

Determinants of risk perception bias: an empirical study of economically active population of the CR[#]

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Introduction

The aim of this paper is to present the results of an empirical study that focused on determinants of risk perception bias of work-related fatal risks. The phenomenon of risk perception has been studied for over 30 years by psychologists, sociologists, and economists. Yet, surprisingly little is known about perception bias of work-related fatal risks. Indeed, we were not able to identify any study that would concentrate specifically on determinants of work-related risk perception bias.

To know about determinants of risk perception bias is important for several reasons. Firstly, many theories in social sciences, including the neoclassical theory in economics and variants of rational choice theory in sociology and psychology assume that actors do make rational and informed choices when faced with a certain risk. Secondly, on a more practical level, public bodies and private firms often need to make trade-offs between safety of products and services they offer, and expenditure on safety. In all these domains, the information about determinants of risk perception bias is instrumental in better understanding of risk-related decision making and risk control.

Our original motivation for this study was the disappointment with many hedonic wage models that were reported in the literature and that use objective risk rates as proxy variables for subjectively perceived risks without any thorough theoretical reflection and without much empirical insight into possible risk perception bias.

The paper proceeds as follows. Firstly we formulate hypotheses concerning determinants of risk perception bias using the results of previous theoretical studies. Further, we test the hypotheses using regression models on data from an original survey conducted on economically active population of the Czech Republic in 2007. Thirdly, we interpret and discuss the result of hypotheses testing.

Previous research of determinants of risk perception

There are two main questions related to risk perception: a) Why are certain hazards considered to be riskier? and, b) Why do some people consider certain hazards as riskier? As

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Chauvin et al. (2007) remind us, the answer to the first question is quite straightforward and has been provided especially by psychometric paradigm that uses characteristics of hazard to explain risk perception (Slovic 1987). The answer to the second question is less straightforward, not least because capturing individual characteristics of actors relevant to their risk perception has turned out to be very difficult. Empirical studies have identified several groups of such determinants: socio-demographic characteristics, religious and quasi-religious beliefs, general trust level, cultural factors, personal facets, experience and information learning process.

As to the socio-demographic characteristics, Hikes and Viscusi (2004) have found that more educated people, older people, and non-minority members of society estimate risks more precisely, and that women underestimate large risks. Similarly, they have noted that for females, the precision of risk estimate depends more on age and education than for males. Savage (1993) has found that women, people with low education and income, younger people, and blacks have generally more dread of hazards, and that this fact cannot be explained by lower level of information, but rather, and in some cases only, by higher perceived personal exposure to hazards. Similar results have been obtained by Brenot et al. (1998).

Religious and quasi-religious beliefs (including magic beliefs) were found to be significant predictors of higher risk perception by Sjöberg and Wahlberg (2002). Kouabenan (1998) observed that religious and quasi-religious beliefs are associated with more imprecise estimation of risks of road accidents, and that believers are willing to undergo higher risks.

Contrary to common knowledge in sociology, as established by the theorists of risk society, general trust is not a particularly strong predictor of perceived risk as noted by Viklund (2003) in his 4-country comparative study. This result is supported also by other empirical evidence (Sjöberg 1999). However, other empirical studies have found a statistically significant association of trust and risk perception (Siegrist 2000, Flynn et al. 1992, Biel and Dahlstrand 1995).

An important group of research on risk perception has been influenced by Mary Douglas's Theory of Cultural Bias (1982). Based on the Theory of Cultural Bias, a set of questionnaire items was developed and applied in series of surveys that have confirmed the Cultural hypothesis (see Dake 1991, 1992; Dake and Wildavsky 1991; Wildavsky and Dake 1990). However, in a more recent empirical study, Brenot et al. (1998) have found that the relationship between variables of cultural theory and perception of risk was significant, yet weak (explaining only 6% of variability). This result is not surprising and corresponds to the results of other empirical studies that found less convincing evidence confirming Cultural Theory (see Sjöberg 1995; Seifert and Tongersen 1995; Marris et al. 1996). In fact, Sjöberg (2000) argues that Cultural Theory models that he had reviewed explained only 5-10% of variability in risk perception.

