3.36pt

Compensating Wage Differentials

Outline

- Heterogeneity in wages.
- Adam Smith: sources of wage differentials.
- Compensating wage differentials.
- Empirical evidence.

The Law of One Price?

- So far, we have analyzed the labor market for *homogeneous* workers.
- Under the assumptions of competition (perfect information, worker and firm rationality, no transaction costs), wage is determined by the intersection of supply and demand curves.
- In practice, there is very substantial heterogeneity in wages.

- 2007 data:
  - Median weekly earnings: \$745. Top decile, \$1674, bottom decile \$358.
  - Less than high school, \$422; high school graduates, \$610; some college \$707; BA, \$993; Advanced degree, \$1254.
  - Management occupations, \$967; Service occupations, \$422; Sales \$589.
  - By industry: goods producing, \$775; services providing, \$567
  - By region...
- Even within narrowly defined occupation groups, a lot of heterogenity.
- Clearly, workers differ in their individual characteristics, jobs differ in their characteristics as well.

Adam Smith on the sources of wage differentials

- "The whole of the advantages and disadvantages of the different employments of labour and stock must, in the same neighbourhood, be either perfectly equal or continually tending to equality..."
- "Pecuniary wages and profit, indeed, are every-where in Europe extremely different according to the different employments of labour and stock. But this difference arises partly from certain circumstances in the employments themselves."
- Five reasons:
  - agreeableness of employment
  - ease of learning the occupation
  - constancy of employment
  - probability of success
  - trust to be reposed in worker

Compensating wage differentials

- Jobs differ in several important characteristics that are valued (either positively or negatively) by workers:
- Examples:
  - health and safety hazards
  - benefits
  - location
  - flexibility of schedule, hours of work
  - interaction with agreeable people
  - status/prestige
- How much do different jobs pay? How do workers sort themselves across jobs?

- Two types of jobs, differ in the level of a *disamenity* z. For example, safe and risky jobs.

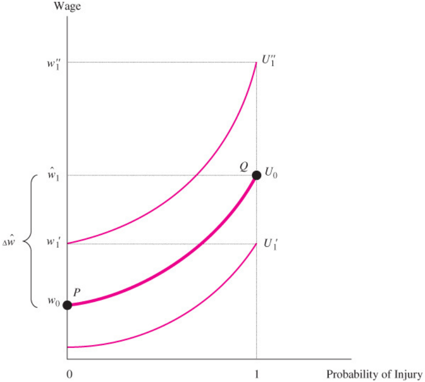
- Workers dislike risky jobs, but differ in their aversion to risk z:

$$U_i\left(w, z\right) = w - \lambda_i z$$

- We can draw indifference curves in the $\left(w, z\right)$ space.

- If risk increases from 0 to 1, worker must be compensated with higher wage to remain indifferent.
- The steeper the slope of the indifference curve, the higher the worker's aversion to risk.

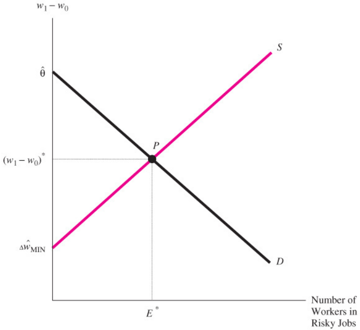
FIGURE 5-1 **Indifference Curves Relating the Wage and the Probability of Injury on the Job**
The worker earns a wage of w_0 dollars and gets U_0 utils if she chooses the safe job. She would prefer the safe job if the risky job paid a wage of w_1' dollars, but would prefer the risky job if that job paid 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 $\Delta\hat{w} = \hat{w}_1 - w_0$.



The supply of workers to risky jobs

- Draw the number of workers willing to work in risky jobs as a function of the wage differential $w_1 - w_0$:

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 supply curve is upward sloping: the higher the wage differential, the larger the number of workers willing to work in risky jobs.

