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Wage Compensation for Risk: The Case of Turkey

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Abstract

In this article, I estimate the premium associated with fatal and non-fatal risk within broad industry categories, using official figures provided by the Ministry of Labor and Social Security and wage data from the 2010 and 2011 Household Labor Force Surveys. The results show only positive and significant fatal risk premiums in the manufacturing sector, whereas injury risk premiums exist in both the manufacturing and industry-wide samples. When wage heterogeneity is allowed, fatal risk compensation increases along the distribution, while that of injury risk follows an inverse-u pattern. Compared to similar country cases, the VSL and VSI estimates are relatively small and not significant for low wage earners. Industry averages show that longer working hours are correlated with accidents rates which implies the importance of firm heterogeneity and institutional factors on the high level and variance, particularly for Turkey.

Keywords: Value of a statistical life; Value of a statistical injury; Hedonic wages; Quantile regression

JEL Classification: J17; J28

1 Introduction

According to recent estimates by the International Labor Organization, 6,300 people die each day from occupational accidents or work-related diseases, and the yearly death toll exceeds more than 2.3 million. Turkey has the highest fatality and injury rates among OECD countries OECD (2006).[1] Between 2000 and 2005, the most occupational accidents in Turkey were observed in the sectors of manufacture of metal goods (excluding for machines), construction, the textile industry, coal mining, and manufacture of transportation vehicles Unsar and Sut (2009). Some papers addressed the issue of work safety in specific sectors such as shipyard Barlas (2012), mining Sari et al. (2004) and construction Gürcanli and Müngen (2009) fatalities. Turkey is not a exceptional case; in many developing countries, higher accident rates have emerged as result of fast growing and unregulated

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[1] Turkey has the highest fatal risk rate reported 20.6 per 100,000 workers. See "Work Accidents", *in Society at a Glance 2006: OECD Social Indicators*.

economies where institutional risk measures are largely neglected and increasing global competition weakens environmental and work safety Hämäläinen (2009). These stylized facts raise the question of risk compensation in low work safety environments particularly for developing countries. In this paper, I will investigate whether and to what extent workers are compensated by a premium for risky jobs in the Turkish labor market using the well-established methods of literature on the value of a statistical life (VSL) and injury (VSI). For the Turkish case, this study contributes as the first attempt to assess the risk compensation at the industry level using micro-data. In addition to the hedonic wage regression introduced by early studies Viscusi (1993), this paper adopts the quantile approach proposed by Evans and Schaur (2010) and Kniesner et al. (2010) in order to take into account the income (wage) heterogeneity in estimating the risk premium. This approach has the advantage of differentiating the wage-risk trade-off of workers along the wage distribution. The OLS results reveal that there is not a fatality risk premium when all industry-wide sub-sectors are included, there is a wage/risk trade-off for fatal risk only in manufacturing sector. For injury risk, both the industry-wide and manufacturing results show that workers are paid a risk premium. Once wage heterogeneity is assumed, the quantile results confirm the findings of the existing studies that workers are increasingly compensated for risky jobs along the wage distribution.

I will present the Turkish data then introduce the model and the estimation strategy to be used. Following the discussion of the OLS and quantile results and the VSL and VSI estimations, some specific issues will be addressed concerning the relationship between some industry-level characteristics and industrial accident rates in Section 3. Section 4 concludes.

2 Data and Estimation Strategy

Choosing an accurate indicator for accident risk is central to the measurement of the premium. Theoretically, in the wage bargaining framework, the compensating differential should be negotiated according to the level of uncertainty related to the nature of the job and the position of the worker in the organization. The employer has information that workers do not have and workers have to deal with the contingencies of the job if they accept the job offer. For workers, the risks associated with certain jobs could be perceived either through their limited personal evaluations (whether on-the-job or prior to the job offer) or through the publicly available information. In some cases, it is possible that both parties might not evaluate the associated risks ex ante. For the Turkish case, to my knowledge, no subjective evaluation of workers for fatality and injury risks at the industry or occupation level is available. The available fatality and injury data are provided by the Ministry of Labor and Social Security (MLSS) and they include all the formally employed wage earning workers who are subject to social coverage under article 4-1/a of Act 5510.[2] Given

[2]ILOSTAT does provide comparable fatality and non-fatality figures for Turkey but figures are only updated through 2008

the size and low standards of informal employment in Turkey and given that the data exclude not only workers with no legal protection but also the self employed, the data excludes a considerable portion of workers.[3]

