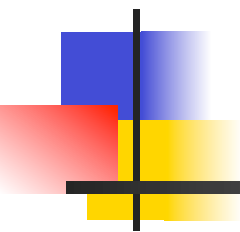


Chapter 3

Investment in Skills

(Theory of Human Capital Education and On-The-Job Training)



Economics 136

Julian Betts



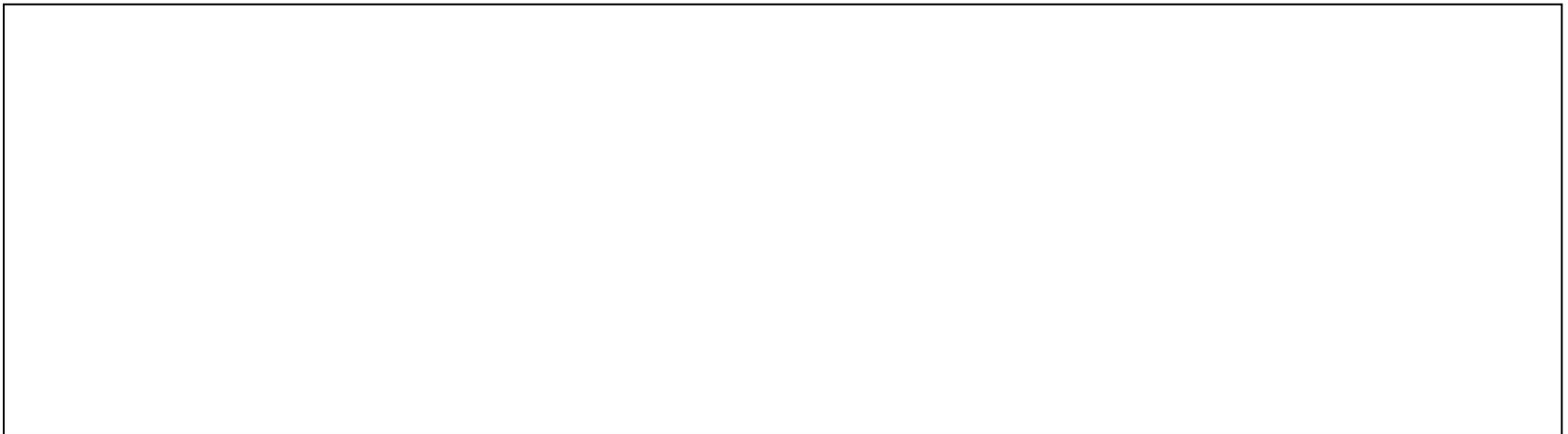
Main Questions

- 1) What determines optimal amount of education people obtain?
- 2) What determines optimal amount of on-the-job training (OJT) people obtain?
- 3) Who should pay for OJT? Worker or both?
 - Important distinction between general and specific OJT



1) What determines optimal amount of education people obtain?

- Consider worker with age A , who retires at age 65, trying to decide whether to go back to school for one more year
- **Rule:**



Showing this result mathematically

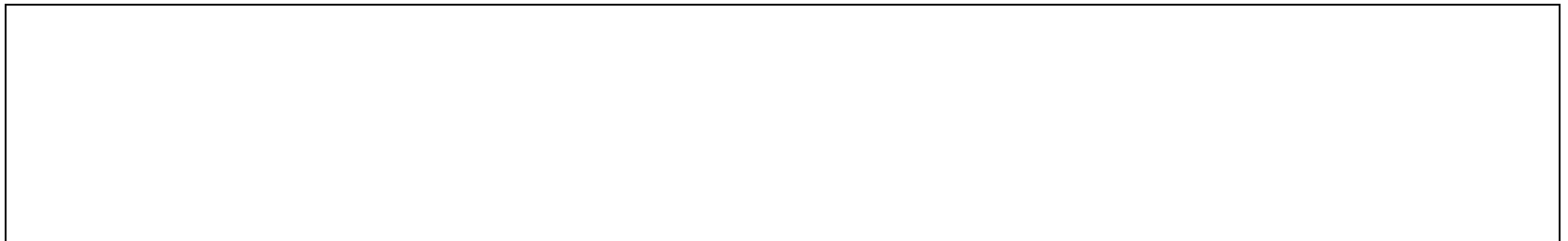
- r – discount rate
- K_t – Wage at age t if gets one more year of schooling now
- J_t – Wage at age t if doesn't get 1 more year of schooling now
 - Note: $K_t > J_t$ for all t
- C_A – Cost of tuition, books etc. if attend 1 year of school/college at age A

Compare the two measures of Present Discounted Value

$$PDV_{NoSchool} = \sum_{t=A}^{65} \frac{J_t}{(1+r)^{t-A}} = J_A + \frac{J_{A+1}}{1+r} + \dots + \frac{J_{65}}{(1+r)^{65-A}}$$

$$PDV_{School} = -C_A + \sum_{t=A+1}^{65} \frac{K_t}{(1+r)^{t-A}}$$

- Rule: Attend school if $PDV_{school} > PDV_{no\ school}$,
or





Interpreting the Inequality

- Really, is simply saying invest in schooling if:
 - $MR > MC$
- Note the two components of marginal cost of schooling are tuition/books (C_A) and the opportunity cost of wages forgone J_A .
 - Often