The demand for risky jobs

- Firms can offer safe or risky environment.
- Profits are a function of wage and z

$$\pi_i\left(w\right) = \theta_i z - w$$

- $\theta_i > 0$: it is costly to provide a safe environment (must install filters, adopt safety standards, make buildings earthquake-proof, etc.), by offering risky jobs firms save money.
- But firms differ in their costs of making the environment safe: those with lower θ_i offer risky jobs only for a low wage differential, otherwise cheaper to provide safe jobs
- If the wage differential to be paid for risky jobs is very high, no firms will offer risky jobs; conversely, if wage differential is low, many firms will offer risky jobs: it's profitable to offer a more risky environment, for a given wage.

Equilibrium

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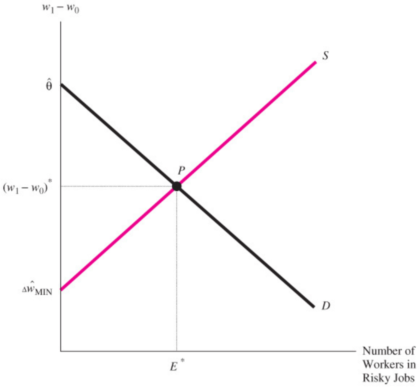


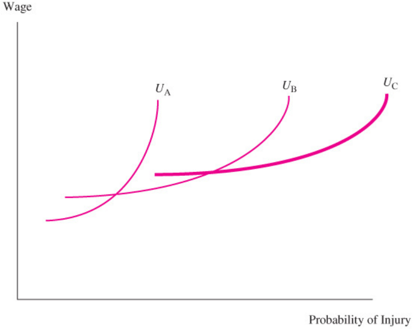
Remarks about equilibrium

- The equilibrium wage differential is positive: risky jobs pay more than safe jobs.
- Equilibrium still depends on the same assumptions as in perfectly competitive market: perfect information, no mobility costs, etc.

The Hedonic Wage Model and Sorting of Workers across Firms

- Now extend the model in which there is a continuum of job types, indexed by their disamenity z.
- Perfect information about job quality, perfect mobility.
- Utility: $U(w, z)$. Upward sloping and convex indifference curves.
- Profits: $\pi(w, z)$. Upward sloping and concave isoprofit curves.

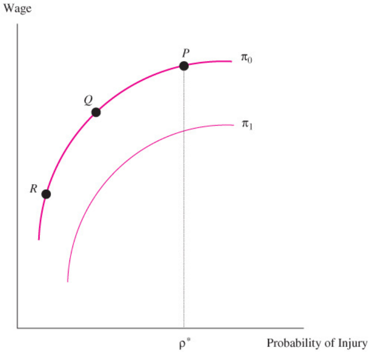
FIGURE 5-4 **Indifference Curves for Three Types of Workers**
Different workers have different preferences for risk. Worker A is very risk-averse. Worker C does not mind risk as much.



- The higher indifference curve has higher utility.
- The flatter the indifference curve, the higher the tolerance for the disamenity: to accept more risk, need less wage increase.

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 ρ^* 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.



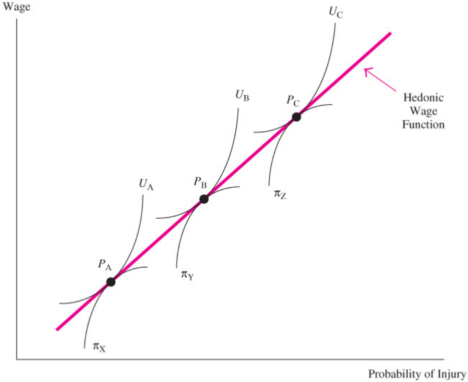
- The lower isoprofit curve has higher profits.
- The flatter the isoprofit curve, the lower marginal costs of reducing the disamenity: to increase safety, reduce more wages

Equilibrium

- In long run competitive equilibrium, all firms must have zero profits.
- Workers choose combination of wage and z that maximizes utility.
- The hedonic wage function is the combination of wages and disamenity levels offered in equilibrium.

