Training

• Widespread view: human capital is engine of growth

• Understanding how individuals accumulate human capital via schooling and/or on-the-job training is key aspect of our understanding of
  – aggregate economic performance;
  – cross-section inequalities
    (think e.g. of recent increase in returns to skills)

• Investment in education and returns to schooling - next term

• This lecture: on-the-job training
1 Becker (1964) theory of training

- Cornerstone of modern thinking on training: Becker’s (1964) *Human Capital* treaty.

- crucial distinction between
  - specific skills - useful with current employer only
  - general skills - also useful with other employers

- In competitive labor markets: wages equal marginal product of labor, i.e. workers capture all returns to their general human capital and firms capture zero
  - thus firms will never pay for general training
A simple 2-period framework

- no discounting

- \( t = 0 \): a worker is hired; may receive general training \( \tau \) at cost \( c(\tau) \); productivity is zero (normalization)

- \( t = 1 \): productivity is \( f(\tau) \)

- assume \( f'(\tau) > 0; f''(\tau) < 0; c'(\tau) > 0; c''(\tau) > 0; c(0) = c'(0) = 0 \).

- social optimum requires \( \tau^* : f'(\tau^*) = c'(\tau^*) \).
  given above assumptions: \( \tau^* > 0 \)

- competitive labor markets: \( w(\tau) = f(\tau) \), because training is general and wages need to match outside options of workers

- if firm pays for training: \( \pi(\tau) = f(\tau) - w(\tau) - c(\tau) = -c(\tau) < 0 \).

- thus the firm will not pay for training as it cannot recoup its investment costs ("holdup" problem)
Figure 1. Training in competitive markets
If the firm will not pay for training, will the worker?
either out of pocket or taking a wage cut)

- as long as worker pays, he has right incentive to achieve $\tau^*$, but
  - he may be resource/credit constrained
  - may not take big enough wage cut, e.g. wages cannot go negative
  - training may not be enforceable
    (firm pays low wage with training promise, then does not deliver; but this would be hardly observable and enforceable)

- bottom line: in perfectly competitive labor markets investment in training is either specific or paid by the worker - with above caveats

- best policy action consists in removing credit constraints and improving credit market
How relevant is this model?

- among merits: explains why education is paid for by families (or government)
  - not by prospective employers

- but there is more to training than this: evidence shows that employers are indeed paying for general training (Acemoglu and Pischke EJ 1999)

1. German apprenticeship system.
   - Youths learn apprenticeship occupations spending time at training firm
   - Training is general as follows a prescribed curriculum, monitored by industry or craft chambers, and tested by an outside exam.
   - Mostly paid by firms.
2. Temp help supply firms
   - Provide workers to employers on short-term contracts, and receive fraction of wage as commission
   - Provide workers with general training (typing, computer and other clerical skills) before firm assignment (see Table I in Autor QJE 2001)
   - Workers have no contractual obligation to THS after training

3. Some firms send their employees to college/MBA programmes
WHY DO TEMP HELP FIRMS PROVIDE TRAINING?

TABLE I
SKILLS TRAINING: PREVALENCE AND POLICIES AT U. S. TEMPORARY HELP SUPPLY
ESTABLISHMENTS, 1994

<table>
<thead>
<tr>
<th>Training provided</th>
<th>Training policies (multiple policies possible)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All skills training</td>
<td></td>
</tr>
<tr>
<td>Any</td>
<td>“Up-front”: All/Volunteers trained</td>
</tr>
<tr>
<td>White-collar workers</td>
<td>Establishment selects trainees</td>
</tr>
<tr>
<td>Clerical/sales workers</td>
<td>Client requests and pays No training</td>
</tr>
<tr>
<td>Blue-collar workers</td>
<td></td>
</tr>
<tr>
<td>Computer skills training</td>
<td>Training methods used (if training given)</td>
</tr>
<tr>
<td>Any</td>
<td>Computer-based tutorials Classroom work, lectures</td>
</tr>
<tr>
<td>White-collar workers</td>
<td>Written self-study materials Audiovisual presentations</td>
</tr>
<tr>
<td>Clerical/sales workers</td>
<td></td>
</tr>
<tr>
<td>Blue-collar workers</td>
<td>Other</td>
</tr>
</tbody>
</table>