Influence of personal facets has been studied empirically only recently. Chauvin (2007) has observed in his study that introversion, agreeableness, conscientiousness, emotional lability and self-closure are associated with higher risk perception.

Importance of information retrieving in Bayesian-learning process has been pointed out by Viscusi (1985) as early as in mid-1980's. In their more recent empirical study, Liu et al. (1998) have concluded that people adjust their risk perception in a dynamic process of information retrieving over time, and that adjustments are asymmetrical with regard to positive and negative information. The complexity of learning process has been stressed by Barnett and Breakwell (2001) who have argued, based on their empirical research, that risk activities have significant effect on perception of risk related to these activities, and that

greater frequency, impact, and a negative outcome of previous risk experience was associated with greater concern about involuntary risk activities (surgery, hurricane, nuclear explosion, contaminated food etc.). However, they have also found that this was not the case with voluntary risks such as smoking, traffic accidents, or sunbathing.

One of the fields where information on risk perception is particularly relevant is the field of economic valuation of labor-related risks based on welfare theory, and especially the application of hedonic wage. Econometric research can benefit greatly from information on how exactly is a subjectively perceived fatal and non-fatal work-related risk related to objective risks that workers are exposed to.

Hypotheses

Using knowledge established in the field of risk perception analysis, we can formulate the following hypotheses (in parenthesis are references of works supporting these hypotheses)

H1-risk perception bias is associated with education level

Generally, less educated people tend to overestimate risks (Savage 1993).

H2- risk perception bias is associated gender

We expect that women will overestimate risk (as found for example by Savage 1993).

H3- risk perception bias is associated with age

We expect that younger people tend to overestimate risks as found for example by Savage (1993).

H4- risk perception bias might be associated with risk aversion

As far as we are aware, this hypothesis has not been tested empirically yet. We expect that people who are risk-acceptive do underestimate risks.

H5- risk perception bias might be associated with experience in profession and a particular job

We have already mentioned the very complex way in which Bayesian learning process influences risk perception. Taking into account the asymmetrical impact of negative and positive experience with risk (Liu et al. 1998), we expect that longer experience in job and in profession will be in both cases associated with overestimation of risks.

H6- risk perception bias is associated with variables of cultural theory

As noted earlier, the cultural theory has been widely discussed. We expect that fatalism and egalitarianism will be positively associated with the overestimation of risk (compare Brenot et al. 1998).

H7 – risk perception bias is related to the size of risk people are actually exposed to

This phenomenon has been observed in many empirical studies, recently for example by Hakes and Viscusi (2004).

H8 – perceived level of information available about risk does not drive risk perception bias downward or upward

We have not found any previous empirical analysis of this problem. However, we assume that people who think that they know risks they are exposed to, do assess risks more correctly. Those who think that they have no such information do assess risks incorrectly but do equally overestimate and underestimate risks. We therefore assume that this variable will have no statistically significant effect on risk perception bias.

Results

An original survey developed by Scasny and Urban within a larger research project coordinated by VÚBP has been conducted by CVVM research agency. A representative sample (N=1040) of economically active population of the Czech Republic has been selected using quotas for age, gender, education level, size of the town or village they were living in, and region.

In the section of the questionnaire that focused on risk perception bias, respondents were informed about the fact that on average 200 people die annually in the Czech Republic due to work-related fatal injuries, which means that there are four fatalities per 100 000 employees. Respondents were also informed about the main causes of work-related fatal injuries (car crashes, injuries caused by other people, falls from heights etc.). Next, the respondents were asked whether they think that their fatal work-related risk is lower or higher than the average.