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.



Remarks

- Wages are positively correlated with the level of disamenity z.
- **Sorting:** workers with high tolerance for z will work at firms where it is relatively costly to reduce z, as they can obtain higher wages.

Policy Application: Impact of Safety and Health Regulations

- Occupational Safety and Health Act (OSHA).
- Enacted in 1970, plays a major role in setting safety standards at the workplace.
- But do more stringent safety standards improve welfare?
- Under traditional competitive assumptions, the answer is unambiguously no.
    - Workers who work in risky jobs do so because they have a high tolerance for risk, and are willing to accept risky job in exchange for higher wages.
- Safety standards can be justified if workers are not fully aware of the risks, or if some risks are not well-known in advance.

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 ρ^*. 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 $\overline{U}$), and the firm earns lower profits (from π^* to $\overline{\pi}$).

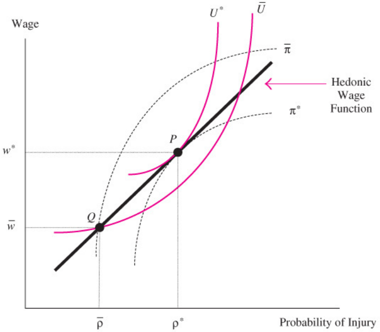
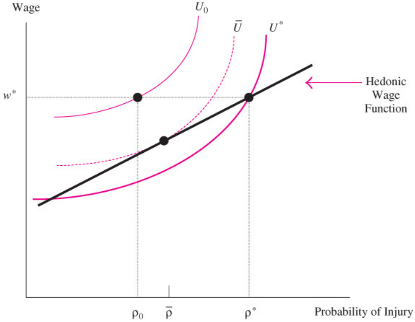


FIGURE 5-8 **Impact of OSHA Regulations When Workers Misperceive Risks on the Job**

Workers earn a wage of w^* and incorrectly believe that their probability of injury is only ρ_0. In fact, their probability of injury is ρ^*. The government can mandate that firms do not offer a probability of injury higher than $\bar{\rho}$, making the uninformed workers better off (that is, increasing their actual utility from U^* to $\overline{U}$).



Empirical implementation

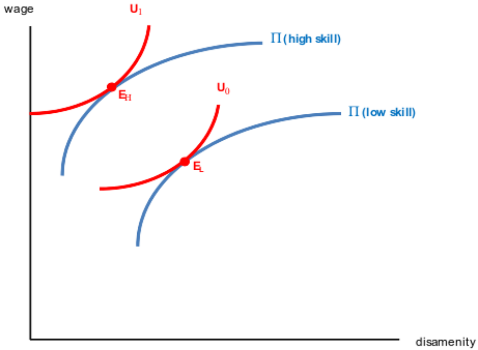
- Model generates fairly straightforward empirical predictions: higher levels of disamenities (injury risk, safety hazard, unpleasant hours of work, working while standing, etc.) should be associated with higher wages.
- For some applications, theory is fairly successful.
    - Large number of studies that attempt to estimate the *value of a statistical life*.
    - By how much do wages increase for a given increase in the probability of fatal injury?
    - Large variability in estimates, but typical result is that a 0.001 increase in the probability of fatal injury is associated with $7,600 increase in annual earnings (2007 dollars).

TABLE 5-1
Injury Rates in the United States, by Industry, 2002

Source: U.S. Department of Commerce, *Statistical Abstract of the United States, 2004,* Washington, DC: Government Printing Office, 2004, Tables 634, 636.