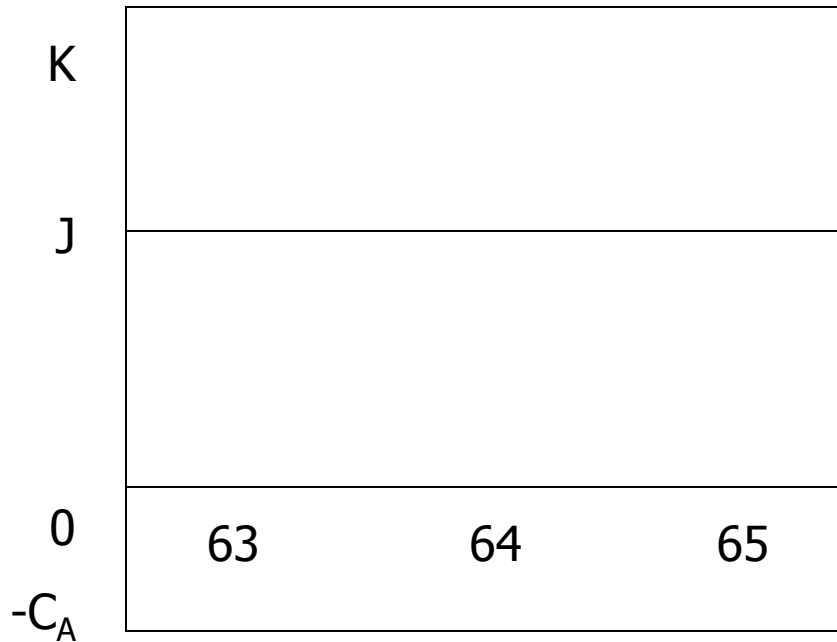
List Changes that Would Decrease the Probability of More Schooling

- 1) If C_A rises
- 2) If current wage J_A rises
 - Those with lots of education less likely to get more!
- 3) If wage gain from schooling, $(K_t - J_t)$, goes down at any age $t > A$
 - Note: This wage “premium” has risen a lot in the U.S. from 1979 to today. (Tech change)
- 4) If the # of years until retirement fall
 - Shorter payback period
- 5) If r rises. (Less patient people get less schooling)

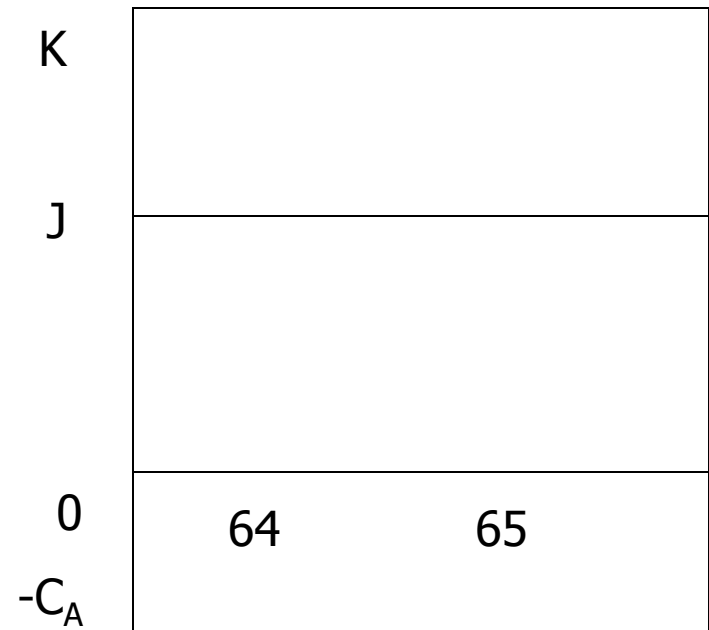
Illustration of the Role of Years to Retirement: Compare a 63- and 64-year old.

Assume wages = J or K (do not vary by age)