Detailed training subject frequencies by major occupation group

<table>
<thead>
<tr>
<th></th>
<th>Any</th>
<th>White-collar</th>
<th>Clerical/sales</th>
<th>Blue-collar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word processing</td>
<td>63%</td>
<td>23%</td>
<td>75%</td>
<td>13%</td>
</tr>
<tr>
<td>Data entry</td>
<td>58%</td>
<td>19%</td>
<td>69%</td>
<td>11%</td>
</tr>
<tr>
<td>Computer programming languages</td>
<td>22%</td>
<td>12%</td>
<td>23%</td>
<td>1%</td>
</tr>
<tr>
<td>Customer service</td>
<td>41%</td>
<td>27%</td>
<td>47%</td>
<td>12%</td>
</tr>
<tr>
<td>Workplace rules/on-job conduct</td>
<td>66%</td>
<td>55%</td>
<td>68%</td>
<td>60%</td>
</tr>
<tr>
<td>Interview and resume development skills</td>
<td>30%</td>
<td>31%</td>
<td>32%</td>
<td>13%</td>
</tr>
<tr>
<td>Communications skills</td>
<td>14%</td>
<td>15%</td>
<td>14%</td>
<td>10%</td>
</tr>
</tbody>
</table>

White-collar occupations are professional specialty, technical, and executive and managerial. Clerical/sales occupations are marketing, sales, and clerical and administrative support. Blue-collar occupations are precision production, craft and repair, machine operators, assemblers, and inspectors, transportation and material movement occupations, and handlers, equipment cleaners, and laborers. The sample includes 1002 temporary establishments supplying white-collar, clerical, or blue-collar temporary workers (establishments may supply more than one type of worker). Training statistics by collar include only the subsample of firms supplying workers in collar (n = 630, 859, and 755 for establishments supplying white-collar, clerical, and blue-collar workers, respectively). All frequencies are weighted by BLS national establishment sampling weights.

the Bureau of Labor Statistics (BLS) in 1994, 78 percent offered some form of skills training, and 65 percent provided computer skills training.⁵

⁵. Computerized tutorials are the most common form of instruction (82 percent), while 52 percent of establishments provide workbook exercises and 45 percent provide classroom-based training. As documented in Table I, firms employ
2 Why do firms pay for general training?

• Noncompetitive labor markets

• Key features
  – \( w(\tau) < f(\tau) \), i.e. there are rents accruing to employers
  – \( w'(\tau) < f'(\tau) \), i.e. wage distribution is compressed

• Firm will provide and pay for \( \tau^f \) :
  \[ c'(\tau^f) = f'(\tau^f) - w'(\tau^f) \]

• \( \tau^f > 0 \) due to shape of \( c(\tau) \) and \( f(\tau) \)
• Intuition: due to labor market imperfections: returns to training partly accrue to firm; thus firm prefers more skilled to less skilled workers

• Labor market imperfections turn *technologically general* skills into de facto *specific* skills

• Is this solution socially efficient? social optimum requires \( f'(\tau) = c'(\tau) \) instead of \( f'(\tau) = w'(\tau) + c'(\tau) \), thus \( \tau^f \) inefficiently low.

• Paradox, the stronger labor market imperfections, the larger the wedge \( \Delta(\tau) = w(\tau) - f(\tau) \), the higher \( \tau^f \).

• (The “right” kind of) imperfections encourage training!
Figure 2. Training with a compressed wage structure.
Sources of labor market rents and wage compression

- search frictions
- asymmetric information
- institutional rigidities
- ...
3 Search frictions

It is costly for workers to quit their jobs and find new jobs; and it is costly for firms to replace employees

- worker and firm set wages in bilateral monopoly: **Nash bargaining**
- worker gets share $\beta$ of match surplus; firm gets share $1 - \beta$
- outside options: $v(\tau)$ for the worker and 0 for the firm
- note $v(\tau) < f(\tau)$ because of rent generated by search frictions
- and $v'(\tau) < f'(\tau)$ because one first needs to find a job before starting to produce employing skills $\tau$
Nash sharing implies

\[ w(\tau) = v(\tau) + \beta[f(\tau) - v(\tau)] \]  
\[ \pi(\tau) = (1 - \beta)[f(\tau) - v(\tau)] - c(\tau) \]

with \( c(\tau) \) is sunk at time of bargaining

Results.

- from (1): \( w(\tau) < f(\tau) \) and \( w'(\tau) < f'(\tau) \)
- these are sufficient conditions for \( \tau^f > 0 \)
- from (2) obtain \( \tau^f : c'(\tau^f) = (1 - \beta) \left[ f'(\tau^f) - v'(\tau^f) \right] \)
- higher \( \beta \) lowers training
Introduce quits:

- with probability \( q \) worker quits before starting production at time 1.