A two-digit industrial breakdown of risk data provides sufficient heterogeneity and conforms with the industry classification of the wage data obtained from the Household Labor Force Survey (HLFS) for 2010 and 2011. At the industry level, the MLSS provides gender-specific fatality and injury cases for 84 sub-sectors.[4] The total number of workers corresponding to each industry is obtained from the HLFS using weights given by TurkStat that conform to the criteria of coverage under article 4-1/a. The fatality risk ratio is calculated per 10.000 workers and the injury risk ratio is given as a percentage as commonly preferred in the literature. Choosing the denominator to be used is problematic. Viscusi (2004) discusses the issues in creating a job risk variable at the aggregated industry level and finds that most studies prefer to use blue-collar or male samples to estimate the risk premium. Without making any skill distinction, I choose gender specific risk rates for two reasons. Firstly, female participation is very low at every industry level and it increases with education level.[5] Thus the total accident figures corresponding to each industry would hide the gender-biased risk because of low participation. Secondly, industry or occupation choice can also indicate a gender bias. In addition to the participation issue, for female workers, the nature of work could also differ within each industry or occupation. In terms of risk disaggregation, it is evident that in industry pairs where gender participation is more balanced, the risk rate still reflects the aggregate level and does not produce any bias but sector selection.

Yearly gender-specific risk ratios (Table 1) reveal that fatality rates are high and show great dispersion across all industries although in the manufacturing sector, they are lower and relatively less dispersed. For Chile, Parada-Contzen et al. (2012) report fatal risk rates that are relatively lower than those of Turkey: 0.584 (3 times lower) and 0.406 (6 times lower) for the manufacturing sector and total industry respectively. However the injury rates are far higher compared to Turkey. Secondly, female rates are expectedly lower for both groups and the accident cases are quite limited compared to the male sample. For both male and female sample, the non-fatal injury risk rates are higher in the manufacturing sector and the existing gender gap is not so wide as it is for fatal risk.

Estimation of the risk premium is generally based on the canonical hedonic wage model which involves the usual wage regression plus a premium (taste) for risk. Following the accepted procedure, the wage equation (1) can be be estimated including the premia for risks associated with a particular industry using HLFS data which include wage earners with a positive wage and working hours and an age interval between 21 and 65.

[3]Turkey is not an exceptional case in providing fatality numbers only for insured/covered workers. By the same token, it has been argued that the global figures provided by ILO underestimate the real accident cases Hämäläinen et al. (2009)

[4]Among the 88 subsectors in the Nace 2 revision, four sectors are unreported.

[5]In recent years, there seems to have been a more equal reallocation of women between sector. See Bakis and Polat (2013) for within and between effects

Table 1: Fatal and Non-Fatal Accident Ratios Across Industries (Nace Rev. 2)

(a) Fatal Risk

	All Industries				Manufacturing			
	Men		Women		Men		Women	
	2010	2011	2010	2011	2010	2011	2010	2011
Mean	6.2919	6.3060	0.4353	0.2387	1.4678	1.6742	0.1207	0.1117
St. dev	27.9832	28.0709	2.3593	1.0157	1.7147	1.7777	0.3032	0.2642
Max.	252.9335	255.6260	19.4553	8.2610	6.8886	6.2701	1.2390	0.9840
Min.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
No. Cases	1121	1322	10	19	256	319	13	13
No. Sub-sectors	84	84	84	84	24	24	24	24

(b) Injury Risk

	All Industries				Manufacturing			
	Men		Women		Men		Women	
	2010	2011	2010	2011	2010	2011	2010	2011
Mean	0.9706	0.9447	0.3079	0.3004	1.2623	1.2739	0.4798	0.4837
St. Dev.	1.7937	1.8037	0.4306	0.4072	1.1085	1.0608	0.3752	0.4185
Max.	13.4770	14.6513	2.3952	1.8545	5.0120	4.5423	1.2235	1.8545
Min.	0.0043	0.0033	0.0000	0.0000	0.0703	0.0758	0.0000	0.0000
No. Cases	26487	30094	1466	1641	32258	34227	2419	2503
No. Sub-sectors	84	84	84	84	24	24	24	24

Accidents cases provided by Ministry of Labor and Social Security, number of insured workers are calculated from HLFSs 2010 and 2011 conforming the criteria under the article 4-1/a of Act 5510.
Data covers 84 sub-sectors for all industries and 24 manufacturing sub-sectors in total.
* Fatal risk per 10.000 workers and **Non-fatal risk per 100 workers

$$ln(w_i) = \alpha + \beta_1 X_i + \beta_2 H_i + \gamma q_i + \varepsilon_i \quad (1)$$

In equation(1), w_i denotes the log hourly wage. X is a set of individual covariates including gender, education(5 categories) age, age squared, tenure and its square, regular working hours, an urban dummy, marital status (4 categories), firm size (6 categories) and a public employee dummy. We control for fixed effects for region (12), industry (84, 24 if manufacturing), occupation (9) and years (2 if pooled). H indicates the industry, occupation and region effects. γ_1 denotes the risk premium associated with the gender specific fatality or injury risk p_i. ε is the error term. Table 2 provides a brief description of variables used in all the regressions.