Income



Income

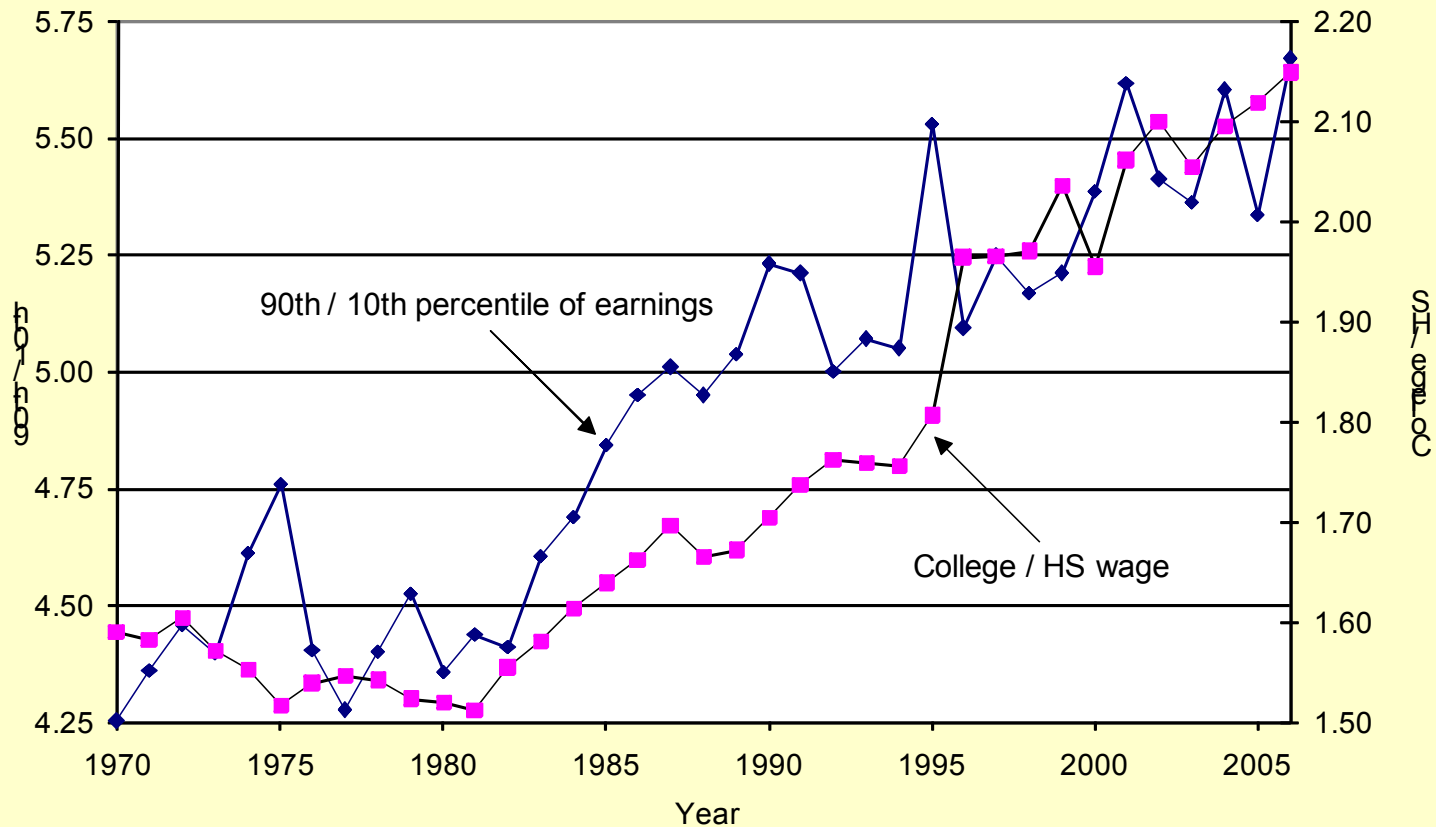


Age

Age

“An Investment in Knowledge Pays the Best Return” (Benjamin Franklin)

Returns to Skills, 1970-2006



about

A Sample Problem from Test 2, 2003 (#3)

- 3) (8 points) A person aims to maximize the present discounted value of lifetime earnings over two periods. In period 1 she can either work or go to college and in period 2 she will work. In period 1, if she attends college, she works part-time, earning \$10,000, while paying tuition of \$5000 and \$1000 for books. In period 2, after finishing college, she earns \$55,000.
- This worker discounts period 2 earnings at a discount rate of 10%.
- Suppose that if she does not attend college in period 1 then she will earn a fixed salary of \$ V in both periods 1 and 2.
- a) Calculate the PDV of earnings conditional upon attending college and not attending college, which you can label PDV_C and PDV_{none} respectively. (6)
- b) Write down a rule that determines whether this student will attend college, conditional upon the value of \$ V . Show your work. (Hint: Do not panic if you don't get round numbers.) (2)



Your answer



On-the-Job Training (OJT)

- OJT is the second main method of acquiring human capital along with education

- Key distinction: general vs. specific OJT

- General: skills learned boost worker's productivity at current firm and other firms equally.

- Example:

- Specific: skills boost productivity at current firm only.

- Example:

Can OJT Explain Turnover Patterns?



- Beginning of chapter points out with real data that many new employees leave in first year or two, but others stay a very long time
- One interpretation: Probation at the start followed by long term investments in training for employees, who then stay.
- Another explanation is matching: workers search for best match and once they find a well matched firm, they stay!



General OJT

- How to set wages? Who should pay for cost of training?
- Assume:
 - workers work for 2 periods
 - cost of training is c
 - worker's alternative wage both periods is w_a
 - increase in productivity after OJT is m
- What are wages in periods 1 and 2, w_1 and w_2 ?!



Optimal Wages with General OJT

- A profit max' g firm will pay least it can.
- In period 2 must pay the productivity the worker would have elsewhere:

- (1)

- In period 1 must pay over 2 periods what could earn elsewhere:

-

- Substitute (1) to get:

- (2)

Pay per period at current firm vs. best alternative

\$ per
period





What are profits (π)?

- $\pi = \text{Output}_1 + \text{output}_2 - w_1 - w_2$
- $\pi = (w_a - c) + (w_a + m) - 2w_a$
- $\pi = m - c$
- If profits < 0 firm goes out of business.
- But what if profits > 0 because $m > c$?
In this case, $w_2 = w_a + m = \text{VMP}_2$. But
make profits in period 1 where $w_1 = w_a - m < \text{VMP} = w_a - c$.

