (environmental pollution, road safety, and occupational safety, among others), but it does not correspond to the ex-post value of the saved lives. Although from ethical and moral points of view, for many people, making an estimate of this type is questionable, in reality, there are certain situations in which this value is indeed quantified, particularly those in which individuals are willing to accept greater or lesser exposure to risk due to the tradeoff between the risk of mortality and money (Gentry and Viscusi 2016). For example, this value is useful for the cost-benefit analysis of projects that may aim to reduce levels of accidents, illness, or mortality. Therefore, having an estimate of VSL contributes greatly to decision-making, especially in low-income countries, where such studies are typically not performed (Hammitt and Robinson 2007).

The most commonly used approaches to quantifying VSL are the revealed preference approach, typically known as the hedonic wage method (which uses labor market information to relate the level of

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remuneration and the risk to which workers are exposed), and the stated preference approach (in which people are asked directly through surveys their willingness to pay for different hypothetical reductions in the level of risk). According to Viscusi and Aldy (2003), most studies in the United States are based on labor market information using the hedonic wage method, whereas in Europe, the emphasis is on using the stated preference approach. Most hedonic wage studies use cross-sectional data; however, recently, the use of panel data (Schaffner and Spengler 2010) has been emphasized, in addition to some other aspects, such as making differential estimates of VSL by type of risk (Scotton and Taylor 2011) or according to age groups (Evans and Schaur 2010), as well as the disaggregation of risk by industry and occupation (Riera Font, Ripoll Penalva, and Sbert 2007).

In many developing countries, the information needed to use one of these methods is not available, so a good alternative approach for the VSL is to extrapolate estimates from other countries (mainly developed) by relating the VSL to the GDP per capita of each country. For example, through a meta-analysis, Miller (2000) estimates a VSL of US$1.2 million for Argentina, US$0.7 million for Brazil, US$0.7 million for Chile, US$0.4 million for Peru, US$0.8 million for Uruguay and US$0.5 million for Venezuela (all values correspond to 1995 dollars). Lindhjem et al. (2011) performed a meta-analysis using previous VSL estimates for thirty-eight countries (all included values using the declared preference approach). These authors report an average VSL of US$6.0 million. When classified according to the context of the study, the average VSL correspond to US$9.0 million for environmental pollution, US$6.9 million for road safety and US$4.0 million for health.

In the case of Chile, some studies use the stated preference approach, but only one previous study uses the hedonic wage method. This last study was carried out by Parada-Contzen, Riquelme-Won, and Vasquez-Lavin (2013), who estimate a VSL of US$12.8 million after correcting for endogeneity and selection bias. This estimate is quite high in comparison to other developing countries and even higher than in some developed countries.[1] This situation is not unusual because, although the concept of the value of statistical life is well established and widely used in economics, there is still controversy over the apparent instability in estimates of excessively large or small values (Viscusi and Aldy 2003). In this sense, some theoretical studies have noted that the potential bias of the estimates arises due to omitted variables (Hwang, Reed, and Hubbard 1992; Shogren and Stamland 2002). From an empirical perspective, Kniesner et al. (2007) demonstrate how the use of the best available data (panel data and risk level with high disaggregation) and the best econometric practices can determine the estimated VSL in previous studies.[2]

This situation motivated the realization of the present study, which uses more updated data with more explanatory variables and new instrumental variables to provide new evidence to clarify if the VSL for Chile estimated with the hedonic wage method is significantly different from the value of other countries with similar GDPs per capita and if the result of the only previous study can be attributed to data and/or methodological problems. Specifically, the contribution of this paper is in the line of demonstrating that the use of relevant instrumental variables[3] that meet the exogeneity requirement makes it possible to correct for the problem of the endogeneity of risk and to improve the previous VSL estimates for the case of Chile.

Methodology

Econometric framework

When the available information is cross-sectional, the hedonic price method uses a linear regression, which represents the relationship between the wage level and the explanatory variables. The general model is as follows:

$$\ln(w_i) = c + \boldsymbol{\beta H}_i' + \boldsymbol{\alpha J}_i' + \boldsymbol{\theta L}_i' + \boldsymbol{\delta G}_i' + \gamma r_i + \tau p_i + e_i \qquad (1)$$

where $\ln(w_i)$ is the natural logarithm of the wage, $\boldsymbol{H}$ corresponds to the vector of personal characteristics, $\boldsymbol{J_i}$ represents the vector of the characteristics of the work, $\boldsymbol{L_i}$ represents the vector of the characteristics of the firm, $\boldsymbol{G_i}$ represents the vector of geographical variables, r_i corresponds to fatal risk, and p_i corresponds to nonfatal risk. In turn, the vectors $\boldsymbol{\beta}$, $\boldsymbol{\alpha}$, $\boldsymbol{\theta}$, and $\boldsymbol{\delta}$ and the scalars c, γ and τ correspond to the parameters

[1] However, it has been used to evaluate environmental policies in Chile (See Mardones, Saavedra, and Jiménez 2015; Mardones 2019).

[2] In Chile, a small panel database at the individual level with labor market information is available only for the years 1996, 2000, and 2005 (CASEN Panel Survey), but for the same years, it is not possible to obtain official statistics on the risk disaggregated to the economic sector level.

[3] An instrumental variable is an exogenous variable that should not be included in the initial model (requirement of exogeneity) and must be partially correlated with the endogenous explanatory variable (relevancy requirement).

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estimated in the regression, whereas e_i is the error term. The subscript i indicates that the information corresponds to the *i-th* individual.

However, if there are unobservable variables that are correlated with one of the variables included in the statistical model (for example, risk aversion is not an observable variable for the researcher), the parameters estimated by the ordinary least squares method (OLS) will be biased and inconsistent. In relation to labor risk variables, what is relevant is not the risk to which the individual is exposed but the individual's perception of the risk. This is why in the literature, the use of instrumental variables is suggested to estimate the perceived risk of individuals related to their work, which would reduce bias and inconsistency due to endogeneity.