The estimating strategy of risk compensation requires consideration of the selection bias inherent to choosing a risky job. The OLS estimation of equation (1) has been criticized because it does not deal with the endogeneity problem. Under the assumption that safety is a normal good, workers with higher incomes could prefer safer jobs in the trade-off between risk and earnings. Following Garen (1988), most of the literature uses non-wage income heterogeneity as a selection criterion. Garen (1988) also argues that job risk is endogenous to worker productivity and some workers with unobservable attributes such as cool-headness are more productive in risky jobs than in safer ones. The general argument is that risk aversion increases with earnings, productivity or

Table 2: Brief Descriptive Statistics

Variables	Mean	Mean
	All Industries	Manufacturing
Female	0.232	0.174
Age	35.833	34.215
Tenure years	7.703	5.735
Administrative Workers	0.100	0.064
Household size	3.896	4.056
Urban	0.858	0.871
Regular Working Hours	49.842	52.540
Public Employee	0.318	0.022
Fatal Risk	1.385	1.088
Injury Risk	0.590	1.285
Log Hourly Wage	1.669	1.391
No. of Subsectors	84	24

Other variables included in regressions
Education Dummies (5 categories, no schooling, less than secondary, secondary, vocational secondary, upper secondary level)
Martial Status Dummies (4 categories, Never married, Married, Divorced, Spouse died)
Firm Size Dummies (6 categories Less than 10 workers, 10-24, 25-49, 50-249, 250-499 and 500 and more workers)
Occupation Dummies (9 categories - one digit isco revision 88)
Region Dummies (12 regions - Nuts1 classification)
Industry Dummies (Industry dummies at Nace Revision 2)

aging.[6] Considering that wage is an important component of income, Evans and Schaur (2010) and Kniesner et al. (2010) use the quantile regression approach to overcome the issue of income heterogeneity by allowing the wage elasticity to change along the distribution. The quantile wage regression allows the risk premium to vary with the wage and differentiates income elasticities for each quantile. Both studies find increasing income elasticity using the quantile approach. Evans and Schaur (2010) also include additional controls to account for age heterogeneity which allow for a differential effect of age on the wage-risk trade-off at different points in the wage distribution. I use both OLS and the quantile approach with different specifications to estimate fatality and injury risks separately for each year and pooled cross-sections. The results of the pooled regression will be the baseline model to estimate the monetary value of a statistical life and injury.

Suppose that the conditional quantile function for the quantile τ, denoted by Q_τ is given as in Eq.(2).

$$Q_\tau(ln(w_i)|X_i) = \alpha + \beta_{1\tau}X_i + \beta_{2\tau}H_i + \gamma_\tau q_i \tag{2}$$

The significance of quantile regression here is that the coefficient γ_τ represents the marginal risk compensation of the individual worker conditional on the parameters of the explanatory variables estimated at the τ^{th} percentile. Evans and Schaur (2010) show using a simple model that the premium scheme could be differentiated when wage heterogeneity is introduced and that through

[6] Viscusi and Aldy (2007) report that the value of statistical life-age relationship follows an inverted U pattern

quantile estimation, such differentials can be estimated. In contrast to their bootstrapping method to estimate asymptotic standard errors, I use the procedure proposed in Machado et al. (2011) which is valid under heteroskedasticity and misspecification.[7] Quantile regressions are estimated for pooled cross-sections of 2010 and 2011.

3 Results and discussion

The OLS estimation results shown in table 3 reveal that fatal risk premium is positive in both samples but only significant in the manufacturing sample. The injury risk is positive and significant in all specifications of each sample as shown in Table 4. The coefficients of the typical individual attributes have the expected signs. Individual wages increase with education, tenure and age. Other variables such as occupation, industry and region controls help to isolate the effect of risk factors in the estimation. However, as is widely reported in the VSL literature, the use of industry controls together with risk variables might lead to a multicollinearity problem and undermine the estimation of parameters.[8]. In our case, adding industry controls changes the sign of the coefficient of the risk premia in some specifications, but the standard errors do not inflate in a significant way.[9] Nevertheless, the inclusion of both risk rates in the model leads to some multicollinearity because there is a strong correlation between the fatality and injury risk rates.[10]

The result that the fatal risk premium is insignificant in the broader sample needs to be explained. Cases of insignificant or negative coefficients are not rare in the VSL literature. If it is not related to the nonexistence of compensation at the industrial level, the misspecification or construction of the risk variable might be responsible for the insignificant fatal risk premium in the industry-wide model.[11] Fatal job risk coefficients for the manufacturing sector are very close, ranging from 0.011% to 0.014%. This range lies within the interval reported in Viscusi and Aldy (2003). The injury risk premium ranges from 1.4% and 2.65% and it is positive and significant in all models. Except for 2011, coefficients are comparably larger for the manufacturing industry.

Table 5 gives the results of the pooled quantile regressions for both sectors and job risk indi-

[7]Koenker and Hallock (2001) argue that the method used in the standard Stata package (qreg) produces "standard errors (which) are frequently considerably smaller" p.16. Machado et al. (2011) compares their estimates with both standard and bootstrapping methods.