Situation with positive profits (because pay $w_a - m$ in period 1)

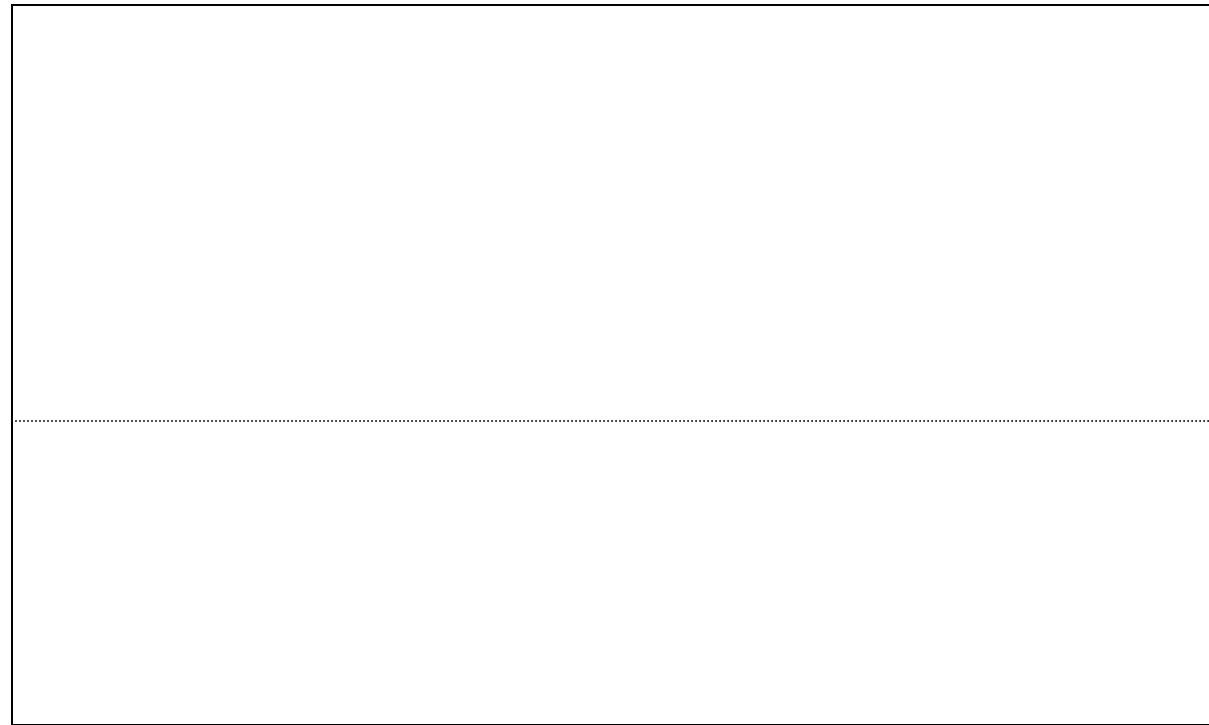
\$ per
period

$$W_2 = w_a + m$$

w_a

$w_a - c$

$$W_1 = w_a - m$$



$$W_a + m$$

1

2

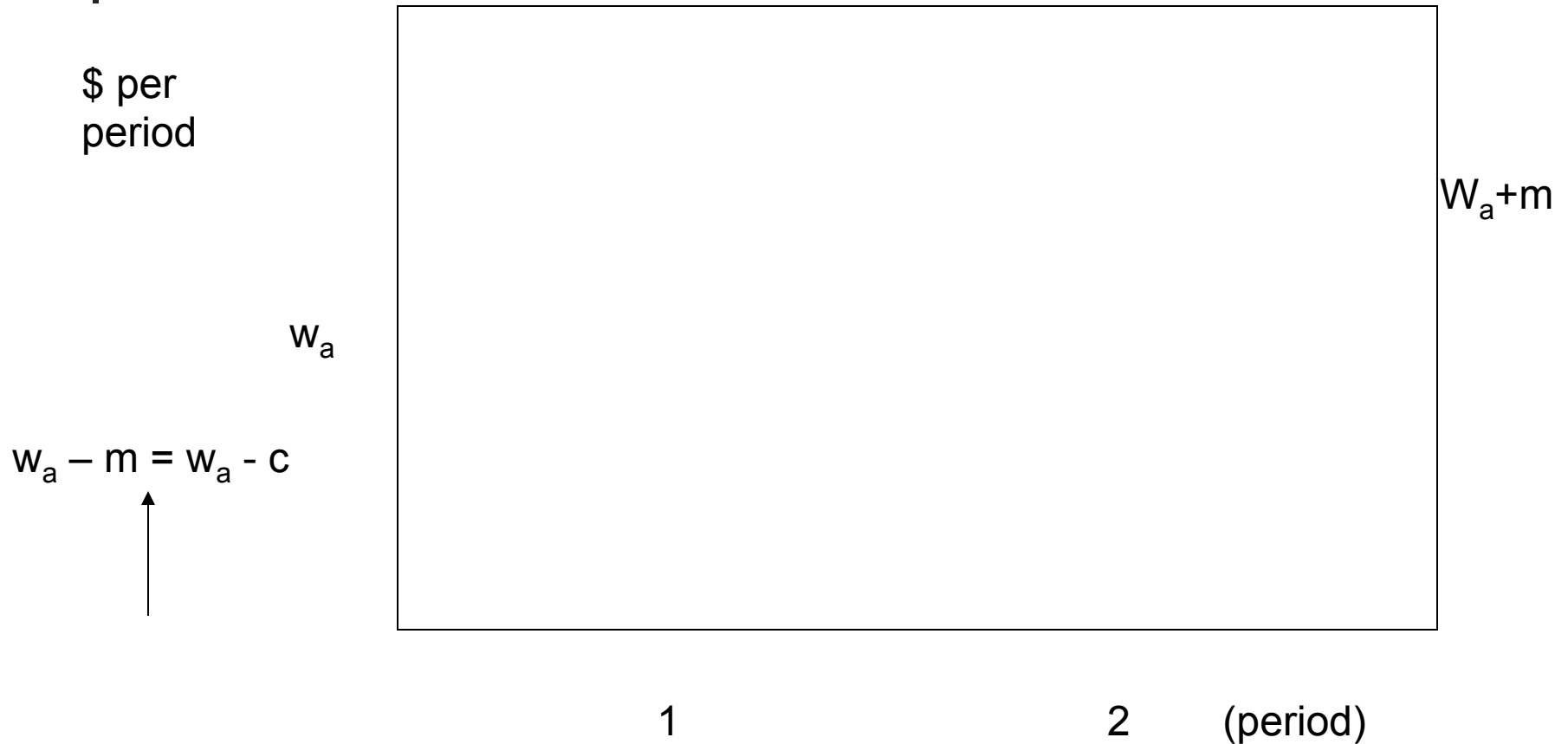
(period)