If there are several instrumental variables to correct the endogeneity of one or several explanatory variables, the method of least squares in two stages (2SLS) can be used. In the first stage, the predicted values of the endogenous explanatory variables (r_i and p_i) are obtained from a regression related with the other exogenous explanatory variables and the instrumental variables. In the second step, a regression is generated through the OLS method of the variable In(w_i) with respect to the exogenous explanatory variables and the estimated values of the endogenous explanatory variables. Specifically, in this case, the predicted value of nonfatal and fatal risk can be obtained with the following regressions:

$$p_i = c_1 + \boldsymbol{\varsigma H_i'} + \boldsymbol{\sigma J_i'} + \boldsymbol{\chi L_i'} + \boldsymbol{\psi G_i'} + \boldsymbol{\varphi_1 S_i'} + \mu_i \tag{2}$$

$$r_i = c_2 + \boldsymbol{\omega H_i'} + \boldsymbol{\xi J_i'} + \boldsymbol{\vartheta L_i'} + \boldsymbol{\kappa G_i'} + \boldsymbol{\varphi_2 S_i'} + \nu_i \tag{3}$$

where $\boldsymbol{S_i}$ is a vector of instrumental variables that determine the risk of the individual, c_1 and c_2 are constants, $\boldsymbol{\varsigma}$, $\boldsymbol{\sigma}$, $\boldsymbol{\chi}$, $\boldsymbol{\psi}$ and $\boldsymbol{\varphi_1}$ correspond to the parameter vectors estimated for the nonfatal risk regression, and $\boldsymbol{\omega}$, $\boldsymbol{\xi}$, $\boldsymbol{\vartheta}$, $\boldsymbol{\kappa}$, and $\boldsymbol{\varphi_2}$ correspond to the parameter vectors estimated for the fatal risk regression. Finally, μ_i and ν_i correspond to the random errors of the respective regressions.

Another problem related to the nature of cross-sectional data in studies to estimate the VSL is the so-called selection bias, which arises when the sample used to perform the regression is not completely random. The problem is that it is intended to estimate the wage offer equation for "all" individuals of working age, regardless of whether the individual is working. However, data related to the wage offer are observable only for those individuals who are currently working. To solve this problem, Heckman (1979) proposed a method known as Heckit, which proposes a regression model that consists of two related equations to correct the bias due to the self-selection of the sample.

$$\ln(w_i) = c + \boldsymbol{\beta H_i'} + \boldsymbol{\alpha J_i'} + \boldsymbol{\theta L_i'} + \boldsymbol{\delta G_i'} + \gamma r_i + \tau p_i + e_i \tag{4}$$

$$y_i^* = \boldsymbol{\pi l_i} + \eta_i \tag{5}$$

where the latent variable y_i^* is greater than zero if the labor offer is observed in the data ($y_i = 1$) or less than zero otherwise ($y_i = 0$). Furthermore, it is assumed that the errors e_i and η_i have a bivariate normal distribution. From these assumptions, it can be shown that the expectation of conditional equation (5) to which labor participation is observed is as follows:

$$E\left(\ln(w_i) | y_i = 1, \boldsymbol{H_i'}, \boldsymbol{J_i'}, \boldsymbol{L_i'}, \boldsymbol{G_i'}, \boldsymbol{l_i}\right) = c + \boldsymbol{\beta H_i'} + \boldsymbol{\alpha J_i'} + \boldsymbol{\theta L_i'} + \boldsymbol{\delta G_i'} + \gamma r_i + \tau p_i + \rho \sigma_e \lambda_i \tag{6}$$

$$\lambda_i = \left[\frac{\phi(\boldsymbol{\pi l_i})}{1 - \Phi(\boldsymbol{\pi l_i})}\right] \tag{7}$$

$\phi(\cdot)$ corresponds to the probability density function and $\Phi(\cdot)$ refers to the cumulative distribution function, both estimated with a Probit model. In addition, for simplicity, the coefficient $\rho\sigma_e$ can be called β_λ because it is the coefficient that accompanies the estimate of the inverse Mills ratio, λ_i. Rearranging equation (6) yields the following:

$$E\left(\ln(w_i) | y_i = 1, \boldsymbol{H_i'}, \boldsymbol{J_i'}, \boldsymbol{L_i'}, \boldsymbol{G_i'}, \boldsymbol{l_i}\right) = c + \boldsymbol{\beta H_i'} + \boldsymbol{\alpha J_i'} + \boldsymbol{\theta L_i'} + \boldsymbol{\delta G_i'} + \gamma r_i + \tau p_i + \beta_\lambda \lambda_i \tag{8}$$

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Once the model is presented, the estimation of the parameters of interest is carried out with a two-step procedure or with maximum likelihood routines.

Additionally, instrumental variables can be included to estimate if some of the explanatory variables are assumed to be endogenous. In this case, the procedure is known as Heckit in two stages with endogenous variables (Heckit 2SLS).

Data description

From the review of several studies of hedonic salaries published in the last two decades, it was possible to determine the explanatory variables that are commonly included in this type of regressions.

As seen in **Table 1**, several categories of variables associated with personal characteristics, the characteristics of firms, labor information, and geographic variables are included. In the case of Chile, these variables are obtained from the CASEN survey performed in 2013.[4]

It is also necessary to include variables associated with labor risk (fatal and nonfatal), which in Chile can be obtained from the records of the Social Security Superintendence (Superintendencia de Seguridad Social). According to data from 2013, the sectors with the highest mortality rate are mining (19.5 per 10,000 workers), transport and communications (17.5 per 10,000 workers), and construction (10.3 per 10,000 workers), whereas the sectors with the highest levels of labor accidents are the manufacturing (6.2 per 100 workers), transport and communications (6.0 per 100 workers), and agriculture (5.4 per 100 workers). In addition, the sector with the lowest accident rate is mining (1.6 per 100 workers).

Table 2 presents the description of all the explanatory variables included in the present research. Moreover, it is necessary to incorporate instrumental variables to solve the problem of the endogeneity of labor risk (fatal and nonfatal).

According to Garen (1988), the instrumental variables that should be included in this type of study correspond to the nonlabor income and factors correlated with the perceived risk in the work but that do not explain the wage (see **Table 3**). Therefore, variables include: a dummy variable that takes a value of 1 if the partner of the individual has some type of disability (*Disabhome*), the nonlabor income in Chilean pesos (*Nonlabincome*), the number of children under six years of age (*Numberkids6*), a variable that determines the interaction between gender and children under six years old (*Genderkids6*), a dummy variable that takes a value of 1 if the individual is married (*Married*), the years of schooling of the couple (*Coupleschooling*), a dummy variable that takes a value of 1 if the individual's partner works (*Coupleworks*), the number of people who are economically dependent on the household (*Peoplehome*), a dummy variable that takes a value of 1 if the individual has a life insurance (*Lifeinsurance*), and another dummy variable that takes a value of 1 if the individual lives with his partner, regardless of whether he is married (*Withcouple*). These are proxy variables of risk aversion that can affect the desire to have a safer job.

