Compensating Wage Differentials

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July, 2016
Overview

- The market for risky jobs
- The hedonic wage function
- Compensating differentials and job amenities
The Market for Risky Jobs

There is a great deal of variation in the injury rate among workers employed in different industries.

TABLE 5-1
Injury Rates in the United States, by Industry, 2008

<table>
<thead>
<tr>
<th>Industry Group</th>
<th>Deaths (per 100,000 Workers)</th>
<th>Number of Disabling Injuries (in 1000s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>2.9</td>
<td>3,200</td>
</tr>
<tr>
<td>Agriculture</td>
<td>29.0</td>
<td>60</td>
</tr>
<tr>
<td>Mining</td>
<td>21.1</td>
<td>10</td>
</tr>
<tr>
<td>Construction</td>
<td>8.9</td>
<td>260</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>2.3</td>
<td>390</td>
</tr>
<tr>
<td>Wholesale trade</td>
<td>3.8</td>
<td>80</td>
</tr>
<tr>
<td>Retail trade</td>
<td>0.9</td>
<td>380</td>
</tr>
<tr>
<td>Transportation and warehousing</td>
<td>13.0</td>
<td>160</td>
</tr>
<tr>
<td>Utilities</td>
<td>4.0</td>
<td>20</td>
</tr>
<tr>
<td>Information</td>
<td>1.0</td>
<td>30</td>
</tr>
<tr>
<td>Financial activities</td>
<td>0.6</td>
<td>70</td>
</tr>
<tr>
<td>Professional and business services</td>
<td>2.2</td>
<td>150</td>
</tr>
<tr>
<td>Educational and health services</td>
<td>0.5</td>
<td>510</td>
</tr>
<tr>
<td>Leisure and hospitality</td>
<td>0.9</td>
<td>270</td>
</tr>
<tr>
<td>Other services</td>
<td>1.8</td>
<td>110</td>
</tr>
<tr>
<td>Government</td>
<td>1.8</td>
<td>700</td>
</tr>
</tbody>
</table>

Notes: A disabling injury is one that results in death or some degree of physical impairment or renders the person unable to perform regular activities for a full day beyond the day of the injury.

Suppose there are only two types of jobs in the labor market,

- some jobs offer a completely safe environment,
- others offer an inherently risky environment.

We assume that the worker has complete information about the risk level associated with every job.

Workers care about whether they work in a risky job or a safe job as well as the wage they earn on the job.

\[ U = f(w, \text{ risk of injury on the job}) \]
The Market for Risky Jobs

FIGURE 5-1  Indifference Curves Relating the Wage and the Probability of Injury on the Job

The worker earns a wage of $w_0$ dollars and gets $U_0$ utils if she chooses the safe job. She would prefer the safe job if the risky job paid a wage of $w'_1$ dollars, but would prefer the risky job if that job paid a wage of $w''_1$ dollars. The worker is indifferent between the two jobs if the risky job pays $\hat{w}_1$. The worker’s reservation price is then given by $\Delta \hat{w} = \hat{w}_1 - w_0$. 

![Graph showing indifference curves between wage and probability of injury](image-url)
The Supply Curve to Risky Jobs

- Workers decide whether to accept job offers from risky firms or from safe firms.
- Reservation price: the amount of money it would take to bribe a worker into accepting the risky job.
- Let $\Delta \hat{w}_{MIN}$ as the smallest one, hence when wage differentials is less than this value, no worker is willing to work in risky environment.
The Demand Curve for Risky Jobs

- firm decide whether to provide a risky or safe work environment to its workers
- suppose firm is going to hire $E^*$ workers regardless of which environment it chooses, and production function is

$$q = \alpha E^*$$

- assume the productivity in risk environment is $\alpha_1$ and $\alpha_0$ in safe environment, hence

$$q_0 = \alpha_0 E^*$$
$$q_1 = \alpha_1 E^*$$
The Demand Curve for Risky Jobs

The firm’s profit under two possibility are

\[ \pi_0 = p\alpha_0 E^* - w_0 E^* \]
\[ \pi_1 = p\alpha_1 E^* - w_1 E^* \]

Define \( \theta = p\alpha_1 - p\alpha_0 \), firm will choose the risk environment if and only if \( w_1 - w_0 < \theta \)