[8]See Hintermann et al. (2010) reports the precariousness of the results for various specifications when industry dummies are included. See also Viscusi and Aldy (2003)for a discussion on the multicollinearity problem. In cases of strong multicollinearity, Kochi (2010) p.22 propose using "risk variables in a way not highly correlated with industry variables" such as a combination of occupation and industry affiliation of workers.

[9]We do not report the results, but they are available upon request. The use of pooled cross-section and gender-specific risk rates partly solves the misspecification problem.

[10]Hintermann et al. (2010) similarly report close correlation. See the next section for the correlation of risk rates.

[11]Doucouliagos et al. (2012) discusses inconsistent VSL results and cites the argument of Dorman and Hagstrom (1998) that it is not because disadvantaged workers "attach less value to life...but they face a restricted set of options in which their preferences for safety are not given much weight...they have found their way into situations of high risk and low pay..." p. 133

Table 3: Results from OLS Hedonic Regression for Industrial Fatal Risk

	All Industries			Manufacturing Industry		
	Pooled	Year 2010	Year 2011	Pooled	Year 2010	Year 2011
Fatal Risk	0.00051	0.00054	0.00018	0.01097***	0.01487*	0.01400**
	(0.00039)	(0.00047)	(0.00069)	(0.00402)	(0.00897)	(0.00594)
Female	-0.10566***	-0.10315***	-0.10807***	-0.12610***	-0.11938***	-0.12775***
	(0.00253)	(0.00366)	(0.00350)	(0.00539)	(0.00813)	(0.00799)
Less than Secondary Education	0.03691***	0.03182***	0.04132***	0.01782*	0.02721**	0.01156
	(0.00718)	(0.00987)	(0.01036)	(0.00995)	(0.01387)	(0.01426)
High School	0.13745***	0.12633***	0.14736***	0.08526***	0.09181***	0.08139***
	(0.00760)	(0.01048)	(0.01095)	(0.01122)	(0.01564)	(0.01609)
Voc. High School	0.14177***	0.12676***	0.15519***	0.11773***	0.11726***	0.11992***
	(0.00757)	(0.01042)	(0.01093)	(0.01077)	(0.01500)	(0.01546)
Upper Secondary	0.35924***	0.35452***	0.36294***	0.30850***	0.31779***	0.30160***
	(0.00800)	(0.01109)	(0.01148)	(0.01312)	(0.01873)	(0.01844)
Age	0.02462***	0.02330***	0.02578***	0.02039***	0.01997***	0.02045***
	(0.00109)	(0.00159)	(0.00150)	(0.00200)	(0.00283)	(0.00284)
Age squared	-0.02854***	-0.02701***	-0.02990***	-0.02293***	-0.02219***	-0.02322***
	(0.00147)	(0.00215)	(0.00201)	(0.00277)	(0.00391)	(0.00394)
Administrative Worker	0.14221***	0.14285***	0.14189***	0.18806***	0.18096***	0.19473***
	(0.00449)	(0.00653)	(0.00619)	(0.01136)	(0.01624)	(0.01587)
Regular Hours	-0.01760***	-0.01767***	-0.01750***	-0.01690***	-0.01679***	-0.01698***
	(0.00011)	(0.00016)	(0.00016)	(0.00022)	(0.00029)	(0.00032)
Tenure	0.01748***	0.01850***	0.01651***	0.01403***	0.01370***	0.01387***
	(0.00042)	(0.00063)	(0.00057)	(0.00084)	(0.00124)	(0.00113)
Tenured squared	-0.03001***	-0.03169***	-0.02832***	-0.00879**	-0.00247	-0.01194**
	(0.00157)	(0.00238)	(0.00209)	(0.00405)	(0.00618)	(0.00529)
Married	0.08108***	0.07764***	0.08434***	0.06945***	0.06264***	0.07648***
	(0.00280)	(0.00405)	(0.00387)	(0.00504)	(0.00722)	(0.00703)
Divorced	0.07129***	0.06923***	0.07310***	0.05272***	0.06348***	0.04493**
	(0.00687)	(0.00989)	(0.00951)	(0.01359)	(0.01949)	(0.01895)
Spouse Died	0.03531***	0.04708**	0.02536	0.02279	0.04258	-0.01110
	(0.01249)	(0.01886)	(0.01677)	(0.02516)	(0.03164)	(0.04004)
Firm Size 10-24	0.07849***	0.07549***	0.08102***	0.01732**	0.01071	0.02273**
	(0.00352)	(0.00507)	(0.00488)	(0.00725)	(0.01046)	(0.01006)
Firm Size 25-49	0.08774***	0.08739***	0.08773***	0.02049***	0.02150**	0.01915**
	(0.00326)	(0.00470)	(0.00453)	(0.00649)	(0.00937)	(0.00900)
Firm Size 50-249	0.12790***	0.12680***	0.12899***	0.05640***	0.05407***	0.05767***
	(0.00330)	(0.00471)	(0.00463)	(0.00619)	(0.00883)	(0.00870)
Firm Size 250-499	0.16886***	0.16466***	0.17295***	0.10333***	0.10088***	0.10492***
	(0.00457)	(0.00649)	(0.00644)	(0.00762)	(0.01095)	(0.01062)
Firm Size 500 and more	0.21427***	0.20925***	0.21888***	0.18263***	0.18731***	0.17846***
	(0.00441)	(0.00631)	(0.00617)	(0.00765)	(0.01086)	(0.01078)
Public Employee	0.28454***	0.27602***	0.29252***	0.33413***	0.31952***	0.35209***
	(0.00517)	(0.00731)	(0.00732)	(0.01317)	(0.01936)	(0.01806)
Year 2011	0.03497***			0.02104***		
	(0.00182)			(0.00344)		
Observations	133,499	64,030	69,469	32,975	15,993	16,982
R-squared	0.74362	0.73944	0.74825	0.61077	0.60223	0.62030