In addition, Angrist and Krueger (2001) state that the inclusion of labor market variables is a useful way to achieve identification with the method of instrumental variables. For this reason, the proportion of firms by size by economic sector is considered as instruments, considering small firms (*VI_smallfirms*), medium firms (*VI_mediumfirms*), and large firms (*VI_largefirms*); in this case, micro firms are the control group. These variables are included because in Chile, a relationship has been observed between the size of the firms and the rate of labor accidents,[5] they reflect the characteristics of the labor market, and the workers in economic sectors with a greater proportion of small firms could have less bargaining power to alter their wages, so it is assumed that the requirement of exogeneity would be met.

Estimation of VSL

After estimating the parameters in the regressions, it is possible to calculate the VSL for Chile with the following equation:

$$VEV = 12\bar{w}\hat{\gamma} \tag{9}$$

where $\bar{w}$ corresponds to the average monthly wage, which is multiplied by 12 to obtain the annual average wage, and γ corresponds to the estimated parameter of the fatal risk. In addition, to make the results of this

[4] Encuesta de Caracterización Socioeconómica Nacional, CASEN 2013 (Ministerio de Desarrollo Social, 2015), http://observatorio.ministeriodesarrollosocial.gob.cl/documentos/Metodologia_Diseno_Muestral_Casen_2013.pdf.

[5] *Informe Nacional 2013: Estadísticas sobre seguridad y salud en el trabajo*, August 2014, Gobierno de Chile, Superindendencia de Seguridad Social, http://info.suseso.cl/awp/publicaciones/informe_nacional_2013.pdf; Informe Final de la Comisión Asesora Presidencial para la Seguridad en el Trabajo 2010, http://datos.gob.cl/uploads/recursos/informeComisi%C3%B3nSeguridaddelTrabajo.pdf; Estadísticas de Accidentabilidad, versión 2011, 2012 y 2013, http://www.suseso.cl/608/w3-propertyvalue-59544.html.

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Table 1: Variables used in published studies of hedonic wages to estimate VSL at the international level.

Source (year)	Country	Number of personal characteristics	Number of variables with labor information	Number of characteristics of firms	Geographical Variables	Labor risk by economic sector	Labor risk by occupational category
Siebert & Wei (1994)	UK	10	3	3	Yes	Yes	Yes
Lanoie, Pedro & Latour (1995)	Canada	10	1	2	No	Yes	Yes
Sandy & Elliot (1996)	UK	10	3	3	No	Yes	Yes
Miller, Mulvey & Norris (1997)	Australia	9	1	1	Yes	Yes	Yes
Siebert & Wei (1998)	Hong Kong	5	0	0	No	Yes	No
Meng & Smith (1999)	Canada	8	2	2	Yes	Yes	Yes
Liu & Hammitt (1999)	Taiwan	5	2	1	No	Yes	Yes
Arabsheibani & Marin (2000)	UK	7	0	1	No	No	Yes
Sandy et al. (2001)	UK	10	3	3	No	Yes	Yes
Baranzini & Ferro Luzzi (2001)	Switzerland	8	4	4	Yes	Yes	No
Riera Font, Ripoll Penalva & Sbert (2007)	Spain	13	3	5	Yes	Yes	Yes
Schaffner & Spengler (2010)	Germany	9	2	2	No	Yes	Yes
Evans & Schaur (2010)	USA	7	1	0	Yes	Yes	Yes
Scotton & Taylor (2011)	USA	7	2	3	Yes	Yes	Yes
Parada-Contzen, Riquelme-Won & Vasquez-Lavin (2013)	Chile	15	5	4	Yes	Yes	No
Polat (2014)	Turkey	9	2	3	Yes	Yes	Yes

Source: Own elaboration.

Table 2: Description of variables.

Variable	Description	Mean	Standard deviation
Dependent variable			
Lnwage (Chilean pesos)	Natural logarithm of wage	12.477	0.819
Personal characteristics			
Schooling (years)	Schooling in years	10.289	4.231
Age years)	Age in years	35.452	22.403
Exper (years)	Experience in years	23.916	15.519
Exper2 (years 2)	Squared experience	812.830	879.755
Gender		0.477	0.499
Ethnicity	If you belong to an indigenous ethnic group	0.128	0.334
Work information			
LaborExp (years)	Working age in years	8.539	10.124
Workh (hours)	Hours worked per week	45.961	58.029
Full time	If the job is full time	0.264	0.441
Indcontract	If the person has an indefinite contract	0.221	0.415
Training	If the person has any type of training	0.072	0.258
Employer	If the person is an employer	0.008	0.090
Indep	If the person is an independent worker	0.083	0.276
Jobcategory1	Executive member or legislative power	0.017	0.130
Jobcategory2	Professional, scientific or intellectual	0.038	0.190
Jobcategory3	Professional	0.030	0.172
Jobcategory4	Office worker	0.034	0.182
Jobcategory5	Service or trade worker	0.065	0.246
Jobcategory6	Farmer or agricultural worker, fishing	0.031	0.174
Jobcategory7	Official, operator, craftsman of mechanical arts	0.063	0.243
Jobcategory8	Machine installation operator	0.039	0.195
Jobcategory9	Unskilled worker	0.086	0.280
Extrahours	Number of extra hours	0.025	0.158
Night shift	If the person works night shifts	0.258	0.438
Firms characteristics			
Numworkersf1	Number of employees in the firm (1)	0.067	0.250
Numworkersf2_5	Number of employees in the firm (2 to 5)	0.046	0.209
Numworkersf6_9	Number of workers in the firms (6 to 9)	0.017	0.129
Numworkersf10_49	Number of workers in the firms (10 to 49)	0.045	0.206
Numworkersf50_199	Number of workers in the firms (50 to 199)	0.033	0.179
Numworkersf200	Number of workers in the firms (200 or more)	0.104	0.305
Geographical variables			
Region1	Tarapaca Region	0.045	0.208
Region2	Antofagasta Region	0.037	0.190
Region3	Atacama Region	0.037	0.188

(contd.)

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Variable	Description	Mean	Standard deviation
Region4	Coquimbo Region	0.048	0.214
Region5	Valparaíso Region	0.094	0.292
Region6	Liberian Bernardo O'Higgins Region	0.076	0.264
Region7	Maule Region	0.067	0.249
Region8	Bío Region	0.143	0.350
Region9	Araucania Region	0.079	0.271
Region10	Los Lagos Region	0.060	0.237
Region11	Aysén Region	0.026	0.158
Region12	Magallanes Region and the Chilean Antarctic	0.027	0.162
MetropolitanRegion	Metropolitan Region of Santiago	0.168	0.374
Region14	Los Ríos Region	0.053	0.224
ExtMigrat	If the person is a foreigner		
IntMigrat	If the person has changed city in the last 5 years	0.007	0.081
Occupational hazard			
Fatalrisk	Fatal risk rate (deaths per worker)	6.96E-04	5.52E-04
Non-fatalrisk	Nonfatal risk ratio (injuries per 100 workers)	4.826	1.210

Source: Own elaboration based on the CASEN Survey (2013) and Social Security Superintendence.

study comparable with previously published international estimates, conversion of values to 2013 dollars is performed.