- Thus

\[
\pi(\tau) = (1 - q)(1 - \beta)[f(\tau) - v(\tau)] - c(\tau)
\]

and

\[
c'(\tau f) = (1 - q)(1 - \beta) \left[f'(\tau f) - v'(\tau f)\right]
\]

- Training is lower because there are fewer trainees around in period 1, from whom the firm can capture returns from training.

- When frictions are more important, the probability of receiving an outside offer is lower, the quit rate is lower and training investment is higher.

- The same result clearly holds in a **wage-posting** framework
4 Asymmetric info bw current and other employers

(Acemoglu and Pischke QJE 1998, see also Acemoglu and Pischke EJ 1999, Section 5, for simplified model)

- Current employer better observes workers’ ability than the outside labor market
- When ability and training are complements, asymmetric information leads to compressed wage structure and encourages training.
- Intuition: high-ability workers cannot quit and signal their ability, thus their employers can keep them and pay less than their marginal product.
- Asymmetric info results in adverse selection, compressed wage distribution and firm provided training
4.1 A simple model

- ability is unobserved in period 0 (while training), revealed at time 1 (while producing)
- training only takes two values $\tau \in \{0, 1\}$
- $c > 0$ is cost of $\tau = 1$
- output produced at time 1 is $f(\tau) = \alpha(\tau)\eta$
- $\eta$ represents ability; binomial: $\Pr(\eta = 0) = p$; $\Pr(\eta = 1) = 1 - p$
- $\alpha(0) = 1$; $\alpha(1) = \alpha > 1$
- in period 1: worker receives “disutility” shock $\theta$; $\theta$ uniform over $[0, 1]$
- utility in current job: $w - \theta$; outside option: $v$
• **in period 1**: $p$ workers are laid-off; $(1 - p)(1 - w + v)$ workers quit [Pr($v > w - \theta$) = 1 – w + v]. Together, they form secondary market.

• firm maximizes profits

• if firm trains

\[ \pi(\tau = 1) = (1 - p)(w - v)(\alpha - w) - c \]

and $w = (\alpha + v)/2$.

• if firm does not train

\[ \pi(\tau = 0) = (1 - p)(w - v)(1 - w) \]

and $w = (1 + v)/2$

• likelihood of training increases with $\alpha$ and decreases with $c$. 
Outside option $v$ equals expected productivity of workers in the secondary market. Suppose there is training:

$$v = \frac{(1 - p)(1 - w + v)\alpha}{p + (1 - p)(1 - w + v)}$$

i.e. $p$ workers have productivity zero, and $(1 - p)(1 - w + v)$ workers have productivity $\alpha$.

As quitters cannot signal their true ability $\alpha$, in the secondary market they receive $v < \alpha$. Adverse selection has compressed the wage structure.

If the secondary market contains relatively many quitters, $v$ is higher, and this in turn encourages quits.

If the secondary market contains relatively few quitters, $v$ is lower, and the quit rate will indeed be lower.
• Possibility of multiple equilibria

• Median number of jobs held by males in first 10 years of labor market experience: 6 in US, 1-2 in Germany.


• Germany: low mobility-high training equilibrium. Low (or negative) gains from job switching, wage growth happens mostly on-the-job.
• Note that complementarity between ability and training is necessary for training.

• Otherwise information rents in period 1 would be independent of training, and increases in productivity through training would be fully reflected in the outside wage.

• [try to show this using \( f(\tau) = \alpha(\tau) + \eta \)]
4.2 Evidence on adverse selection

Evidence from workers who have gone through an apprenticeship in Germany.

3 main reasons why apprentices leave training firm:

(i) firm does not offer perm contract after apprenticeship

(ii) worker quits voluntarily

(iii) worker is (randomly) drafted into military service

Prospective employers cannot distinguish between (i) and (ii), but can observe whether a worker has just come back from the military.
Implications:

- stayers should earn more than laid-off workers and quitters - as latter are affected by adverse selection

- military quitters should earn more than all leavers - as former left for exogenous reasons and are not affected by adverse selection

- military quitters may even earn more than stayers - as former may be paid their marginal product
• Data from German Qualification and Career Survey, containing detailed info on apprenticeship and why left training firm.

• Sample used: male workers who completed secondary education, went through an apprenticeship, and did not return to education afterwards.

• Wage equations controlling for usual human capital variables, plus reason for leaving training firm

• Both stayers and military quitters earn more than other quitters;

• military quitters earn more than stayers.