The omitted category for dummies; having no schooling for education, less than 10 workers for firms size, unmarried for marital status, the year 2010 for year effect, agricultural sector for industry, executive managers for occupations, the istanbul province for regions. We control region(12), year, occupation(9) and industry(84) fixed effects. For manufacturing the omitted category is food industry among 24 sub-sectors.
*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

Table 4: Results from OLS Hedonic Regression for Industrial Injury Risk

	All Industries			Manufacturing Industry		
	Pooled	Year 2010	Year 2011	Pooled	Year 2010	Year 2011
Injury Risk	0.01643***	0.01399***	0.02674***	0.02085***	0.02193**	0.01730**
	(0.00395)	(0.00533)	(0.00651)	(0.00610)	(0.01016)	(0.00812)
Female	-0.10321***	-0.10110***	-0.10365***	-0.12353***	-0.11745***	-0.13025***
	(0.00259)	(0.00373)	(0.00363)	(0.00547)	(0.00798)	(0.00770)
Less than Secondary	0.03692***	0.03188***	0.04141***	0.01847*	0.02728**	0.01232
	(0.00718)	(0.00987)	(0.01036)	(0.00996)	(0.01387)	(0.01427)
High School	0.13756***	0.12650***	0.14751***	0.08645***	0.09228***	0.08242***
	(0.00760)	(0.01048)	(0.01096)	(0.01124)	(0.01565)	(0.01610)
Voc. High School	0.14170***	0.12675***	0.15507***	0.11831***	0.11734***	0.12057***
	(0.00758)	(0.01042)	(0.01094)	(0.01078)	(0.01500)	(0.01547)
Upper Secondary	0.35932***	0.35466***	0.36304***	0.30935***	0.31799***	0.30232***
	(0.00800)	(0.01109)	(0.01149)	(0.01314)	(0.01873)	(0.01845)
Age	0.02463***	0.02332***	0.02577***	0.02039***	0.02001***	0.02042***
	(0.00109)	(0.00159)	(0.00150)	(0.00201)	(0.00283)	(0.00284)
Age squared	-0.02855***	-0.02703***	-0.02988***	-0.02293***	-0.02223***	-0.02319***
	(0.00147)	(0.00215)	(0.00201)	(0.00278)	(0.00391)	(0.00394)
Administrative Worker	0.14222***	0.14288***	0.14189***	0.18773***	0.18067***	0.19436***
	(0.00449)	(0.00653)	(0.00619)	(0.01136)	(0.01624)	(0.01586)
Regular Hours	-0.01760***	-0.01767***	-0.01750***	-0.01689***	-0.01678***	-0.01696***
	(0.00011)	(0.00016)	(0.00016)	(0.00022)	(0.00029)	(0.00032)
Tenure	0.01748***	0.01850***	0.01649***	0.01402***	0.01372***	0.01386***
	(0.00042)	(0.00063)	(0.00057)	(0.00084)	(0.00124)	(0.00113)
Tenure squared	-0.02998***	-0.03169***	-0.02828***	-0.00871**	-0.00248	-0.01184**
	(0.00157)	(0.00238)	(0.00208)	(0.00405)	(0.00618)	(0.00529)
Married	0.08091***	0.07742***	0.08422***	0.06933***	0.06232***	0.07628***
	(0.00280)	(0.00405)	(0.00387)	(0.00504)	(0.00721)	(0.00703)
Divorced	0.07111***	0.06886***	0.07329***	0.05287***	0.06352***	0.04460**
	(0.00687)	(0.00989)	(0.00951)	(0.01359)	(0.01948)	(0.01893)
Spouse Died	0.03474***	0.04679**	0.02404	0.02187	0.04170	-0.01103
	(0.01249)	(0.01884)	(0.01678)	(0.02517)	(0.03149)	(0.04038)
Firm Size 10-24	0.07857***	0.07554***	0.08114***	0.01725**	0.01048	0.02251**
	(0.00352)	(0.00507)	(0.00488)	(0.00725)	(0.01046)	(0.01006)
Firm Size 25-49	0.08774***	0.08738***	0.08776***	0.02025***	0.02123**	0.01881**
	(0.00326)	(0.00470)	(0.00452)	(0.00649)	(0.00936)	(0.00900)
Firm Size 50-249	0.12784***	0.12674***	0.12898***	0.05590***	0.05375***	0.05722***
	(0.00330)	(0.00470)	(0.00463)	(0.00619)	(0.00882)	(0.00871)
Firm Size 250-499	0.16881***	0.16465***	0.17290***	0.10279***	0.10061***	0.10444***
	(0.00457)	(0.00648)	(0.00644)	(0.00762)	(0.01094)	(0.01062)
Firm Size 500 and more	0.21408***	0.20910***	0.21860***	0.18181***	0.18664***	0.17777***
	(0.00441)	(0.00631)	(0.00617)	(0.00766)	(0.01086)	(0.01079)
Public Employee	0.28493***	0.27641***	0.29265***	0.33542***	0.32016***	0.35305***
	(0.00518)	(0.00731)	(0.00733)	(0.01319)	(0.01939)	(0.01807)
Year 2011	0.03494***			0.02303***		
	(0.00182)			(0.00338)		
Constant	1.84968***	1.83761***	1.88722***	2.25033***	2.19809***	2.32198***
	(0.02640)	(0.03961)	(0.03548)	(0.04278)	(0.06073)	(0.06029)
Observations	133,499	64,030	69,469	32,975	15,993	16,982
R-squared	0.74365	0.73947	0.74831	0.61083	0.60228	0.62027