Transfer of benefits from VSL

The empirical literature for developing countries is scarce in this area, so there are no estimates for individual countries. This has led to suggesting the transfer of the VSLs from countries with estimates to countries that do not have them. The most common approach to transfer benefits is to assume that the ratio of VSL relative to GDP per capita is constant across countries, which implies assuming an income elasticity equal of 1.0. However, recent studies state that an income elasticity equal to 1.0 may be inadequate for low-income countries, so Hammitt and Robinson (2011) suggest using an income elasticity of 1.5 to provide a range of values for VSLs in countries of low and middle incomes. Another approach to extrapolate the results is to relate the VSL to each country's GDP per capita by performing a meta-analysis (see Miller 2000; De Blaeij et al. 2003; Bellavance, Dionne, and Lebeau 2009; Hammitt and Robinson 2011).

Therefore, after estimating the VSL for Chile, this value will be included along with estimates previously published in scientific journals for different countries that also use the hedonic wage approach in order to extrapolate the VSL for other Latin American countries.

Results

Estimation of the VSL for Chile

Different statistical methods were used to estimate the VSL for Chile (OLS, 2SLS, Heckit, and Heckit 2SLS).[6] Most of the estimated parameters are significant at 1 percent, except for certain dichotomous variables related to firm size, type of occupation, and geographical variables. Moreover, the coefficients related to schooling, experience, training, and contract type show expected magnitudes and signs in relation to what the theory postulates and what has been observed in other studies of hedonic wages. In particular, the estimated coefficient for the educational variable has a magnitude between 0.037 and 0.049, which would indicate that one year of schooling increases wages approximately between 3.7 percent and 4.9 percent. Another variable to be highlighted is gender, which was positive in the estimates that did not correct

[6] The estimates' variances were corrected by clustering because each observation has risk associated with its economic sector.

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Table 3: Description of instrumental variables.

Instrumental variables	Description	Mean	Standard deviation
Numberkids6	Number of children under 6 years	0.155	0.436
Genderkids6	Variable that relates gender and children under 6 years	0.061	0.287
Disabhome	If the partner has any type of disability	0.031	0.174
Married	If the person is married	0.283	0.451
Withcouple	If the person lives with his/her partner	0.401	0.490
Coupleschooling	Schooling of the couple in years	1.988	4.397
Coupleworks	If the couple works	0.182	0.386
Peoplehome	Individuals who are financially dependent on the worker individual	4.089	1.790
Nonlabincome	Nonlabor income in Chilean pesos	23909	116786
Lifeinsurance	If the person has life insurance	0.044	0.205
VI_Largefirms	Proportion of large firms by economic sector	1.902	1.699
VI_Mediumfirms	Proportion of medium-sized firms by economic sector	3.588	2.217
VI_smallfirms	Proportion of small firms by economic sector	22.729	8.254

Source: CASEN Survey (2013) and Ministry of Economy.
Note: The variables with units not specified correspond to the proportion of membership, which is defined by a dichotomous variable that takes a value of 0 or 1, where 1 implies membership and 0 implies nonmembership.

for selection bias; this would indicate that men earn between 25.9 percent and 31.9 percent more than women. However, this gap is reduced (between 15.2 percent and 20.6 percent) when estimating the Heckit and Heckit 2SLS models, which correct the selection bias associated with women tending to participate less in the labor market.

In relation to the fatal risk parameter, this proved to be positive and significant at 1 percent in all estimates. However, there is a considerable difference in the estimated magnitudes; for example, the parameters estimated through the OLS and Heckit were found to be less than one third of the values estimated through the 2SLS and Heckit 2SLS method.

In contrast, the parameter of nonfatal risk was found to be significant in all the estimates, with a negative sign, contrary to what was expected. However, this result is also observed in other studies such as Riera Font, Ripoll Penalva, and Sbert (2007) and Arabsheibani and Marin (2000). In this case, the negative sign could be attributed to the fact that in Chile, the mining sector pays the highest average wages and presents a high fatal risk but also less nonfatal risk with respect to other economic sectors. Furthermore, nonfatal risk data may not be totally useful in this kind of estimation, even with better instrumental variables, because typically in official statistics serious accidents are presented together with nonserious ones.

At the same time, it can be observed that in the 2SLS and Heckit 2SLS estimates most of the estimated parameters are not sensitive to the inclusion of instrumental variables, except the coefficients associated with the variables related to fatal and nonfatal risk. In addition, the R^2 values calculated are similar, with a magnitude close to 0.45, which is common in hedonic wage studies.

In the case of estimates with instrumental variables, their validity must be tested because the stronger the relationship between an instrumental variable and the endogenous explanatory variable(s) are, the better the instrument is. In addition, it is required that the instrumental variable is not correlated with other variables that affect the outcome (exogenous condition). These requirements ensure that the instrument can estimate parameters in an unbiased and consistent way.

Most of the included instrumental variables were significant at 1 percent or 5 percent, but only the instrument inclusion related to the proportion of firms by size according to economic sector significantly improved the regression adjustments for the variables of fatal risk ($R^2 = 0.43$) and nonfatal risks ($R^2 = 0.45$). This is important because if the instruments are poorly correlated with the endogenous explanatory variable, the parameters estimated by the 2SLS method may be even worse than using the OLS method. If there is only one endogenous regressor variable and the instrumental variables have an *F* test value close to or less

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than 10, it should be considered as a weak instrument group according to a finger rule established by Staiger and Stock (1997). This was corrected by Stock and Yogo (2005), who simulated critical values to detect weak instruments under multiple endogenous explanatory variables using a Wald test based on the Cragg-Donald statistic.

In replicating the study by Parada-Contzen, Riquelme-Won, and Vasquez-Lavin (2013) with data from CASEN 2013, the value of the test proposed by Stock and Yogo (2005) is lower than the critical value, so the hypothesis of weak instruments cannot be rejected. In contrast, if the instruments used in the present study are considered, the values of the tests in the 2SLS and Heckit 2SLS models are much higher than the critical value, which is why the hypothesis of weak instruments is rejected in this case.