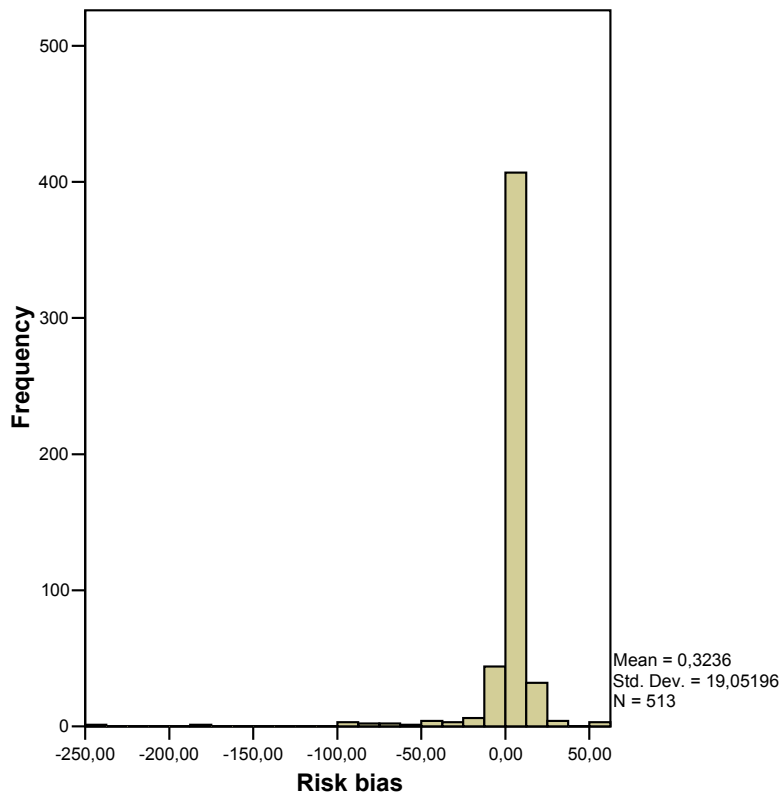
We found that 103 respondents (9,9%) stated that their risk is higher, and 575 respondents (55,3%) that it is lower than the average. Some 362 respondents (34,7%) stated that they do not know whether it is higher or lower than the average.

Consequently, those respondents who stated “higher” or “lower” were asked to state how big exactly they think their risk is (in relative terms per 100 000 workers). To this question, some 165 (15,8%) respondents stated that they do not know exactly how big it is; remaining 513 (49,4%) of respondents were able to answer this question. The distribution of stated risks was right-skewed with long tail with mean of 5,65; median 1,00; and standard deviation 19,14.

Using this information, we have computed risk perception bias for each respondent. The risk perception bias has been computed as the difference between the objective risk and the stated risk. The objective work-related mortality risk has been determined using the characteristics of the respondent (age, gender, occupation or KZAM, and the branch he/she was working in or OKEČ). Using the records of all work-related fatal injuries in the Czech Republic in the last 5 years and the abovementioned characteristics of respondents, we have assigned objective risk of fatal injury to each individual worker.

The distribution of risk perception bias (mean 0,32; median 1,00; s.d. 19,05) is displayed in the graph below.

Figure 1: histogram of risk perception bias variable



To test the hypothesis that we formulated earlier, we have run two linear regression models (model 1 and model 2 – see the table bellow) that differed only in the transformation of the dependent variable. In both regression models, the risk perception bias was the dependent variable, while characteristics of respondents and the risk were independent variables. For the description of variables included in the models see Appendix 1. The estimates of parameters of regression models are displayed in Table 1 bellow. Let us interpret the model 1 with untransformed risk perception bias variable first.

As we can see in the table bellow, people with only elementary education (or with technical training) tend to overestimate the risk they are exposed to ($\alpha = 0,05$). Further, people who are working longer in their profession tend to overestimate their risks ($\alpha = 0,01$), while people with longer experience with their particular job tend to underestimate the risk ($\alpha = 0,05$). These results are somehow surprising. We have experimented with other specifications of the model excluding one or the other of the two variables and we still observed the same pattern. One of our working hypotheses that could explain this phenomenon is that people update in Bayesian learning process their risk perception and due to the asymmetry of the effect of positive and negative experience on the risk perception, people working longer in their profession tend to overestimate the risk. On the other hand, EXPERJOB or the number of years in the current particular job may be associated with flexibility of the worker and/or with his other characteristics that may influence his risk perception. The age of the respondents and its square did not have a statistically significant effect on the risk perception bias in this model, contrary to the second model described bellow. Not surprisingly, people who are exposed to larger risks tend to underestimate the risk and vice versa. Other variables in this model did not have any statistically significant effect on the risk perception bias.

