0 E47 Economics of Labour Index

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Week 1: Introduction and Labour Supply - Part I

Textbook Ch.1: Introduction

1-1 An Economic Story of the Labor Market

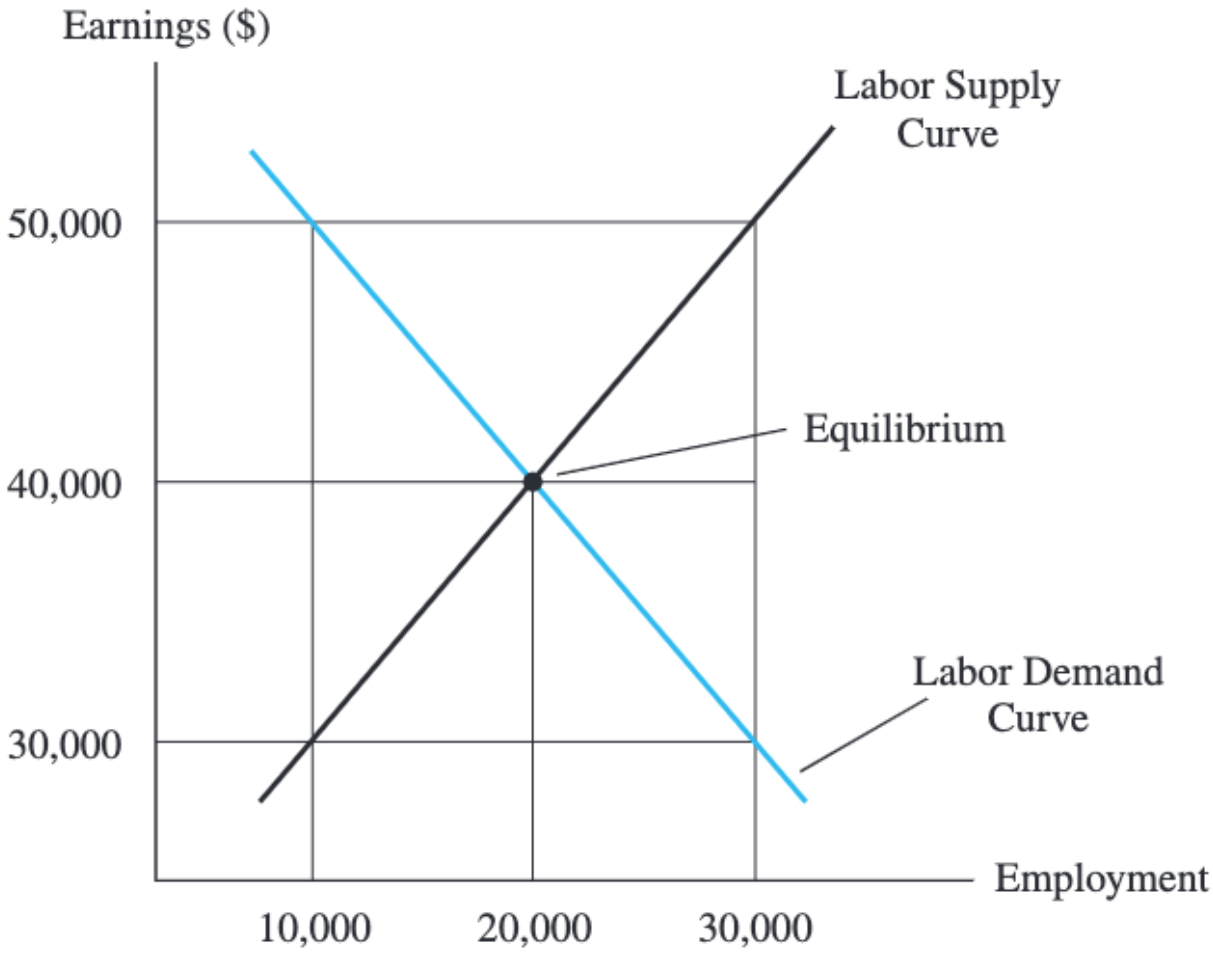
- Emphasis on both theory and facts: theory helps us understand how the facts are generated; facts help shape our thinking about the way the labour market works