Regarding the exogeneity condition, only three of the instrumental variables proposed in this study fulfilled the Hansen *J* test, which evaluates partial exogeneity. These instrumental variables were the number of people who are economically dependent on the household, the proportion of large firms by economic sector and the proportion of small firms by economic sector. Consequently, the inclusion of these three instruments meets the requirements of relevance and exogeneity required by the method of instrumental variables; therefore, they were the only ones used in the regressions reported in **Table 4**. While replicating the study of Parada-Contzen, Riquelme-Won, and Vasquez-Lavin (2013) with the data from CASEN 2013, the value of the *J* test is high, rejecting the hypothesis of partial exogeneity of the instrumental variables included in that study.

From the tests performed, it is concluded that the instrumental variables used by Parada-Contzen, Riquelme-Won, and Vasquez-Lavin (2013) correspond to weak instruments and do not meet the requirement of exogeneity. Therefore, the parameters estimated through the 2SLS method based on these instruments would be biased and inconsistent, which would explain the high value of the VSL for Chile estimated by that study compared to other estimates for countries with similar GDPs per capita.[7] In contrast, the three instrumental variables used in this study meet the relevance and exogeneity requirements, which validates the estimates made by the 2SLS and Heckit 2SLS methods. However, because we detected the presence of a selection bias (significant inverse Mills ratio variable in the Heckit regression), the best statistical model is Heckit 2SLS, which delivers a VSL of US$3.73 million (see **Table 5**).[8]

Lindhjem et al. (2011) mention that it is not appropriate to compare estimates of the VSL obtained through different approaches. However, for illustrative purposes only, **Table 6** presents previous estimates made in Chile using the declared preference approach.

Most of all, the estimates obtained through the declared preference approach are several times smaller than those estimated through the revealed preference approach estimated in this study, which contradicts the results found by De Blaeij et al. (2003). The lowest VSLs were published in scientific journals, whereas the highest VSLs were estimated in a report by GreenLab (2014) developed for the Chilean Ministry of the Environment. In addition, it is observed that none of the estimates with stated preferences are found in the confidence intervals reported in **Table 6**.

Extrapolation of VSL for Latin America

In this section, the available estimates for performing a meta-analysis and extrapolating the VSL for different countries in Latin America are reviewed. For this, the results of previous studies that use the hedonic wage method published in scientific journals are used, including the estimated VSL for Chile in this research.

To determine the relationship between the GDP per capita and VSL for each country, linear and logarithmic regressions were estimated. The regression with the least mean square error was as follows:

$$\begin{aligned} \ln(VSL) &= -3.862203 + 1.642119 * \ln(GDP\ per\ capita) \quad R^2 = 0.45 \\ &\quad\ (2.322233) \quad\ (0.6027472) \end{aligned} \tag{10}$$

[7] In replicating the previous study by Parada-Contzen, Riquelme-Won, and Vasquez-Lavin (2013) with the data from the CASEN 2013 survey, a VSL of up to US$16.6 million (estimates not reported by space themes) is obtained, similar to the value obtained by them (US$14.8 million, updated to 2013 dollars).

[8] The value of the coefficient estimated for fatal risk with Heckit 2SLS (or Heckit) model is used to calculate the marginal effect of VSL conditional on labor force participation.

The average wage used for calculations is Ch$372,316 per month.

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Table 4: Results according to the estimation method.

Variable	OLS		Heckit		2SLS		Heckit 2SLS	
	Coef.	St. Dev.	Coef.	St. Dev.	Coef.	St. Dev.	Coef.	St. Dev.
Constant	11.605	0.128**	11.963	0.107**	10.975	0.148**	11.322	0.148**
Schooling	0.048	0.005**	0.037	0.004**	0.049	0.001**	0.038	0.001**
Exper	0.023	0.002**	0.021	0.002**	0.022	0.001**	0.020	0.001**
Exper2	−3.51E-04	4.05E-05**	−3.18E-04	3.91E-05**	0.000	0.000**	0.000	0.000**
Gender	0.319	0.035**	0.206	0.033**	0.259	0.007**	0.152	0.009**
Labortime	0.005	0.001**	0.005	0.001**	0.005	0.000**	0.005	0.000**
Worktime	0.001	0.000*	0.001	0.000*	0.001	0.000**	0.001	0.000**
Fulltime	0.238	0.054**	0.237	0.053**	0.255	0.009**	0.254	0.009**
Indefinitecontract	0.115	0.015**	0.109	0.014**	0.140	0.006**	0.135	0.006**
Training	0.066	0.011**	0.061	0.011**	0.061	0.007**	0.057	0.007**
Numworkerf1	−0.204	0.033**	−0.204	0.033**	−0.196	0.012**	−0.196	0.012**
Numworkerf2_5	−0.093	0.033*	−0.094	0.033*	−0.072	0.010**	−0.073	0.010**
Numworkerf6_9	−0.014	0.014	−0.014	0.014	0.006	0.011	0.006	0.011
Numworkerf10_49	0.010	0.007	0.010	0.007	0.020	0.008*	0.019	0.008*
Numworkerf50_199	0.056	0.010**	0.052	0.011**	0.051	0.009**	0.047	0.009**
Numworkerf200	0.061	0.016**	0.058	0.016**	0.045	0.007**	0.043	0.007**
Region1	0.277	0.043**	0.277	0.042**	0.294	0.016**	0.294	0.016**
Region2	0.274	0.035**	0.278	0.034**	0.280	0.017**	0.284	0.017**
Region3	0.170	0.051*	0.174	0.050*	0.155	0.017**	0.160	0.017**
Region4	0.036	0.032	0.038	0.032	0.041	0.017*	0.043	0.017**
Region5	0.008	0.024	0.012	0.024	0.030	0.015*	0.032	0.015*
Region6	0.037	0.025	0.039	0.024	0.066	0.015**	0.067	0.015**
Region7	0.019	0.022	0.022	0.022	0.045	0.015**	0.047	0.015**
Region8	−0.082	0.053	−0.078	0.053	−0.043	0.015**	−0.040	0.014**
Region9	−0.126	0.049*	−0.125	0.048*	−0.096	0.016**	−0.095	0.016**
Region10	−0.029	0.035	−0.026	0.034	0.001	0.016	0.003	0.016
Region11	0.210	0.028**	0.213	0.028**	0.236	0.019**	0.238	0.019**
Region12	0.191	0.025**	0.194	0.024**	0.218	0.018**	0.220	0.018**
MetropolitanRegion	0.137	0.039**	0.142	0.039**	0.185	0.014**	0.188	0.014**
Region14	−0.122	0.042*	−0.119	0.041*	−0.093	0.017**	−0.091	0.017**
Employer	0.534	0.083**	0.523	0.081**	0.576	0.025**	0.565	0.025**
Independent	−0.076	0.059	−0.080	0.058	−0.014	0.015	−0.019	0.015
Jobcategory1	0.098	0.096	0.121	0.094	0.390	0.142**	0.408	0.141**
Jobcategory2	0.401	0.068**	0.430	0.068**	0.662	0.142**	0.688	0.141**
Jobcategory3	−0.033	0.072	−0.005	0.073	0.242	0.142	0.267	0.141
Jobcategory4	−0.343	0.060**	−0.314	0.062**	−0.109	0.141	−0.083	0.140
Jobcategory5	−0.416	0.068**	−0.386	0.070**	−0.098	0.142	−0.073	0.141
Jobcategory6	−0.510	0.076**	−0.482	0.077**	−0.321	0.141*	−0.296	0.140*
Jobcategory7	−0.363	0.085**	−0.338	0.085**	−0.173	0.141	−0.152	0.140

(contd.)