Industry	Nonfatal Injuries per 100 Full-Time Workers	Fatal Injuries per 100,000 Workers
Agriculture	6.4	23
Mining	4.0	24
Coal	6.8	29
Oil and gas extraction	3.4	23
Construction	7.1	12
Manufacturing	7.2	3
Food and kindred products	9.3	3
Lumber and wood products	10.1	20
Transportation and public utilities	6.1	11
Local passenger transit	7.9	9
Trucking and warehousing	7.0	21
Transportation by air	11.8	9
Wholesale trade	5.2	4
Retail trade	5.3	2
Finance	1.7	1
Services	4.6	2
Business services	2.7	2
Auto repairs	4.5	7

- Limitation of many empirical applications: it's difficult to hold everything else constant.
  - College professors, investment bankers, lawyers
  - Construction workers, miners, truck drivers
- The former have much safer working environment, also higher wages.
- Clearly, wage differential is driven by differences in human capital.
- Graphical analysis illustrates how you can get a "wrong-signed" compensating wage differential if workers differ by skill.



- The zero-isoprofit curve for skilled workers is shifted upwards (at the low skill wage, firms make positive profits on high-skill workers).
- In equilibrium, not difficult to get a negative relationship between wages and the level of the disamenity.

A Clean Estimate of Compensating Wage Differential for Workplace Safety

- Jonathan Lee and Laura Taylor: "Randomized Safety Inspections and risk exposure on the job: Quasi-experimental Estimates of the Value of a Statistical Life"

- Typical studies attempting to estimate compensating wage differentials suffer from two main problems:
  - Exposure to workplace risk is endogenous.
  - Risk is measured at broad occupation-industry level, likely much measurement error.

- Ideal solution: must have workplace-level data, and exogenous variation in worker risk

- Lee and Taylor: exploit random nature of OSHA inspections to identify the effect of workplace saefty on wages.
- Between 1978 and 1999, OSHA implemented a program of (conditionally) random inspections (with some variation over time).
- Conditional on industry, firm size, state and recent inspection history, plants are randomly selected for a *surprise* comprehensive inspection.
- Safety violations are recorded and must be corrected within 30 days.

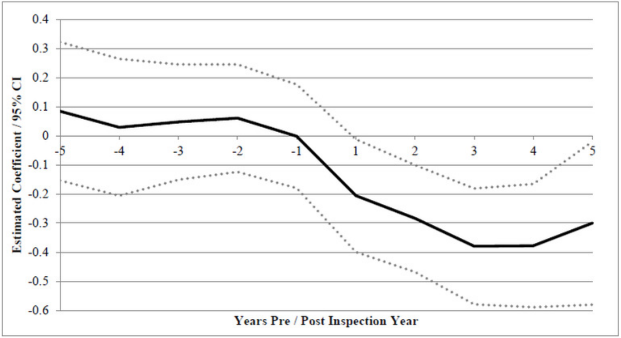
- Random nature of inspections means that inspected establishments will experience *exogenous* improvement in safety.
- Reduced form:

$$wage_{jt} = \alpha + \rho PI_{jt} + T_t + P_j + \beta X_{jt} + u_{jt}$$

  - PI_{jt} is an indicator variable for inspected plant in post-inspection year.
  - T_t : time effects.
  - P_j : plant fixed effects.
- First stage:

$$fatrate_{jt} = \alpha + \varphi PI_{jt} + T_t + P_j + \gamma X_{jt} + u_{jt}$$

Figure 1: Event Study Analysis of Compensating Wages.[a]



[a]Results based on estimation of equation (3). The sample includes all inspected plants five years before and after treatment and uninspected plants matched within the same industry, state, and year.

Table 6. DID estimates of plant-level changes in risks in response to receiving an OSHA inspection (dependent variable is annual plant-level fatality rates per 10,000 workers).[a]