Perfect Competition Drives Up Alternative Wages

- Perfect competition in goods market: if other firms observe $m > c$ then they see that they can make $\pi > 0$ if they imitate the first firm by using same sort of training.
- Drives up best alternative wage w_a until $m=c$ and $\pi=0$ again:

Pay per period at current firm vs. best alternative after w_a rises to eliminate positive profits





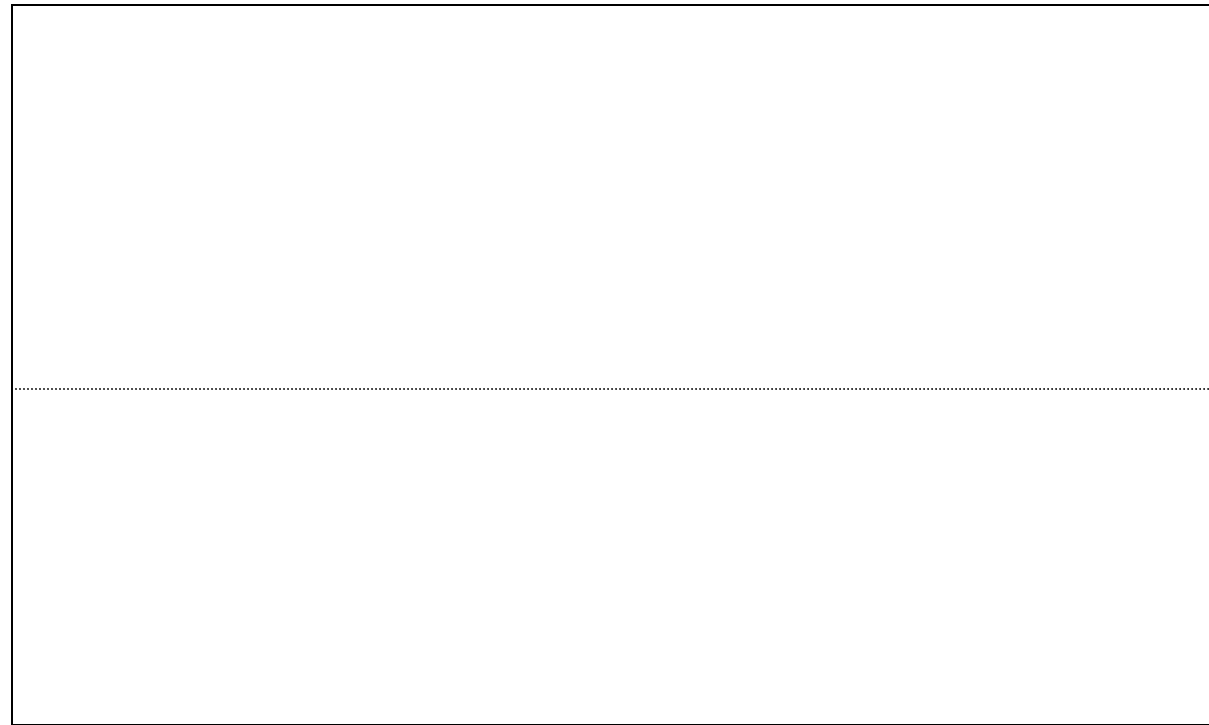
Who pays for cost of general training, worker or firm?