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Variable	OLS		Heckit		2SLS		Heckit 2SLS	
	Coef.	St. Dev.	Coef.	St. Dev.	Coef.	St. Dev.	Coef.	St. Dev.
Jobcategory8	–0.306	0.108*	–0.286	0.108*	–0.253	0.141	–0.234	0.139
Jobcategory9	–0.562	0.068**	–0.531	0.069**	–0.325	0.141*	–0.297	0.140*
Extrahours	0.025	0.010*	0.017	0.010	0.045	0.007**	0.036	0.007**
Nightshift	–0.035	0.016	–0.035	0.016	–0.018	0.007**	–0.018	0.007**
Ethnia	–0.053	0.012**	–0.051	0.012**	–0.057	0.008**	–0.055	0.008**
Externalmigrat	0.104	0.021**	0.096	0.021**	0.117	0.021**	0.110	0.022**
Intmigrat	0.103	0.012**	0.088	0.012**	0.104	0.009**	0.090	0.009**
Non-fatalrisk	–0.049	0.010**	–0.048	0.010**	–0.015	0.004**	–0.014	0.004**
Fatalrisk	134.367	21.769**	132.695	21.487**	447.984	17.611**	442.138	17.532**
MillsInverseRatio			–0.247	0.017**			–0.237	0.012**
Test for weak instruments					2549.8**		2546.8**	
Hansen *J* Test					0.516		1.152	
p-value χ^2 (1)					0.473		0.283	
Observations	64260		64260		64260		64260	
R^2	0.4542		0.4577		0.4199		0.4207	

Source: Own elaboration.
Note: **significant at 1%, *significant at 5%.

Table 5: Estimation of VSL for Chile (millions of US$ year 2013).

Method	OLS	Heckit	2SLS	Heckit 2SLS
VSL (mean)	1.13	1.12	3.78	3.73
IC 95% [higher – lower]	[0.70–1.57]	[0.69–1.55]	[3.49–4.07]	[3.44–4.02]
VSL (10th percentile)	0.30	0.30	1.02	1.00
IC 95% [higher – lower]	[0.19–0.42]	[0.19–0.42]	[0.94–1.09]	[0.92–1.08]
VSL (25th percentile)	0.61	0.60	2.03	2.00
IC 95% [higher – lower]	[0.38–0.84]	[0.37–0.83]	[1.87–2.19]	[1.85–2.16]
VSL (50th percentile)	0.76	0.75	2.54	2.50
IC 95% [higher – lower]	[0.47–1.05]	[0.46–1.04]	[2.34–2.73]	[2.31–2.70]
VSL (75th percentile)	1.21	1.20	4.06	4.01
IC 95% [higher – lower]	[0.75–1.69]	[0.74–1.67]	[3.75–4.37]	[3.70–4.32]
VSL (90th percentile)	2.12	2.11	7.11	7.01
IC 95% [higher – lower]	[1.32–2.95]	[1.30–2.91]	[6.56–7.65]	[6.47–7.56]

Source: Own elaboration.

Thus, equation (10) was used to generate the VSL extrapolations for the different countries of Latin America, using the GDP per capita from 2013 of each country reported by the World Bank (see **Table 7**).

The results of **Table 8** show that the estimated VSL for Chile from the meta-analysis is lower than the VSL estimated in this study using instrumental variables (2SLS or Heckit 2SLS). It could be explained because meta-analysis does not include many observations from developing countries. In consequence, the results show the importance of performing empirical studies with micro-data in each country to have

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Table 6: Estimates of VSL for Chile with the stated preference approach.

Stated preference approach	VSL estimated (millions of US$ 2013)
Ortúzar, Cifuentes & Williams (2000) – road safety	0.68
Ortúzar, Cifuentes & Williams (2000) – air pollution	0.41
Rizzi & Ortúzar (2003)	0.28
Iragüen & Ortúzar (2004)	0.39
Hojman, Ortúzar & Rizzi (2005) – road safety route 5	0.40
Hojman Ortúzar & Rizzi (2005) – road safety route 68	0.38
GreenLab UC (2014) – road safety	0.82
GreenLab UC (2014) – air pollution	5.40

Source: Own elaboration.

Table 7: GDP per capita and VSL estimated by study in 2013 dollars.

Country	GDP per capita (millions of US$)	VSL (millions of US$)
Australia (Miller, Mulvey & Norris 1997)	67.6	25.7
Canada (Lanoie, Pedro & Latour 1995)	52.3	26.6
Canada (Meng & Smith 1999)	52.3	9.6
Canada (Gunderson & Hyatt 2001)	52.3	27.2
Chile (Parada-Contzen, Riquelme-Won & Vasquez-Lavin 2013)	15.7	14.8
Chile (study under method Heckit 2SLS)	15.7	3.7
Germany (Schaffner & Spengler 2010)	46.4	9.3
Hong Kong (Siebert & Wei 1994)	38.4	2.4
Spain (Riera Font, Ripoll Penalva & Sbert 2007)	29.4	2.7
Switzerland (Baranzini & Ferro Luzzi 2001)	84.7	10.5
Taiwan (Liu & Hammitt 1999)	18.5	1.0
Turkey (Polat 2014)	11.2	0.2
UK (Siebert & Wei 1994)	42.3	28.1
UK (Arabsheibani & Marin 2000)	42.3	27.3
UK (Sandy & Elliot 1996)	42.3	42.2
UK (Sandy et al. 2001)	42.3	7.7
USA (Viscusi 2003)	53.0	18.0
USA (Viscusi 2004)	53.0	5.7
USA (Evans & Schaur 2010)	53.0	9.6
USA (Scotton & Taylor 2011)	53.0	12.4

Source: Own elaboration.

more accurate estimates In addition, Chile has the third highest estimated VSL based on the meta-analysis approach, behind Puerto Rico and Uruguay, which have estimated VSLs of US$5.20 million and US$2.18 million, respectively. In contrast, the lowest VSL is presented by Haiti, which amounts to US$0.01 million, followed by Nicaragua, Honduras, and Bolivia, which have values of US$0.06 million, US$0.09 million, and US$0.12 million, respectively.