• but coefficients not precisely estimated - see Table III in paper.
### TABLE III
**Basic Wage Regressions (Dependent variable: log average hourly earnings)**

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Qualification and career survey</th>
<th>1984 SOEP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Attended 10th grade</td>
<td>0.160</td>
<td>0.162</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Experience</td>
<td>0.123</td>
<td>0.108</td>
</tr>
<tr>
<td></td>
<td>(0.024)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>Experience$^2$/100</td>
<td>-0.694</td>
<td>-0.532</td>
</tr>
<tr>
<td></td>
<td>(0.182)</td>
<td>(0.126)</td>
</tr>
<tr>
<td>Experience$^3$/10,000</td>
<td>1.840</td>
<td>1.229</td>
</tr>
<tr>
<td></td>
<td>(0.558)</td>
<td>(0.379)</td>
</tr>
<tr>
<td>Experience$^4$/1,000,000</td>
<td>-1.806</td>
<td>-1.063</td>
</tr>
<tr>
<td></td>
<td>(0.597)</td>
<td>(0.399)</td>
</tr>
<tr>
<td>Apprenticeship in manufacturing</td>
<td>0.024</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td></td>
</tr>
<tr>
<td>Apprenticeship in trade</td>
<td>0.036</td>
<td>0.022</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td></td>
</tr>
<tr>
<td>Apprenticeship in other sector</td>
<td>0.041</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td></td>
</tr>
<tr>
<td>Apprenticeship firm had 100–499 employees</td>
<td>0.045</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td></td>
</tr>
<tr>
<td>Apprenticeship firm had 500–999 employees</td>
<td>0.072</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td></td>
</tr>
<tr>
<td>Apprenticeship firm had 1000+ employees</td>
<td>0.095</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td></td>
</tr>
<tr>
<td>Stayer</td>
<td>0.012</td>
<td>0.027</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>Military quitter</td>
<td>0.045</td>
<td>0.011</td>
</tr>
<tr>
<td></td>
<td>(0.025)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>Ever did military service</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.384</td>
<td>0.337</td>
</tr>
</tbody>
</table>

White standard errors are in parentheses. Samples in the first two columns are pooled from the 1973, 1985/86, and 1991/92 German Qualification and Career Surveys and consist of German males, age 23–59, with nine or ten years of schooling, who left secondary school in 1948 or later, completed private sector apprenticeship training without returning to school after the apprenticeship, were employed in the private sector outside construction, and were working full-time. Column (1) includes workers who did an apprenticeship in a firm with 50 employees or more; column (2) uses apprentices from firms of all sizes. Number of observations is 5,355 in column (1) and 13,051 in column (2). "Stayers" are those workers who continued in their apprenticeship firm after training; "military quitters" are those who left their training firm for military service. Sample in the last column is from the Socioeconomic Panel and consists of German males, age 23–59, with nine or ten years of schooling, who left secondary school in 1948 or later, were employed in the private sector outside construction, and were working full-time. Number of observations is 513. All regressions also include a constant, and the regressions in columns (1) and (2) include two additional dummies for the survey year.
• Alternative interpretation: military positively selects draftees, or military im-
parts skills that are valued in civilian labor market.

• But men who are ever drafted in the military (not just after apprenticeship) earn less than others (though not significantly).
5 Asymmetric info bw employer and worker

(Autor QJE 2001)

• Why temp-help firms provide general training, despite record turnover rates?
• Assume workers know own ability better than employers
  – If training and ability are complements, training firms attract more able workers
  – Firms may learn about ability by training, training incorporates testing
• Testable implication: for training to induce self-selection, training firms initially pay lower wages than non-training firms, and higher wages later
  – otherwise, without initial wage cut, all workers (more and less-able) would self-select into training
• Prediction confirmed on data from THS survey
6 Asymmetric information on worker effort

(Acemoglu and Pischke JPE 1998)

• Moral hazard: wages need to satisfy the worker’s incentive compatibility constraint
• there exists a minimum payment $w^*$ that induces worker’s effort
• when productivity is below this level, it can be raised, without raising wages
• for workers receiving $w^*$, the wage structure is distorted (or compressed), and any increase in productivity due to training accrues to the firm
• for the firm to be profitable: there are rents, due to some other mechanism (e.g. mobility costs).
• $w(\tau) = \max[w^*, f(\tau) - \Delta]$, where $\Delta$ represents rents.
• the firm may thus be willing to invest in training up to $\tau^f: w^* = f(\tau^f) - \Delta$
Figure 3. Training with a minimum wage payment
7 Minimum wages

- Imposition of a binding minimum wage increases pay of less-skilled workers, while leaving pay of skilled worker largely unaffected.

- The resulting wage distribution is compressed and the firm is residual claimant of increases in productivity, thus encouraging training.

- Same mechanism as with moral hazard and minimum payment that induces effort

- Existing evidence is mixed.