- Suppose a firm offers to subsidize training cost, paying $w_1 > VMP_1 = w_a - c$ in period 1 and then paying $w_2 < VMP_2 = w_a + m$ in period 2.
 - (Firm loses money in period 1 and makes a profit in period 2. Worker earns the same amount over 2 periods but might prefer having earnings smoothed out.)
- Will this work?
- A:

Illustration of a firm's failed attempt to subsidize general training in period 1 and earn it back in period 2

\$ per
period

w_a
 w_1
 $w_a - m$



1

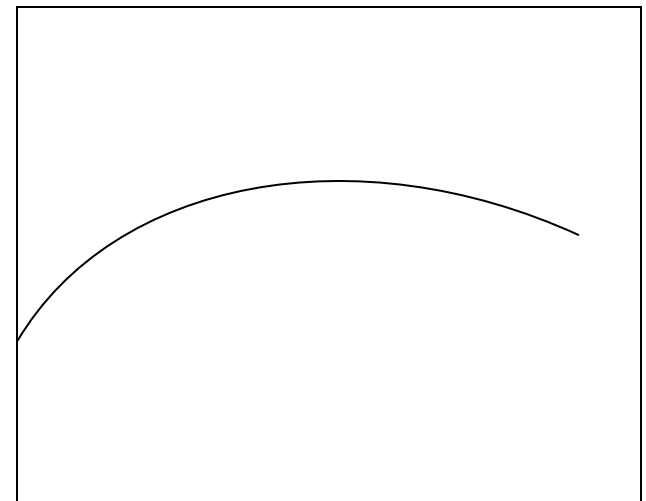
2

(period)

$w_a + m$
 w_2

Age and Training

- Younger workers more likely to accept job with large training component.
 - Can afford to undergo low initial wages due to long career to get “payback”
- Leads to positively sloped wage:age profiles



Age



Firm-Specific Human Capital

- Best way to see who pays for such training:
 - Consider the two extremes and show that they are not “incentive compatible”.
- Scenario 1: Firm pays all training costs and gets all period 2 productivity benefits
 - That is, $w_1 = w_2 = w_a$
 - Problem:



Firm-Specific Human Capital

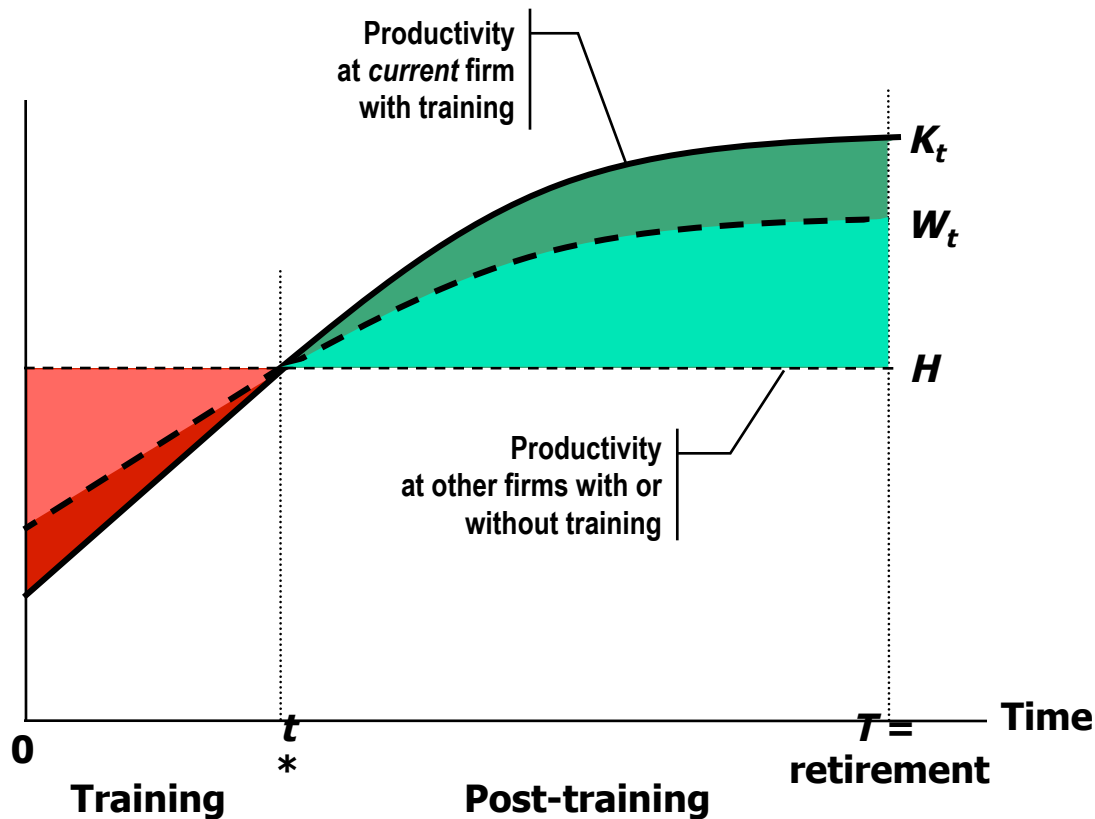
- Scenario 2: Worker all training costs and gets all period 2 productivity benefits
 - That is, $w_1 = w_a - c$ $w_2 = w_a + m$
 - Reverse Problem: In period 2 firm indifferent between keeping the worker and firing. Can blackmail worker: reduce w_2 below $w_a + m$ or you are fired.
- Both of these scenarios are examples of the “holdup problem”: One party invests now, with gain expected in future, but the other party is then tempted to renegotiate or renege altogether!