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Table 8: VSL estimation for Latin American countries.

Country	GDP per capita year 2013 (millions of US$)	Estimated VSL (millions of US$)
Argentina	14.44	1.69
Bolivia	2.95	0.12
Brazil	11.71	1.19
Chile	15.74	1.94
Colombia	8.03	0.64
Costa Rica	10.46	0.99
Cuba	6.79	0.49
Dominican Republic	5.97	0.40
Ecuador	6.05	0.40
El Salvador	4.00	0.20
Guatemala	3.43	0.16
Haiti	0.81	0.01
Honduras	2.36	0.09
Mexico	10.17	0.95
Nicaragua	1.82	0.06
Panama	11.21	1.11
Paraguay	4.50	0.25
Peru	6.60	0.47
Puerto Rico	28.68	5.20
Uruguay	16.88	2.18
Venezuela (*)	12.77	1.38

Source: Own elaboration.
*Venezuela's per capita GDP corresponds to 2012, because there are no records after that year.

The results of the meta-analysis carried out in this study provide evidence to suggest an income elasticity higher than 1.6, which agrees with recent studies that suggest the use of elasticities greater than 1, especially when results are extrapolated to low-income countries (Hammitt and Robinson 2011).

Conclusions

In this study, we obtain the value of a statistical life in Chile using labor market information under different estimation methods to later calculate the VSL for different countries of Latin America through a meta-analysis.

Estimates for Chile with labor market data at the individual level are approximately double the values obtained by extrapolating the VSL from other studies of hedonic wages for countries with a similar GDP per capita. This shows the importance of performing empirical studies in each country to have more accurate estimates. In particular, the Heckit 2SLS method presented a VSL value of US$3.73 million (between US$3.44 million and US$4.02 million with a 95 percent confidence interval). It should be noted that the use of instrumental variables with weak instrument tests and partial exogeneity was validated, so the estimated parameters should be consistent despite the endogeneity of explanatory variables associated with fatal and nonfatal risk.

Additionally, from the meta-analysis, the VSL is obtained for each Latin American country, with an average value of US$0.82 million for this region. In addition, it is concluded that before an increase of GDP per capita of 1 percent per year, the VSL would grow by 1.64 percent.

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Despite the low amount of data available to perform the meta-analysis and the fact that the scarcity of studies for low- and middle-income countries limits the extrapolation of VSLs for Latin American countries, the results obtained in this study could be an acceptable proxy in relation to the value of statistical life, considering that there are many countries in Latin America that do not have their own VSL estimates and that this information would allow for better decision-making in projects that directly or indirectly involve changes in the mortality risk of people.

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References

Angrist, Joshua, and Alan Krueger. 2001. "Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments." *Journal of Economic Perspectives* 15 (4): 69–85. DOI: https://doi.org/10.1257/jep.15.4.69

Arabsheibani, Reza, and Alan Marin. 2000. "Stability of Estimates of the Compensation for Danger." *Journal of Risk and Uncertainty* 20 (3): 247–269. DOI: https://doi.org/10.1023/A:1007819530588

Baranzini, Andrea, and Giovanni Ferro Luzzi. 2001. "The Economic Value of Risks to Life: Evidence from the Swiss Labour Market." *Revue Suisse d'Economie Politique et de Statistique* 137 (2): 149–170.

Bellavance, François, Georges Dionne, and Martin Lebeau. 2009. "The Value of a Statistical Life: A Meta-Analysis with a Mixed Effects Regression Model." *Journal of Health Economics* 28 (2): 444–464. DOI: https://doi.org/10.1016/j.jhealeco.2008.10.013

De Blaeij, Arianne, Raymond Florax, Piet Rietveld, and Erik Verhoef. 2003. "The Value of Statistical Life in Road Safety: A Meta-Analysis." *Accident Analysis and Prevention* 35 (6): 973–986. DOI: https://doi.org/10.1016/S0001-4575(02)00105-7

Evans, Mary, and Georg Schaur. 2010. "A Quantile Estimation Approach to Identify Income and Age Variation in the Value of a Statistical Life." *Journal of Environmental Economics and Management* 59 (3): 260–270. DOI: https://doi.org/10.1016/j.jeem.2009.11.004

Garen, John. 1988. "Compensating Wage Differentials and the Endogeneity of Job Riskiness." *Review of Economics and Statistics* 70 (1): 9–16. DOI: https://doi.org/10.2307/1928145

Gentry, Elissa, and Kip Viscusi. 2016. "The Fatality and Morbidity Components of the Value of Statistical Life." *Journal of Health Economics* 46: 90–99. DOI: https://doi.org/10.1016/j.jhealeco.2016.01.011

GreenLab UC. 2014. "Estimación del valor de la vida estadística asociado a contaminación atmosférica y accidentes de tránsito." Informe Final preparado para el Ministerio del Medio Ambiente, 1–217, Santiago.

Gunderson, Morley, and Douglas Hyatt. 2001. "Workplace Risks and Wages: Canadian Evidence from Alternative Models." *Canadian Journal of Economics/Revue Canadienne d'Économique* 34 (2): 377–395. DOI: https://doi.org/10.1111/0008-4085.00079

Hammitt, James, and Lisa Robinson. 2011. "The Income Elasticity of the Value per Statistical Life: Transferring Estimates between High and Low Income Populations." *Journal of Benefit-Cost Analysis* 2 (1): 1–29. DOI: https://doi.org/10.2202/2152-2812.1009

Heckman, James. 1979. "Sample Selection Bias as a Specification Error." *Econometrica* 47 (1): 153. DOI: https://doi.org/10.2307/1912352

Hojman, Pablo, Juan Ortúzar, and Luis Rizzi. 2005. "On the Joint Valuation of Averting Fatal and Severe Injuries in Highway Accidents." *Journal of Safety Research* 36 (4): 377–386. DOI: https://doi.org/10.1016/j.jsr.2005.07.003

Hwang, Hae-shin, Robert Reed, and Carlton Hubbard. 1992. "Compensating Wage Differentials and Unobserved Productivity." *Journal of Political Economy* 100 (4): 835–858. DOI: https://doi.org/10.1086/261842

Iragüen, Paula, and Juan Ortúzar. 2004. "Willingness-to-Pay for Reducing Fatal Accident Risk in Urban Areas: An Internet-Based Web Page Stated Preference Survey." *Accident Analysis & Prevention* 36 (4): 513–524. DOI: https://doi.org/10.1016/S0001-4575(03)00057-5

Kniesner, Thomas, Kip Viscusi, Christopher Woock, and James Ziliak. 2007. "Pinning Down the Value of Statistical Life." *IZA Discussion Paper* 3107.