	Estimated Coefficients (standard errors)[b]					
Variable Name	*Seven Industries*			*Full Sample*		
Turnover	0.026	0.008	0.049	0.035	0.024	0.043
	(0.171)	(0.168)	(0.202)	(0.089)	(0.089)	(0.104)
Productivity	0.197	0.215	0.208	0.074	0.079	0.076
	(0.160)	(0.160)	(0.171)	(0.059)	(0.060)	(0.064)
Number of Employees	0.069	-0.032	0.349	0.014	0.021	0.048
	(0.497)	(0.491)	(0.637)	(0.062)	(0.063)	(0.084)
Cost of Materials	-0.018	-0.009	0.003	-0.006	-0.005	-0.00004
	(0.025)	(0.027)	(0.031)	(0.004)	(0.005)	(0.005)
No. Production Workers	0.162	0.245	-0.144	-0.002	0.061	-0.049
	(0.612)	(0.588)	(0.748)	(0.153)	(0.158)	(0.188)
Single Unit Plant	0.217	0.235	0.185	0.117	0.137	0.130
	(0.282)	(0.281)	(0.291)	(0.133)	(0.133)	(0.140)
Programmed	-3.393***	-3.368***	-3.522***	-2.483***	-2.480***	-2.605***
Inspections (PI)	(0.691)	(0.712)	(0.751)	(0.371)	(0.380)	(0.405)
Fixed Effects Included:	Plant; Year	Plant; Year; Industry; Industry-by-Year	Plant; Year; Industry; Industry-by-State-by-Year	Plant; Year	Plant; Year; Industry; Industry-by-Year	Plant; Year; Industry; Industry-by-State-by-Year
Number of obs.	112,865	112,865	112,865	254,514	254,514	254,514
R-squared	0.001	0.002	0.028	0.001	0.002	0.028
Number of plants	28,071	28,071	28,071	65,326	65,326	65,326
F-statistic[c]	24.11	22.38	22.00	44.77	42.69	41.34

[a]Statistical significance at the 1%, 5%, and 10% level are represented by ***, **, and *, respectively.

[b] All models are estimated with standard errors clustered at the plant level that are robust to within-unit autocorrelation.

[c]The reported F-statistics test the restriction that *Programmed Inspections* has no effect on plant-level accident/fatality rates.

Table 7. DID estimates comparing wages at inspected and uninspected plants (dependent variable is hourly production worker wages).[a]

Variable Name	Estimated Coefficients (standard errors)[b] Seven Industries			Full Sample		
Turnover	0.145**	0.143**	0.137**	0.138***	0.152***	0.153***
	(0.059)	(0.059)	(0.060)	(0.040)	(0.040)	(0.040)
Productivity	0.855**	0.847**	0.888***	0.608***	0.598***	0.614***
	(0.360)	(0.357)	(0.332)	(0.154)	(0.153)	(0.144)
Number of Employees	-0.442	-0.448	-0.484	-0.066	-0.034	-0.0007
	(0.725)	(0.716)	(0.727)	(0.229)	(0.223)	(0.214)
Cost of Materials	0.041**	0.033**	0.031**	0.012*	0.010	0.010
	(0.017)	(0.016)	(0.016)	(0.007)	(0.007)	(0.007)
No. Production Workers	-2.516***	-2.422***	-2.277***	-1.577***	-1.615***	-1.668***
	(0.732)	(0.736)	(0.747)	(0.374)	(0.370)	(0.354)
Single Unit Plant	0.255***	0.249**	0.245**	0.262***	0.266***	0.263***
	(0.099)	(0.099)	(0.099)	(0.064)	(0.064)	(0.065)
Programmed Inspections (PI)	-0.299***	-0.203***	-0.206***	-0.259***	-0.229***	-0.203***
	(0.074)	(0.074)	(0.075)	(0.052)	(0.052)	(0.054)
Fixed Effects Included:	Plant; Year	Plant; Year; Industry; Industry-by-Year	Plant; Year; Industry; Industry-by-State-by-Year	Plant; Year	Plant; Year; Industry; Industry-by-Year	Plant; Year; Industry; Industry-by-State-by-Year
Number of obs.	112,865	112,865	112,865	254,514	254,514	254,514
R-squared	0.213	0.218	0.237	0.192	0.200	0.222
Number of Plants	28,071	28,071	28,071	65,326	65,326	65,326

[a]Statistical significance at the 10%, 5%, and 1% level are represented by *, **, and ***, respectively.
[b] All models are estimated with standard errors clustered at the plant level that are robust to within-unit autocorrelation.