The omitted category for dummies; having no schooling for education, less than 10 workers for firms size, unmarried for marital status, the year 2010 for year effect, agricultural sector for industry, executive managers for occupations, the istanbul province for regions. We control region(12), year, occupation(9) and industry(84) fixed effects. For manufacturing the omitted category is food industry among 24 sub-sectors.
*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

cators. In the broader industry-wide model, compared to the OLS results in Table 3 model 1, the coefficient is not significant at the median. Other risk premia are significant at 10th, 25th,75th and 90th percentiles and increase with the wage reaching the highest premium at the 90th percentile. A similar pattern is partly valid for the manufacturing sector, although the coefficients are very close at the upper percentiles and there is no significant compensation for the lower 10th and 25th quantiles. In the manufacturing sample, the wage-risk trade-off at the median exceeds that of the mean (OLS) estimation in Table 3 model 4. Evans and Schaur (2010) reports similar findings and argue that risk compensation increases along the wage distribution.

In terms of injury risk similarly, the median exceeds the estimated mean risk premium for both samples. The lower 10th quantile (Table 5 c and d) does not have a significant coefficient for both samples. Moreover, for the manufacturing sector, premium is not significant and it becomes to negative at the 90th percentile. Compared to fatality risk compensation, the pattern of the wage/risk trade-off is quite different. The median has the highest value and the injury risk premium follows an inverse-u shape which does not conform with the findings of Evans and Schaur (2010).

The monetary value of a statistical life or risk is based on the estimated risk coefficients in Eqs.(1) or(2) for a quantile of the wage distribution.[12]:

$$VSL(\tau_j) = [(\frac{\partial w}{\partial \gamma})\tau_j = \beta_1 \tau_j \text{ x } w(\tau_j) \text{ x } 2000 \text{ x } 1000]$$

the VSL and VSI calculations based on the pooled cross-section results are given in Table 6. Significant coefficients are included in the table and the amounts are given in dollars to facilitate comparison with similar studies of other country cases. In the broader sample, the VSL increases through wage quantiles ranging from 14,000 to 231,000 USD. For the smaller manufacturing sample, the corresponding VSL estimates are much higher, ranging from 520,000 to 1,473,000 USD. In both samples, lower wages provide very low or no earnings with regard to fatal risk. Viscusi and Aldy (2003) document that the VSL (estimated using OLS) varies within the range of 4 million to 9 millions USD in various studies using US labor market data. It would be misleading to compare these VSL estimates with those of developed countries. For example Giergiczny (2008) reports mean VSL estimates ranging between 0.8 and 2.4 million USD using Polish data. For Chile, Parada-Contzen et al. (2012) find a much higher VSL around 4.5 milion USD (uncorrected for selection bias) which is nine times greater than the mean estimation found in the manufacturing sector. Compared to these studies, the VSL for Turkey is relatively lower. On the other hand,the VSI estimates with selection correction (30.000 USD) is very close to our estimate for the low wage earners. It is commonly accepted that using 2SLS techniques might increase the risk premium considerably.[13] The VSI estimations for the Turkish case remain very modest and are well below the range reported in Viscusi and Aldy (2003).