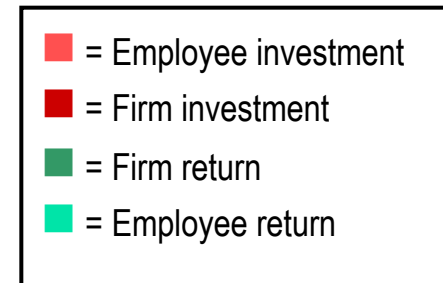
Solution to the Holdup Problem in Firm-Specific Human Capital

- Solution to both incentive problems: worker and firm should each pay some fraction of training costs and get corresponding share of period 2 productivity gains.
 - Both “lose” in period 1 and want the relationship to continue in period 2 so that can do better than they could without the relationship.

Sharing Investments in Firm Specific Human Capital



- Investments in FSHC will generally be shared by both, to reduce temptation to renegotiate
- A special case of a more general issue: *relationship-specific investments*



Employee Non-Compete Agreements



- Another way to reduce risk of employee Hold-Up: add a non-compete agreement often difficult to enforce in court
 - legal system balances firm's interest in protecting assets, against employee's liberty in choosing employment
- Possible clauses
 - require adequate notice before leaving
 - require to describe new employer, job duties
 - require to train successor; introduce to clients
 - prohibit from recruiting colleagues to leave as well
 - tie vesting to non-compete performance after leaving
- Restricting outside options imposes a cost on employee
 - compensate through higher salary or signing bonus when making offer
 - if non-compete signed after employment starts, compensate w/ lump sum
 - also helps legal enforceability



In Real World, Is Training General or Specific?

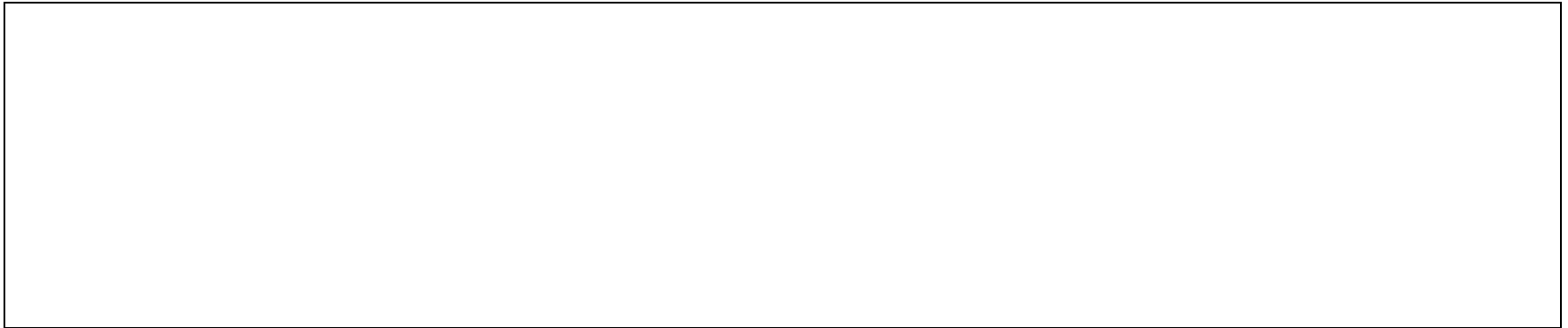
- Since both types of OJT increase wages with age, hard to distinguish.
-
- Do we really see jobs with lots of training paying less than other jobs initially?
 - Barron Black and Berger (Journal of Human Resources, 1999) among first to measure actual training. Find muted evidence in favor of this idea. Unclear why (worker liquidity constraints?)

Industry-Specific Human Capital



- Derek Neal (Journal of Labor Economics, October 1995): Evidence for industry-specific human capital.

- Evidence:



- Argues that firm-specific human capital could be quite minor.



b. On-the-Job Training

- Let's model OJT formally (Appendix)
- Suppose there are only 2 skills, Java (J) & Tax (T)
 - investments in skills cost $C(J, T) = \frac{1}{2}(J^2 + T^2)$
- Firms value skills differently, depending on job design
 - your productivity *in this firm* is $Q^F = \alpha J + (1-\alpha)T$
 - you estimate your value *in the labor market* to be $Q^M = \beta J + (1-\beta)T$
 - α = your firm's relative weight on J compared to T; β = market's weight
 - assume that your firm gives relatively more weight to Java; $\alpha > \beta$



How Should you Invest?