- different firms may have different technologies for produce safety, hence different \( \theta \),
- let \( \hat{\theta} \) the largest one in the economy, meaning that as long as wage differentials above this value no firm will demand workers for risky job.
The Market for Risky Jobs

**FIGURE 5-2 Determining the Market Compensating Differential**
The supply curve slopes up because as the wage gap between the risky job and the safe job increases, more and more workers are willing to work in the risky job. The demand curve slopes down because fewer firms will offer risky working conditions if risky firms have to offer high wages to attract workers. The market compensation differential equates supply and demand and gives the bribe required to attract the last worker hired by risky firms.
The Market for Risky Jobs

Equilibrium

Is it right to interpret the market wage differential \((w_1 - w_0)\) as a measure of the average dislike for risk among workers in the economy?
The Market for Risky Jobs

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No, in fact, it measures the reservation price of the last worker hired and has nothing to do with the average dislike for risk in the population.
The Market for Risky Jobs
Can the compensating wage differential go the “wrong” way?

FIGURE 5-3 Market Equilibrium When Some Workers Prefer to Work in Risky Jobs
If some workers like to work in risky jobs (they are willing to pay for the right to be injured) and if the demand for such workers is small, the market compensating differential is negative. At point $P$, where supply equals demand, workers employed in risky jobs earn less than workers employed in safe jobs.
The Hedonic Wage Function

- Suppose that there are many types of firms
- the probability of injury on the job, which we will denote by $\rho$, can take on any value between 0 and 1.
- isoprofit curve: all points along an isoprofit curve yield the same level of profits
FIGURE 5-5  Isoprofit Curves
An isoprofit curve gives all the risk-wage combinations that yield the same profits. Because it is costly to produce safety, a firm offering risk level $\rho^*$ can make the workplace safer only if it reduces wages (while keeping profits constant), so that the isoprofit curve is upward sloping. Higher isoprofit curves yield lower profits.
The Hedonic Wage Function

Isoprofit curves have a number of important properties

1. Isoprofit curves are upward sloping because it costs money to produce safety.

2. Wage-risk combinations that lie on a higher isoprofit curve yield lower profits.

3. Isoprofit curves are concave: law of diminishing returns applies to the production of safety.
The Hedonic Wage Function

**FIGURE 5-4** Indifference Curves for Three Types of Workers
Different workers have different preferences for risk. Worker A is very risk-averse. Worker C does not mind risk as much.

Probability of Injury

Wage

$U_A$ $U_B$ $U_C$

Figure:
The Hedonic Wage Function

Hedonic wage function summarizes the relationship between the wage that workers get paid and job characteristics.

**FIGURE 5-6 The Hedonic Wage Function**

Different firms have different isoprofit curves and different workers have different indifference curves. The labor market marries workers who dislike risk (such as worker A) with firms that find it easy to provide a safe environment (like firm X); and workers who do not mind risk as much (worker C) with firms that find it difficult to provide a safe environment (firm Z). The observed relationship between wages and job characteristics is called a hedonic wage function.
A recent survey of the evidence concludes that a .001-point increase in the probability of total injury may increase annual earnings by about $7,600 (in 2007 dollars).

One interpretation is that 1,000 workers employed in firm are willing to give up $7.6 million to save the life of the one worker who will almost surely die in any given year.

Therefore, the workers in the firm value a life at $7.6 million.

Note: this calculation gives the amount that workers are jointly willing to pay to reduce the likelihood that one of them will suffer a fatal injury in any given year, put differently, it is the value of statistical life.
Since the enactment of the Occupational Safety and Health Act of 1970, the federal government in the United States has played a major role in setting safety standards at the workplace.

In the past 20 years, Occupational Safety and Health Administration (OSHA) has set workplace standards that mandate the maximum amount of cotton dust in the air in textile plants, the amount of asbestos in the air in working settings and a host of other restrictions on the job environment.
Policy Application: Safety and Health Regulations

- Are workers better off as a result of these regulations?
- How do the safety standards alter the nature of the labor market equilibrium that generates compensating wage differentials?
- Do these government mandates actually reduce the probability of injury on the job?
Policy Application: Safety and Health Regulations

**FIGURE 5-7** Impact of OSHA Regulation on Wage, Profits, and Utility

A worker maximizes utility by choosing the job at point $P$, which pays a wage of $w^*$ and offers a probability of injury of $\rho^*$. The government prohibits firms from offering a probability of injury higher than $\bar{\rho}$ shifting both the worker and the firm to point $Q$. As a result, the worker gets a lower wage and receives less utility (from $U^*$ to $\bar{U}$), and the firm earns lower profits (from $\pi^*$ to $\bar{\pi}$).