[12] 2,000 working hours a year for a typical worker

[13] See Gunderson and Hyatt (2001) for a comparison of self-selection and an uncorrected model using Canadian data

Table 5: Results from Quantile Hedonic Regression for Industrial Accidents

	Quantiles				
	10	25	50	75	90
(a) Fatal Risk All Industries					
Fatal risk	0.00047*	0.00041*	0.00033	0.00083***	0.00151***
	(0.00025)	(0.00022)	(0.00042)	(0.00021)	(0.00033)
Female	-0.07784***	-0.07481***	-0.08941***	-0.10670***	-0.12845***
	(0.00343)	(0.00222)	(0.00231)	(0.00305)	(0.00452)
Observations	133,499	133,499	133,499	133,499	133,499
Pseudo R2	0.496	0.496	0.496	0.496	0.496
(b) Fatal Risk Manufacturing Industry					
Fatal Risk	0.00208	0.00197	0.01210***	0.01624***	0.01595*
	(0.00352)	(0.00307)	(0.00433)	(0.00486)	(0.00955)
Female	-0.07200***	-0.08830***	-0.10138***	-0.13139***	-0.16131***
	(0.00467)	(0.00416)	(0.00496)	(0.00645)	(0.01089)
Observations	32,975	32,975	32,975	32,975	32,975
Pseudo R2	0.471	0.471	0.471	0.471	0.471
(c) Injury Risk All Industries					
Injury Risk	0.00056	0.01236***	0.02366***	0.01577***	0.01368***
	(0.00283)	(0.00274)	(0.00739)	(0.00437)	(0.00176)
Female	-0.07817***	-0.07235***	-0.08595***	-0.10525***	-0.12689***
	(0.00350)	(0.00233)	(0.00247)	(0.00310)	(0.00453)
Observations	133,499	133,499	133,499	133,499	133,499
Pseudo R2	0.496	0.496	0.496	0.496	0.496
(d) Injury Risk Manufacturing Industry					
Injury Risk	0.00318	0.01410***	0.02761***	0.02838***	-0.00157
	(0.00523)	(0.00454)	(0.00543)	(0.00705)	(0.00855
Female	-0.07193***	-0.08330***	-0.09762***	-0.12972***	-0.17246***
	(0.00508)	(0.00417)	(0.00482)	(0.00626)	(0.00945)
Observations	32,975	32,975	32,975	32,975	32,975
Pseudo R2	0.471	0.471	0.471	0.471	0.471

The omitted category for dummies; having no schooling for education,less than 10 workers for firms size, unmarried for marital status, the year 2010 for year effect, agricultural sector for industry, executive managers for occupations, the istanbul province for regions. We control region(12), year, occupation(9) and industry(84) fixed effects. For manufacturing the omitted category is food industry among 24 sub-sectors.
*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

Table 6: Estimated marginal impacts of job risk and associated values of statistical life (VSL) and injury(VSI) estimates by real wage percentiles.

	All Industries					Manufacturing Industry				
Quantiles	log (wage)	Fatal Risk	VSL	Injury Risk	VSI	log (wage)	Fatal Risk	VSL	Injury Risk	VSI
10%	0.916291	0.00047	14,072	0.00056*	-	0.916291	0.00208*	-	0.00318*	-
25%	1.140288	0.00041	15,357	0.01236	4,630	1.095759	0.00197*	-	0.01410	5,051
50%	1.529395	0.00033*	-	0.02366	13,078	1.278081	0.01210	520,191	0.02761	11,866
75%	2.206896	0.00083	90,330	0.01577	17,163	1.592273	0.01624	953,551	0.02838	16,717
90%	2.547785	0.00151	231,089	0.01368	20,936	2.040221	0.01577	1,473,975	-0.00157*	-
Mean	1.668867	0.00051*	-	0.01643	10,441	1.391260	0.01097	529,569	0.02085	10,062

* not significant coefficients.
VSL estimates are measured in 2011 dollars (1$=1.67 TL) and are calculated as the marginal impact of risk*real wage*2000 hours*10,000
VSI estimates are measured in 2011 dollars (1$=1.67 TL) and are calculated as the marginal impact of risk*real wage*2000 hours*100.

Much of the VSL literature is built on US data and there have been few studies on developing countries. Several observations can help to explain the high variation in industrial accidents, particularly for these economies. Firstly, labor markets are more segmented and informal jobs account for a greater portion of employment in developing countries which induces cost reduction schemes in terms of safer technology. The fact that institutions are not so developed and regulated leads to insufficient work safety controls and measures, as inspection frequency and penalty rates are supposed to be institutional costs attached to the production cost. Secondly, firm dynamics can differ substantially. Compared to developed countries, firms show substantial heterogeneity in size[14] and finance (limited capital) to adopt the necessary technology to reduce the risk of industrial accidents and compete in the global market. In addition to insufficient institutions and governmental controls, low union coverage and lack of collective bargaining schemes contribute to the reluctance of firms to adopt risk reducing technologies. [15]