- Acemoglu and Pischke (RLE 2003) look at impact of min wage increases in the US on training of low-skill workers and find no evidence that min wages increase or decrease training
8 Trade unions

- Unions tend to compress the wage structure by forcing employers to pay higher wages to less-skilled workers.

- Similar mechanism to Nash bargaining framework (see also Acemoglu and Pischke JPE 1998)

- Other labor market “rigidities” such as unemployment benefits and firing costs can lead to similar results
9 Policy

(Acemoglu and Pischke EJ 1999)

- Standard theory of human capital: training investment is efficient if workers are not liquidity constrained.
  - Government intervention should be limited to improving credit markets
  - Subsidies to training would be counterproductive because they distort the returns to training
- In noncompetitive labor markets:
  - Even when workers are liquidity constrained, firms may still provide general training
  - Even when workers are not constrained, training is below the first-best level
- Thus removing credit constraints may not be necessary or sufficient
Why underinvestment in training?

- with a compressed wage structure, both the firm and the worker share the proceeds from training, but neither is the full residual claimant

- neither party internalizes effect of training on the other party, and training investment is inefficiently low

- also: positive externality of training investments on future employers not internalized (Acemoglu RES 1997)
Possible remedies to underinvestment problem

- Training subsidies, so as to equalize private and social benefits of training
  - but the amount or quality of training may not be fully contractible or even observable

- Direct provision of training by the government
  - but government training programmes fail to exploit the complementarity between training and production, and may not keep pace with evolving needs of businesses and trainees
  - US experience with government training programmes is mixed; 200+ pages chapter by Heckman et al. in Handbook qualifies government programmes as largely unsuccessful.

- Supplement subsidies to firms with regulation and monitoring (German apprenticeship system)
The most “general” human capital investment: Health


- In the US most of the working age population obtain health insurance through their employers
- Health is as general a form of human capital as it gets
- Model: productivity is \( f(\tau, h) \), where \( h \) is investment in health and \( \tau \) is training
- Employers in high-turnover industries have lower incentives to invest in employees’ health
- Turnover thus leads to dynamic inefficiencies: inefficient low level of human capital investment.
Empirical specification

\[ y_i = \alpha ASVP + \beta X_i + \epsilon_i \]

where \( y_i \) is health-insurance outcome and \( ASVP \) is industry specific Average Specific Vocational Preparation

- measures importance of job specific skills in each industry, proxy for job attachment

Results: individuals in industries with higher \( ASVP \) are much more likely to be offered health insurance

- one unit change in \( ASVP \) (1.2 st dev.) raises an employee’s likelihood of receiving health insurance by 9%
- similar results with levels of expenditure
• Is there an endogeneity problem? i.e. employees more likely to quit jobs that do not offer health insurance
  – use IV capturing difference in sectoral turnover that are independent of health insurance provided
    → average turnover in 3-digit industries in the UK
  – reverse causality not a concern in the UK as there is a National Health Service
  – very similar results as in OLS regression
EC423 2007 exam, question 4

Consider the consequences of asymmetric information between current and prospective employers in a simple 2-period framework with the following ingredients. In period 1 workers are hired at the representative firm, may receive training $\tau$, where $c > 0$ is the cost to the firm of $\tau = 1$, production is zero, worker ability ($\eta$) is unobserved, and is distributed binomial, with $\Pr(\eta = 0) = p$ and $\Pr(\eta = 1) = 1 - p$. In period 2 production is $f(\tau) = \alpha(\tau)\eta$, with $\alpha(0) = 1$ and $\alpha(1) = \alpha > 1$, workers are paid a wage $w$ and receive a “disutility” shock $\theta$ such that utility in the current job is $w - \theta$ while the value of their outside option is $v$. Workers with zero ability are laid off. Among others workers, those with $w - \theta < v$ quit voluntarily. Outside firms observe levels of training of workers in the secondary market, but do not observe ability nor the reason for separation. There is no discounting throughout.
(a) The representative firm maximises profits. Derive expressions for profits and wages when \( \tau = 0 \) and \( \tau = 1 \).

(b) Compute the wage \( \upsilon \) that outside firms are willing to pay to workers in the secondary market under \( \tau = 0 \) and \( \tau = 1 \). Is the increase in productivity due to training \([f(1) - f(0)]\) fully reflected in the outside wage \([\upsilon(1) - \upsilon(0)]\)? Is training potentially profitable in this model? Discuss in words why complementarity of ability and effort in production is necessary to deliver firm provided training in equilibrium.

(c) Explain how this model can generate multiple equilibria in training and turnover. How can these results be reconciled with the existing evidence on training and turnover for Germany versus the US?