Lanoie, Paul, Carmen Pedro, and Robert Latour. 1995. "The Value of a Statistical Life: A Comparison of Two Approaches." *Journal of Risk and Uncertainty* 10 (3): 235–257. DOI: https://doi.org/10.1007/BF01207553

Lindhjem, Henrik, Ståle Navrud, Nils Axel Braathen, and Vincent Biausque. 2011. "Valuing Mortality Risk Reductions from Environmental, Transport, and Health Policies: A Global Meta-Analysis of Stated Preference Studies: Valuing Mortality Risk Reductions from Environmental, Transport, and Health Policies." *Risk Analysis* 3 (9): 1381–1407. DOI: https://doi.org/10.1111/j.1539-6924.2011.01694.x

Liu, Jin-Tan, and James Hammitt. 1999. "Perceived Risk and Value of Workplace Safety in a Developing Country." *Journal of Risk Research* 2 (3): 263–275. DOI: https://doi.org/10.1080/136698799376835

Mardones, Cristian. 2019. "Determining the 'Optimal' Level of Pollution (PM2.5) Generated by Industrial and Residential Sources." *Environmental Impact Assessment Review* 74: 14–22. DOI: https://doi.org/10.1016/j.eiar.2018.09.003

Mardones, Cristian, Andrés Saavedra, and Jorge Jiménez. 2015. "Cuantificación económica de los beneficios en salud asociados a la reducción de la contaminación por MP10 en Concepción Metropolitano, Chile." *Revista Médica de Chile* 143: 475–483. DOI: https://doi.org/10.4067/S0034-98872015000400009

Meng, Ronald, and Douglas Smith. 1999. "The Impact of Workers' Compensation on Wage Premiums for Job Hazards." *Applied Economics* 31 (9): 1101–1108. DOI: https://doi.org/10.1080/000368499323580

Miller, Paul, Charles Mulvey, and Keith Norris. 1997. "Compensating Differentials for Risk of Death in Australia." *Economic Record* 73 (223): 363–372. DOI: https://doi.org/10.1111/j.1475-4932.1997.tb01008.x

Miller, Ted. 2000. "Variations between Countries in Values of Statistical Life." *Journal of Transport Economics and Policy* 34: 169–188.

Ortúzar, Juan, Luis Cifuentes, and Hug Williams. 2000. "Application of Willingness-to-Pay Methods to Value Transport Externalities in Less Developed Countries." *Environment and Planning A* 32 (11): 2007–2018. DOI: https://doi.org/10.1068/a3324

Parada-Contzen, Marcela, Andrés Riquelme-Won, and Felipe Vasquez-Lavin. 2013. "The Value of a Statistical Life in Chile." *Empirical Economics* 45 (3): 1073–1087. DOI: https://doi.org/10.1007/s00181-012-0660-7

Polat, Sezgin. 2014. "Wage Compensation for Risk: The Case of Turkey." *Safety Science* 70: 153–160. DOI: https://doi.org/10.1016/j.ssci.2014.05.018

Riera Font, Antoni, Aina Ripoll Penalva, and Josep Mateu Sbert. 2007. "Estimación del valor estadístico de la vida en España: Una aplicación del método de salarios hedónicos." *Hacienda Pública Española* (181): 29–48.

Rizzi, Luis, and Juan Ortúzar. 2003. "Stated Preference in the Valuation of Interurban Road Safety." *Accident Analysis & Prevention* 35(1): 9–22. DOI: https://doi.org/10.1016/S0001-4575(01)00082-3

Sandy, Robert, and Robert Elliott. 1996. "Unions and Risk: Their Impact on the Level of Compensation for Fatal Risk." *Economica* 63 (250): 291. DOI: https://doi.org/10.2307/2554764

Sandy, Robert, Robert Elliott, W. Stanley Siebert, and Xiangdong Wei. 2001. "Measurement Error and the Effects of Unions on the Compensating Differentials for Fatal Workplace Risks." *Journal of Risk and Uncertainty* 23 (1): 33–56. DOI: https://doi.org/10.1023/A:1011112631522

Schaffner, Sandra, and Hannes Spengler. 2010. "Using Job Changes to Evaluate the Bias of Value of a Statistical Life Estimates." *Resource and Energy Economics* 32 (1): 15–27. DOI: https://doi.org/10.1016/j.reseneeco.2009.06.001

Scotton, Carol R., and Laura Taylor. 2011. "Valuing Risk Reductions: Incorporating Risk Heterogeneity into a Revealed Preference Framework." *Resource and Energy Economics* 33 (2): 381–397. DOI: https://doi.org/10.1016/j.reseneeco.2010.06.001

Shogren, Jason, and Tommy Stamland. 2002. "Skill and the Value of Life." *Journal of Political Economy* 110 (5): 1168–1173. DOI: https://doi.org/10.1086/341875

Siebert, W. Stan, and Xiangdong Wei. 1998. "Wage Compensation for Job Risks: The Case of Hong Kong." *Asian Economic Journal* 12 (2): 171–181. DOI: https://doi.org/10.1111/1467-8381.00058

Siebert, W. Stanley, and Xiangdong Wei. 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. DOI: https://doi.org/10.1007/BF01073403

https://doi.org/10.25222/larr.61 Published online by Cambridge University Press

Staiger, Douglas, and James H. Stock. 1997. "Instrumental Variables Regression with Weak Instruments." *Econometrica* 65 (3): 557–586. DOI: https://doi.org/10.2307/2171753
Stock, James, and Motohiro Yogo. 2005. "Testing for Weak Instruments in Linear IV Regression." *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*.
Viscusi, W. Kip. 2003. "Radical Differences in Labor Market Values of a Statistical Life." *Journal of Risk and Uncertainty* 27 (3): 239–256. DOI: https://doi.org/10.1023/A:1025893226730
Viscusi, W. Kip. 2004. "The Value of a Statistical Life: Estimates with Risk by Occupation and Industry." *Economic Inquiry* 42 (1): 29–48. DOI: https://doi.org/10.1093/ei/cbh042
Viscusi, W. Kip, and Joseph E. Aldy. 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. DOI: https://doi.org/10.1023/A:1025598106257

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