Theoretically, the argument that job risk is endogenous to worker productivity only addresses the supply side of the issue. Institutions and constraints on production technology are neutral in this setting. From firms' perspective, when costly safety measures are adopted, the risk premium paid to workers would be less than it would otherwise be. Consider the case where firms face a trade-off between choosing a safer technology or bearing the cost of delegating the risk workers and offering a wage premium as a compensation for risk. We do not have firm-specific information on technology choice or where the individual cost equilibrium will prevail. Following the argument of Garen (1988), workers can avoid risky jobs in industries where the cost of safety measures exceeds the risk premium paid to workers.[16] It is hard to identify workers who are likely to prefer risky jobs (e.g. cool-headed workers) or to include heterogeneous individual productivity in the selection equation. The VSL literature generally uses income as a proxy in addition to the usual workers attributes. The inclusion of firm heterogeneity can explain why industries differ in fatality

[14] The domination of small and medium-sized firms is another source of heterogeneity in terms of access to technology.
[15] Viscusi and Aldy (2003) report that "union members in U.S. labor markets appear to enjoy greater risk premiums than non-members, while the evidence in other developed countries is rather mixed." p.63
[16] Put differently, the sum of risk premiums is the price of capital for providing safe production.

Table 7: Industrial Accident Risks by Industry Breakdown

	Manufacturing		Non-Manufacturing		All	
	F	I	F	I	F	I
Fatal Risk	1	0.4738*	1	0.0803	1	0.0716
Injury Risk	0.4738*	1	0.0803	1	0.0716	1
Av. Regular Hours	0.3116*	0.2550*	-0.0285	0.1620*	-0.0275	0.1769*
Av. Actual Hours	0.3010*	0.2449*	-0.0068	0.1575*	-0.0066	0.1710*
Av. Tenure Years	0.4796*	0.2743*	0.1603*	-0.0123	0.1685*	-0.002
Share of Public Sector	0.1324	-0.0115	0.1212	-0.0261	0.1375*	-0.0555
Share of Unqualified Workers	0.1896	0.1905	-0.0088	0.2585*	-0.0298	0.2705*

* pairwise correlation coefficients significant at the 5% level.
F and I stand for fatal and injury risk respectively

rates and why firms choose less safe technology. For example, using Taiwanese data to consider firm-specific risk, Tsai et al. (2011) argue that "conventional VSL estimates, based on industry risk data, are likely to have been contaminated by discarding information on variation in job risk within industries, thereby yielding underestimates of the benefits of health, safety and environmental regulations. Similarly, Hämäläinen (2009) discusses the relationship between loose safety measures and globalization in the context of developing economies. The existence of high variation in the risk premium is evidence for the importance of institutional setting and variance in firm heterogeneity.

Another point that reflects the importance of institutional setting is the regulation of working conditions. Turkey is a notable example of the importance of institutional interaction between working hours and accident rates.[17] The legal framework in Turkey gives incentives to firms to allocate the working hours of each worker in a week. According to the World Bank Doing Business Index[18] (2010), the standard number of working hours in a day in Turkey is not restricted to eight as it is in the other countries. No daily standard workday has been established by law, only a maximum of 11 hours per day and of 45 hours per week (Art. 63, Labor Law, 2003). Working hours exceeding 45 hours per month are very common both in formal and informal sectors in the Turkish labor market Toksöz (2008);Messenger (2011). In this institutional setting, workplace environment and job requirements seem to be relevant to the frequency of industrial accidents. Table 7 reports the pair-wise correlations between the various variables created as industry averages. We observe that while the correlation of working hours with injury risk is positive and significant for all industry sub-sector classifications, the only positive and significant correlation for fatality risk is in the manufacturing sector. Other variables averaged at the industry level such as tenure, education and public employment are less correlated and statistically not significant. There are no studies on workplace safety for Turkey based on micro data, however work safety studies show that long working hours increase the likeliness of workplace accidents (Dembe et al. (2005); Folkard and Tucker (2003); Vegso et al. (2007)). Dembe et al. (2005) provide evidence for the high injury exposure of overtime and longer working schedules. The hazard rates for overtime workers increases by 61%

[17]No study on workplace safety for Turkey using on micro data exists
[18]http://www.doingbusiness.org/data/exploretopics/employing-workers

and the adjusted injury rates increase by 37% for those who work 12 hours a day and by 23% for those who work 60 hours a week. Vegso et al. (2007) show that the length of shifts and the risk of workplace injury are positively correlated. For longer shifts, the risk of injury in the twelfth hour is more than twice that in the first eight hours. Schuster and Rhodes (1985) find that consecutive overtime workdays and accidents are related. Further study is needed to investigate the impact of working hour allocation and high industrial accident cases in similar developing countries to Turkey.

4 Conclusion

The VSL literature is limited particularly for developing countries. This paper is the first study using a broad industry classification for Turkey. The results show that in the manufacturing sector, workers are compensated in terms of both fatal and injury risks, while a fatal risk premium is not found when all industries are included. For fatality risk, the quantile regression results support the recent findings that suggest that the risk premium increases along the wage distribution and that the wage heterogeneity is important in determining the level of the wage-risk trade-off. The estimated VSL and VSI are relatively low compared to countries such as Chile and Poland. Considering the importance of institutional factors in developing countries, firm heterogeneity and working conditions might explain the high number and variance of industrial accidents in Turkey.

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