In this model and also in the model 2, some of the variables expected to have statistically significant effect on risk bias were found to be insignificant. Thus, we detected that having a university degree, being male, risk-acceptive, being fatalist or egalitarian did not have any statistically significant effect on risk bias in this and in the second model.

Anyway, the predictive power of model 1 was quite low and in fact it explained only some 6% of the variability of the risk perception.

Table 1: Regression models of risk perception bias (untransformed and transformed)

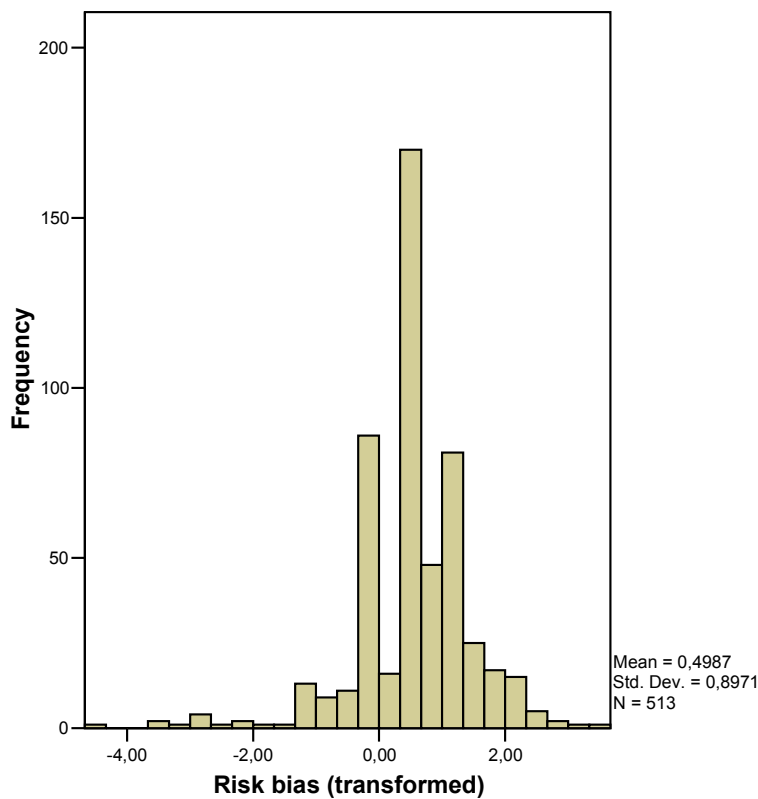
	Model 1 (risk bias)		Model 2 (risk bias transformed)	
	Coefficients	Significance	Coefficients	Significance
intercept	25,653	0,000	-0,011	0,954
college	-1,425	0,567	0,111	0,350
element	-4,474	0,025	-0,223	0,019
male	2,579	0,256	-0,010	0,929
inform	2,487	0,340	0,223	0,071
riskier	-0,132	0,953	-0,088	0,415
experwork	-0,418	0,002	-0,018	0,005
experjob	0,348	0,014	0,017	0,010
agestd	0,548	0,928	-0,582	0,044
agestd2	0,000	0,960	0,001	0,040
fatalism	1,020	0,269	0,001	0,985
egalitarianism	-1,173	0,214	0,044	0,321
risk	3,891	0,003	0,446	0,000
Adjusted R-square	0,055		0,164	

To increase the power of our model, we have transformed the risk perception bias variable. The transformed variable of risk perception bias is computed as the difference between the natural logarithms of objective risk of fatal injury and of perceived risk of fatal injury as shown in equation 1:

$$RPB = \ln(R_{obj}) - \ln(R_{perc}) \quad (1)$$

This transformation helped us to normalize somehow the risk perception bias variable as can be seen in the figure bellow.