![Graph showing the impact of OSHA regulation on wage, profits, and utility](image)

**Figure:**
Policy Application: Safety and Health Regulations

- Both worker’s utility and firm’s profit are getting less
- why government bother to regulate safety standards at all?
Both worker’s utility and firm’s profit are getting less.

Why government bother to regulate safety standards at all?

Workers are unaware of the true risks associated with particular jobs.
Policy Application: Safety and Health Regulations

**FIGURE 5-8**  Impact of OSHA Regulations When Workers Misperceive Risks on the Job

Workers earn a wage of $w^*$ and incorrectly believe that their probability of injury is only $\rho_0$. In fact, their probability of injury is $\rho^*$. The government can mandate that firms do not offer a probability of injury higher than $\tilde{\rho}$, making the uninformed workers better off (that is, increasing their actual utility from $U^*$ to $\bar{U}$).

![Diagram showing wage and probability of injury](image)
The model can apply to multiple jobs characteristics, such as
- whether the job involves repetitive and monotonous work,
- whether the job involves better location and so on.

The key implication is easily summarized:
- as long as all persons in the population agree on whether a particular job characteristic is a “good” or a “bad”, good job characteristics are associated with low wage rates and bad job characteristics are associated with high wage rates.
But the empirical study does not support this theory

- For instance, jobs that demand physical strength are presumably more unpleasant than other jobs, and hence would be expected to pay higher wage rates.
- In fact, jobs requiring workers to have substantial physical strength often pay less, sometimes on the order of a 17 percent wage disadvantage.
The estimates of the compensating wage differentials associated with particular job characteristics are valid only if all the other factors that influence a worker’s wages are held constant.

For instance, more able workers are likely to earn higher wages, while they may spend more on job amenities, then it turns out they have higher wage as well as good job amenities.
Policy Application: Health Insurance and the Labor Market

- In the United States, employers provide health insurance coverage as a fringe benefit to a large fraction of the workforce.
- In 2001, 63 percent of the population was covered by an employer-provided health insurance program.
Policy Application: Health Insurance and the Labor Market

**FIGURE 5-10 Health Benefits and Compensating Differentials**

Workers A and B have the same earnings potential and face the same isoprobfit curve giving the various compensation packages offered by firms. Worker A chooses a package with a high wage and no health insurance benefits. Worker B chooses a package with wage $w_B$ and health benefits $H_B$. The observed data identify the trade-off between job benefits and wages. Workers B and $B^*$ have different earnings potential, so their job packages lie on different isoprobfit curves. Their choices generate a positive correlation between wages and health benefits. The observed data do not identify the trade-off between wages and health benefits.
Policy Application: Health Insurance and the Labor Market

Because of different potential, people who get higher wage may also get higher health benefit, hence the observed data do not identify the trade-off between wages and health benefits.
In many countries, when workers become unemployed, the UI system pays a fraction of the worker’s salary while the worker looks for alternative employment.

UI is much less appealing if the labor market, through compensating wage differentials, already compensates workers with high layoff probabilities.
Compensating Differentials and Layoffs

**FIGURE 5-9  Layoffs and Compensating Differentials**

At point $P$, a person maximizes utility by working $h_0$ hours at a wage of $w_0$ dollars. An alternative job offers the worker a seasonal schedule, where she gets the same wage but works only $h_1$ hours. The worker is worse off in the seasonal job (her utility declines from $U_0$ to $U'$). If the seasonal job is to attract any workers, the job must raise the wage to $w_1$ so that workers will be indifferent between the two jobs.

Income
There is some evidence that the labor market indeed provides compensating differentials to workers at risk of layoff. For instance, wages are higher in industries that have higher layoff rates: an increase of 5 percentage points in the probability of layoff raises wage by about 1 percent. The available evidence suggests that if laid-off workers can receive unemployment insurance, an increase in the probability of unemployment has only a negligible effect on the wage.