- First assume you plan to stay at this firm
 - $\max Q^F = IJ + (1-I)T - \frac{1}{2}(J^2 + T^2)$
 - first-order conditions imply that:
 -
 - If you plan to quit, optimal investment is:
 - $J^M = \frac{I}{2}; T^M = \frac{1-I}{2}$
 - Intuitively, invest in proportion to relative values



Optimal OJT

- More realistically, let p = probability you stay in this job next year

- your optimal investment is

- $\max Q^F = p[IJ + (1-I)T] + (1-p)[I\bar{J} + (1-\bar{I})T] - \frac{1}{2}(J^2 + T^2)$

- So $J^* = pI + (1-p)\bar{I}$; $T^* = p(1-I) + (1-p)(1-\bar{I})$

- Intuitively, weight investment by prob. of working here or elsewhere

- It is easy to show that if your current job weights skill J relatively more ($I > \bar{I}$),

- $J^M < J^* < J^F$

- $T^M > T^* > T^F$

- in other words, you do *not* invest optimally for this job, but hedge your bet toward your outside market value



Implications

- The greater the odds of staying in your job, the more should you invest in your firm's desired skills, & vice versa
- The longer you work at a firm, the more will your skill investment
 - match the firm's desired mix, & diverge from the market's desired mix
 - & thus the lower the chance you will leave the firm
- Different optimal training strategies for
 - younger & older workers
 - those who expect to quit or to stay
 - those with low or high tenure at your firm

Thick & Thin Markets for Talent

- Some types of talent have “thick” markets, others “thin”
 - “thick” market: outside options similar to value to the employer ... $I \approx \underline{I}$
 - worker is more willing to invest in the firm’s desired skill portfolio, since it’s similar to what the market values
 - The extreme cases are usually called “general human capital” (GHC) & “firm-specific human capital” (FSHC)
 - GHC = most extreme thick market, $I = \underline{I}$
 - FSHC = most extreme thin market – your firm values a completely different set of skills from the market, say $I = 1$ & $\underline{I} = 0$ (or vice versa)

A Bird's Eye View: Complex Contracting



- Our probation model → multi-period contracts
 - contract adds performance evaluation, contingent rewards or termination
- Our firm-specific human capital model → want shared investments
- These only reinforce the need for a relationship
- Both rely on promises



Explicit & Implicit Contracting

- Promises are problematic, as they are hard to enforce
- Why use implicit contracts (promises)? Because complete formal contracts are usually impossible to write
 - too many contingencies, too costly
 - example: Ford's contract w/ UAW
 - some contingencies are unforeseeable
 - lower transactions costs (sometimes)
 - e.g., network structures
 - some actions cannot be verified / enforced in a court
 - e.g., subjective performance evaluations
- If one or both sides trust the other, we don't have to rely on formal contracts & courts, or on constant negotiation



“My Word is My Bond”

- The greater your credibility, the more willing are others to work with & invest in you
 - #1 driver of employee engagement = “trust of your manager”
- How do you establish credibility?
 - align incentives
 - Shared firm-specific human capital investment implies both benefit later, reducing incentives to renege
 - signal: incur personal cost up-front to prove your trustworthiness
 - pre-commit / limit some of your options
 - pay up front costs
 - offer forms of insurance (e.g., severance clause in employment contract)
 - personality: hard to change, but an advantage if yours makes you credible

A sample problem from Test 2, 2005 (#3)

- 3. (16 points) Assume that a worker works for two periods, and chooses the job that maximizes the sum of her earnings. She can earn w_a per period at any other job in the economy on average. At your firm you supply workers with training, so that the workers each have a value marginal product of VMP_1 and VMP_2 in periods 1 and 2 respectively. Note that
 - $VMP_1 < w_a < VMP_2$. However, average productivity over two periods equals w_a :
 - $VMP_1 + VMP_2 = 2w_a$.
 - The firm must set wages in the two periods, W_1 and W_2 respectively.
 - *The training is valuable to your firm but of no use to any other firms in the economy.*
 - a) (1 point) Is this an example of general or specific human capital?
 - b) (5 points) Suppose the firm sets wages equal to VMP in the two periods (that is $W_j = VMP_j$ in periods $j=1,2$) Explain why the worker and firm are likely to re-negotiate the wage in period 2 (W_2). Which party would lose from this renegotiation in period 2, the firm or worker?
 - c) (5 points) Suppose the firm sets wages equal to W_a in the two periods (that is $W_j = W_a$ in periods $j=1,2$) Explain why the worker and firm are likely to re-negotiate the wage in period 2 (W_2). Which party would lose from this renegotiation in period 2, the firm or worker?
 - d) (5 points) Finally, explain why if the firm sets W_1 and W_2 such that
 - $VMP_1 < W_1 < W$ and $W < W_2 < VMP_2$, while ensuring that
 - $VMP_1 + VMP_2 = 2w_a = W_1 + W_2$, then neither firm nor worker will seek to re-negotiate the wage in period 2.



Your answer

A Sample Problem from Test 2

Spring 2003, #2

- 2. (14 points) a) In a sentence or two, define general on the job training and firm-specific on the job training. (2)
- b) The theory of human capital argues that firms should not provide training that provides general human capital unless it makes the workers bear the entire costs of the training. Explain in a few sentences and a diagram what would happen to a firm that subsidized general training for new workers. (It would do this in the hope that it could later make up for this lost profit by paying the worker less than his VMP after training.) (If you prefer you can instead give a specific mathematical example.) No matter how you choose to answer this question be sure to define all of your terms carefully. (6)
- c) Temp agencies hire employees which they then send to work temporarily at client companies. These temp agencies have often been observed to provide general training such as computer training at no cost to the employee. According to the work of David Autor, why would a temp agency want to do this? (2)
- d) According to the work of Derek Neal, what is the third type of human capital that exists in addition to general and firm-specific? What is the approach he used to prove this? (4 points)



Your answer