Figure 2: Histogram of transformed risk perception bias variable



Estimates of the regression model for the transformed risk bias variable are displayed in the two left columns in table 1. We see here that this model performs better in terms of explained variability. In this model we also see that, similarly to the first model, lower education level and longer experience with particular occupation is associated with overestimation of the fatal risk, while larger experience with a particular job and larger objective risk of fatal injury the worker is exposed to are associated with underestimation of the fatal risk injury. What is new in the model 2 is the pattern of influence of the respondent's age on the risk bias variable: we see that older people tend to overestimate the risk (coefficient for age is negative) but we also see that the effect is not constant (linear) and tends to be rather smaller for older people (i.e. the marginal rate of overestimation is decreasing with age). What should also be noticed in the model 2 is the fact that people who think to be more informed about their work-related fatal risk are more likely to underestimate their risk. However, this effect is only significant at $\alpha=0,1$ level and therefore would be conventionally considered statistically insignificant.

One fact that should be specifically stressed and that we have not talked about yet is that the two variables of cultural theory indicating fatalism and egalitarianism were not statistically significantly related to risk perception bias in models that we have estimated. As noted earlier, the variables of cultural theory were not found to be particularly strong determinants of risk perception. In our case also, the factor analysis revealed that variability of the two variables (egalitarianism, fatalism) was saturated by underlying latent factors that were not identical to the expected latent variables of egalitarianism and fatalism as constructed for example by Brenot et al. (1998).

Returning back to the hypothesis that we have formulated, we have confirmed fully only H1 H7, and H8. We could not confirm H2. As to the H3, we found out that age is associated with risk, but differently than expected. We did not find any empirical support for H4. We have partially confirmed H5 (longer work-experience was associated with overestimation of risk). However, the job-experience was associated with risk perception bias in the opposite direction than expected. We could not confirm H6, since we have not found variables of cultural theory to be associated with risk perception bias.

Conclusion

In this paper, we have presented the results of the empirical study that examined factors influencing perception bias of workers related to their work-related mortality risks. The study used the data from an original survey representative of the Czech population that was conducted in 2007.

In the paper we used regression models to test the hypotheses about factors influencing risk perception bias. Two models were tested: one with risk perception bias variable and the other one with transformed risk perception bias variable. Although both models were relatively weak, the latter model was able to explain some 16% of the variability in risk perception bias.

As expected, people exposed to higher fatal work-related risks do underestimate these risks. Further, people who think that they know better their risk of fatal work-related injury do underestimate their risks. Fatal risks are also underestimated by people who have been working in their particular job longer. However, people who are working longer in their profession tend to overestimate the risk as do also people with only elementary education.

We have also found that the influence of age on risk perception bias is not linear. Older people generally tend to overestimate the fatal injury risk but the marginal rate of risk perception bias is not constant but rather is decreasing with age.

We have also found that people who are risk-acceptive are more likely to underestimate their risks. This result is intuitive, but the estimated coefficient was not statistically significant in our model so we must take this model as only preliminary.

Results of this study show that people are systematically biased when it comes to the estimation of their risk of work-related fatal injury. These results are in accordance with the already established knowledge from previous empirical research.

Our results also show that using objective levels of risk as proxy variables for subjectively perceived risk may be in fact wrong. The study also shows directions in which risk perception is biased in its relation to objective level of risk. This knowledge may prove helpful in many applications, including hedonic wage studies.

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Appendix 1: Variables used in the regression model

Variable name	Variable description	Mean	S.D.
college	respondent has higher than high-school education (dummy)	0,15	0,361
element	respondent has only elementary or technical education without high school degree (dummy)	0,48	0,500
male	respondent is male (dummy)	0,57	0,496
inform	respondent thinks s/he is "well" or "very well" informed about his/her work-related risks (dummy)	0,81	0,391
risker	respondent would "certainly" or "quite certainly" say about himself/herself that s/he is a person that likes to take the risk (dummy)	0,21	0,410
experwork	number of years that the respondent has spent working in his/her profession (years)	12,68	10,678
experjob	number of years that the respondent has spent working in his/her particular job (years)	8,45	8,134
age	standardized age of respondents ($\text{std.age} = (\text{real age} - 17)/10$)	2,35	1,163
fatalism	normalized summed score of the fatalism battery (see appendix 3)	0,00	0,986
egalitarianism	normalized summed score of the egalitarianism battery (see appendix 3)	0,00	0,992
risk	size of the objective fatal risk that the respondent is exposed at work that is characterized by KZAM (classification of occupation) and OKEČ (industry)	1,33	0,883

Appendix 2: Wording of questions on risk perception bias

Please try to estimate how big is the risk of fatal injury that you are exposed to at your work. At your work you are exposed to a risk of fatal injury equal to (fill in): _____ fatalities per 100 000 workers per year.

Appendix 3: Wording of fatalism and egalitarianism question items

EGALITARIANISM

Please indicate to what degree do you agree with the following statements (very much agree 1-2-3-4-5 very much disagree):

- If people were treated more equally in our society, we would have less problems.
- People that are richer should pay higher taxes so that poorer citizens can be supported.
- Differences between poor and rich countries are not right.
- In this country stress is being put on equal rights.
- Racial discrimination is a big problem in our country.

FATALISM

Please indicate to what degree do you agree with following statements (very much agree 1-2-3-4-5 very much disagree):

- You are often discriminated against.
- It is better not to trust people too much in our society nowadays.
- I think that an ordinary person does not have any influence on political situation in our society.
- There is no use in doing things for people - you only get it in the neck in the long run.

Determinants of risk perception bias: an empirical study of economically active population of the Czech Republic

Jan Urban – Milan Ščasný

ABSTRACT

The paper presents the results of an original survey (N=1040) that focused, among others, on perception of work-related fatal risks among economically active population of the Czech Republic. The paper reviews existing literature on risk perception and risk perception bias. Further, hypotheses are suggested and tested by multinomial regression analysis.

As expected, people exposed to higher fatal work-related risks do underestimate these risks and vice versa. Further, people who think that they know better their risk of fatal work-related injury do underestimate their risks. Fatal risks are also underestimated by people who have been working in their particular job longer. However, people who are working longer in their profession tend, ceteris paribus, to overestimate the risk as do people with only elementary education. Influence of age on risk perception bias is not linear. Older people generally tend to overestimate the fatal injury risk but the marginal rate of risk perception bias is not constant but rather is decreasing with age.

Keywords: Risk perception; Labor market; Fatal risk; Fatal injury.

Determinanty zkreslení percepce rizika: empirická studie ekonomicky aktivní populace České Republiky

ABSTRAKT

Příspěvek představuje výsledky šetření (N=1040), které se mimo jiné zaměřovalo na percepci rizika pracovního úmrtí u ekonomicky aktivní populace ČR. Příspěvek podává přehled existující literatury v oblasti percepce rizik. Následně jsou formulovány výzkumné hypotézy a testovány pomocí vícenásobné regresní analýzy.

Podle předpokladu se ukazuje, že lidé vystaveni větším rizikům tato rizika podceňují a vice versa. Dále se ukazuje, že lidé, kteří si myslí, že jsou lépe informováni o rizicích své riziko smrtelného úrazu podceňují. Riziko smrtelného pracovního úrazu je také podceňováno lidmi, kteří mají delší pracovní na svém konkrétním pracovním místě. Naopak lidé, kteří pracují déle ve své profesi mají tendenci, ceteris paribus, riziko smrtelného pracovního úrazu přeceňovat. Stejným způsobem riziko přeceňují také lidé s nižším vzděláním a starší lidé (u nich ale není relativní míra přeceňování rizika konstantní, ale klesá s věkem).

Klíčová slova: Percepce rizika; Trh práce; Riziko smrtelného úrazu; Smrtelný úraz.

REVIEW

The aim of this paper is to present the results of an empirical study that focused on determinants of risk perception bias of work-related fatal risks. I highly appreciate that apart from interesting empirical results paper presents a very good review of relating research and articles. I would have welcome if the authors had expressed their opinion how possibly the research results might impact upon prevailing assumption of perfect rationality in microeconomic models. I with no other remarks recommend the paper to be published.

doc. Ing. Jiří Hnilica, Ph.D.