1-2 The Actors in the Labor Market

- 3 actors: workers, firms, and the government
- Decisions are driven by the desire to optimise
- Workers: *Labour Supply Curve*:
    - Upward sloping: optimising persons tend to supply more time and more effort to activities with a higher payoff
    - The labour supply curve relates the number of person-hours supplied to the economy to the wage that is being offered. The higher the wage that is being offered,

the larger the labour supplied

- Firms:
  - maximise profits by making production decisions ⇝ employing decision
  - The firm's demand for labour is a *derived demand*, a demand derived from the desires of consumers
  - adding up individual demand -> *Labour Demand Curve*
    - Downward sloping: profit maximisation -> hire more when labour is cheap
- *Equilibrium*: in a free-market economy, equilibrium is attained when supply = demand
  - "balance out" conflicting interests between workers and firms



- The Government
  - uses tax, legislation, training programmes, etc. to influence the equilibrium
- An example: The Trans-Alaska Oil Pipeline

1-3 Why Do We Need a Theory?

- There is a tradeoff between realism and simplicity, and good economics hits the mark just right
  - Focus on the essential variables while leaving out other, less crucial, factors.
- *Positive Economics*: addresses questions that can, in principle, be answered with the tools of economics, without interjecting any value judgment as to whether the particular outcome is desirable or harmful.

- *Normative Economics*: addresses much broader “What should be?” questions; the answers require value judgments
- A policy is said to be "*efficient*" if it can potentially improve the well-being of everyone in the economy
- As long as there are winners and losers -- and government policies inevitably leave winners and losers -- neither the theoretical implications of economic models nor the facts are sufficient to answer the normative question of whether a particular policy is desirable.
    - But positive economics is important in a sense that it tells us who are the winners/losers and how much will they lose/gain

Appendix: An Introduction to Regression Analysis

Textbook Ch.2: Labour Supply

2-1 Measuring the Labor Force

- The CPS (Current Population Survey) classifies all persons aged 16 or older into 1 of the 3 categories:
    - *Employed / Unemployed / Residual group (out of the labour force)*
- Labour force (employed + unemployed):

$$LF = E + U$$

- Labour Force Participation Rate gives the fraction of the population that is in the labour force:

$$LFPR = \frac{LF}{P}$$

- Employment Rate gives the fraction of population that is employed:

$$\text{Employment Rate} = \frac{E}{P}$$

- Unemployment Rate gives the fraction of labour force participants who are unemployed:

$$\text{Unemployment Rate} = \frac{U}{LF}$$

- *Hidden Unemployed*: individuals who are discouraged over job prospects and dropped out of the labour market
    - These people will be ignored when calculating the unemployment rate, but we cannot simply turn to the employment rate because it also considers people with little intentions to work (retirees, students, etc.)

2-2 Basic Facts about Labor Supply

- LFPR: slight decrease for men, huge increase for women since the 20th century
- decline in average hours of work per week

2-3 The Worker's Preferences

- Neoclassical model of labor–leisure choice

Utility and Indifference Curves

- Utility Function:in a given time period:

$$U = f(C, L)$$

  where C is the total dollar value of all goods purchased, L is the number of hours of leisure that a person consumes
- Indifference Curve: the locus of combinations of C and L that generate a particular level of utility
- 4 Important Properties of Indifference Curves:
  - downward sloping
  - higher IC -> higher utility
  - do not intersect
  - convex to the origin

The Slope of an Indifference Curve

- Marginal Utility of Leisure (MU_L): the change in utility resulting from an additional hour devoted to leisure activities, holding constant the amount of goods consumed
- Marginal Utility of Consumption (MU_C): the change in utility resulting from an additional dollar of goods, holding constant the amount of leisure consumed
- The *slope of the indifference curve* measures the rate at which a person is willing to give up some leisure time in return for additional consumption, while holding utility constant. Expression:

$$\text{Slope} = \frac{\Delta C}{\Delta L} = -\frac{MU_L}{MU_C} = -MRS$$

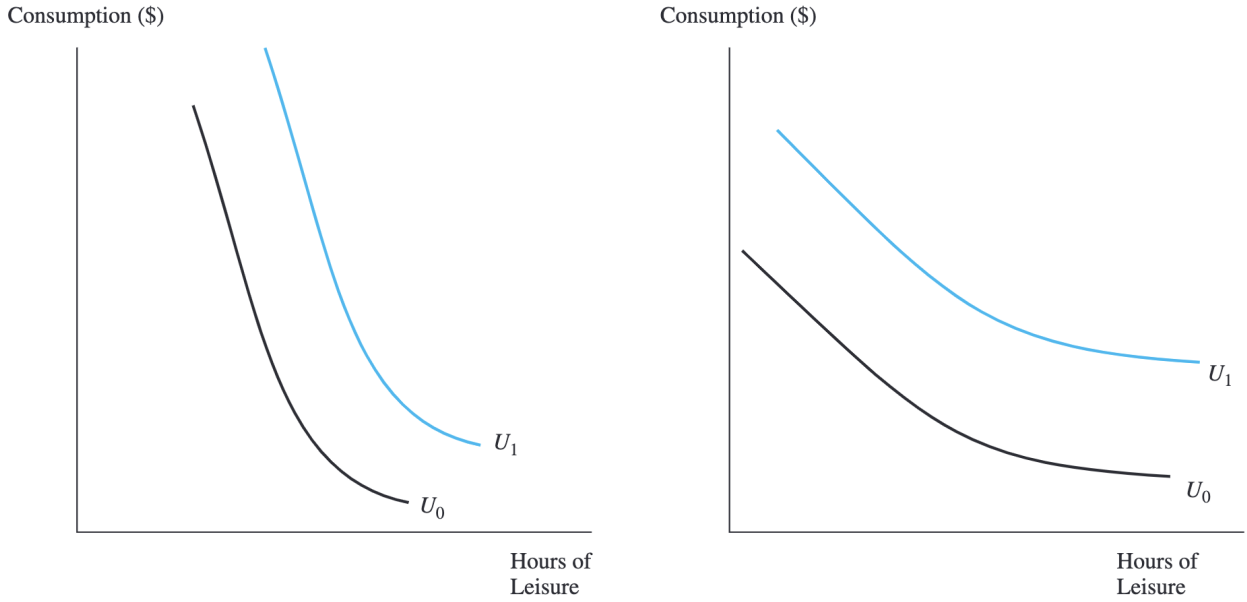
- Marginal Rate of Substitution (MRS) in consumption is the absolute value of the slope of an indifference curve / ratio of marginal utilities:

$$MRS = |\text{Slope}| = \frac{MU_L}{MU_C}$$

- Convexity assumption $\iff$ diminishing MRS

Differences in Preferences across Workers

- Steep IC $\leftrightarrow$ High MRS $\leftrightarrow$ Value leisure a lot



- For the most part, economic models ignore such heterogeneity

2-4 The Budget Constraint

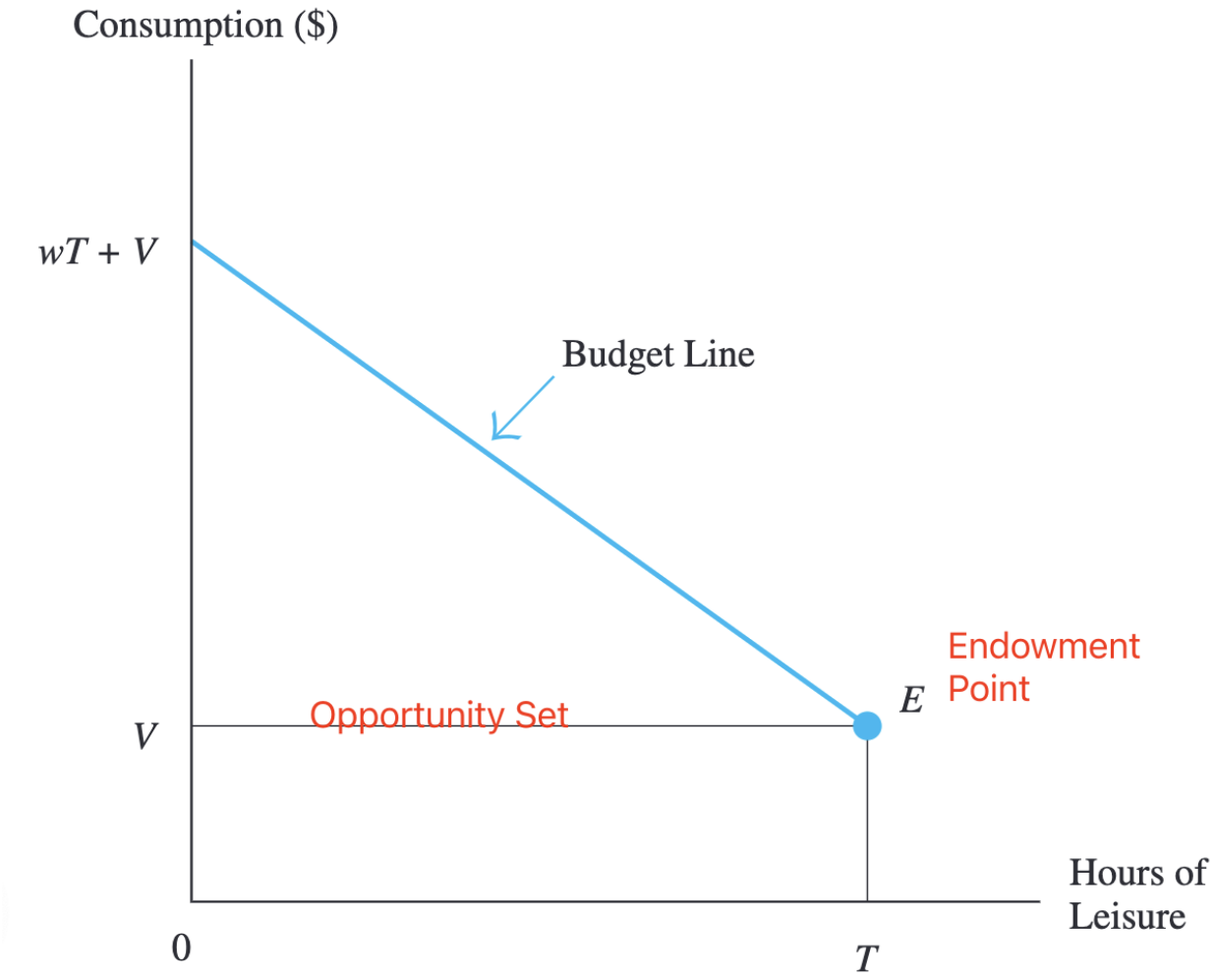
- Budget Constraint: the dollar value of expenditure on goods (C) must equal the sum of *labour earnings* (wh) and *non-labour income* (V):

$$C = wh + V$$

  - Denote the total time in a given period as $T = h + l$:

$$C = (wT + V) - wl = w(T - L) + V = -w(L - T) + V$$

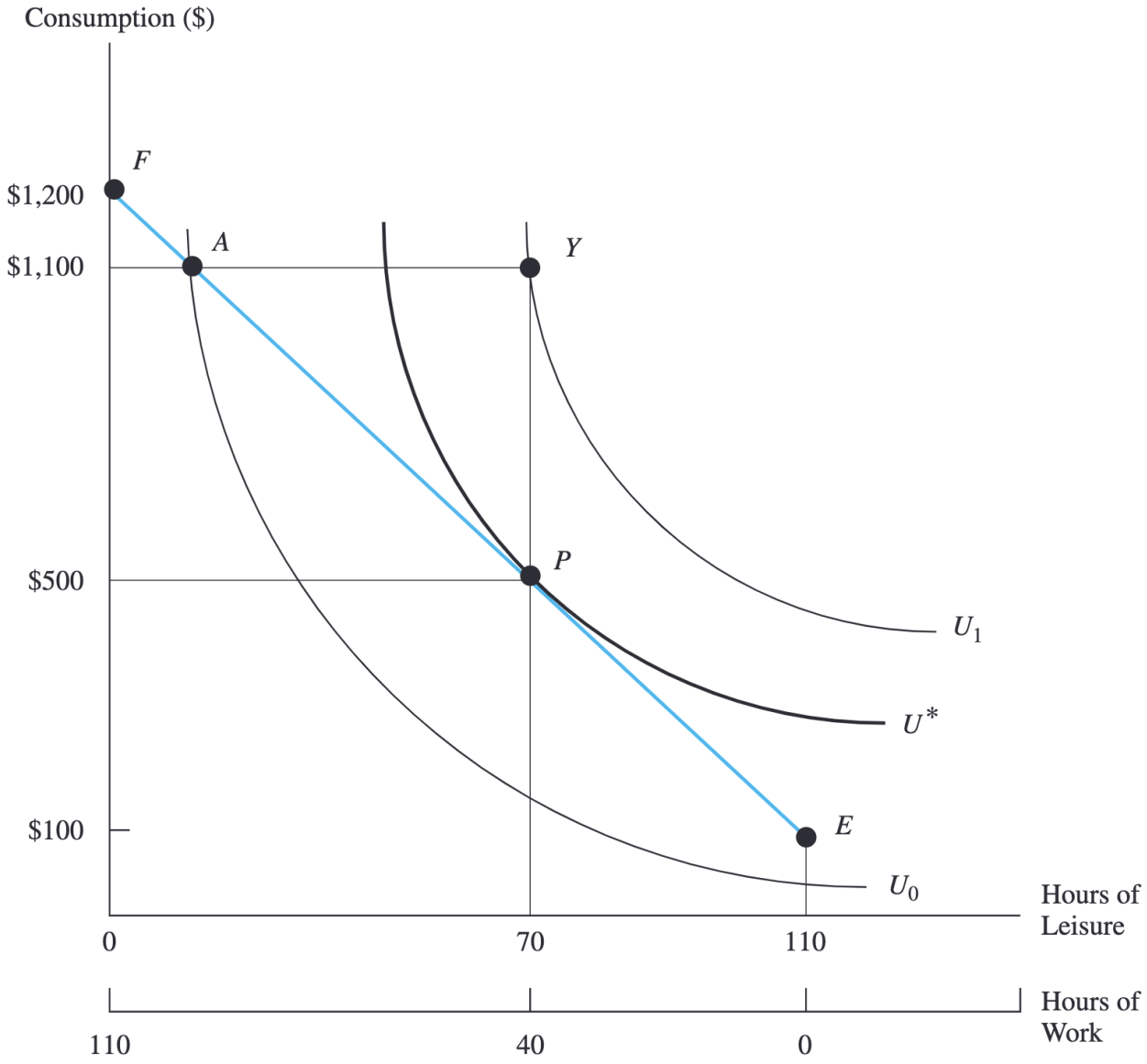
- Budget Line:



  - Point E: *Endowment Point*: if the person decides not to work at all and devotes T hours to leisure, she can still purchase V dollars' worth of consumption goods
  - Trade-off: 1 hour of leisure $\leftrightarrow$ w dollars' worth of goods
    - The price of 1 hour of leisure is the wage rate
  - The budget is also the frontier of the worker's *opportunity set* (lies below the budget line)
- Labor Supply Decisions:
  - Intensive Margin: how many hours to work (conditional on participating)
  - Extensive Margin: whether to participate in the labour market or not

2-5 The Hours of Work Decision

- Assumption: the person chooses the particular combination of goods and leisure that maximises his/her utility given the limitations imposed by the budget constraint
- Interior Solution to the Labour-Leisure Decision (point P): the tangent point of the budget line and the indifference curve



Interpreting the Tangency Condition

- Tangency Condition: at the optimal point P, slope of the indifference curve equals to the slop of the budget line:

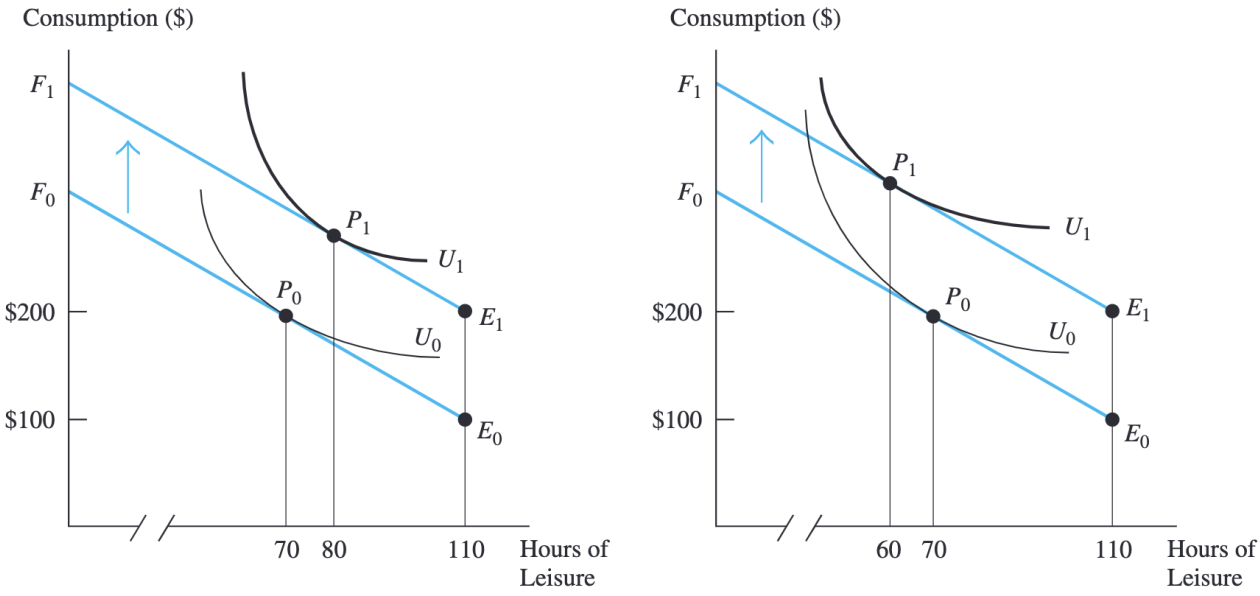
$$MRS = \frac{MU_L}{MU_C} = w$$

i.e. the marginal rate of substitution (the rate at which a person is willing to give up leisure hours in exchange for additional consumption) equals the wage rate (the rate at which the market allows the worker to substitute one hour of leisure time for consumption). Equivalently:

$$\underbrace{\frac{MU_L}{w}}_{\text{MU of \$1 spent on leisure}} = \underbrace{MU_C}_{\text{MU of \$1 spent on goods}}$$

What Happens to Hours of Work When Nonlabour Income Changes?

- An increase in non-labour income ($V \uparrow$) that holds the wage constant expands the worker's opportunity set through a parallel shift in the budget line
- The impact of the change in non-labour income (holding wages constant) on the number of hours worked is called an income effect.
- *Normal/Inferior* good:
  - Income$\uparrow$ consumption$\uparrow$ $\Longrightarrow$ normal
  - Income$\downarrow$ consumption$\downarrow$ $\Longrightarrow$ inferior

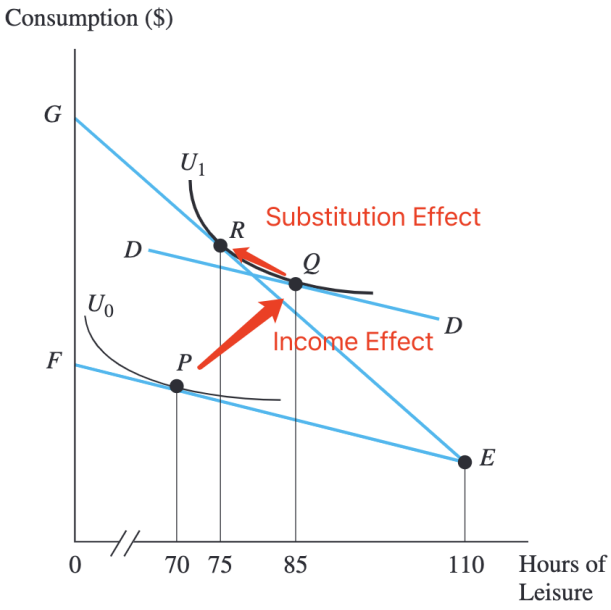


(*a*) Leisure Is a Normal Good (*b*) Leisure Is an Inferior Good

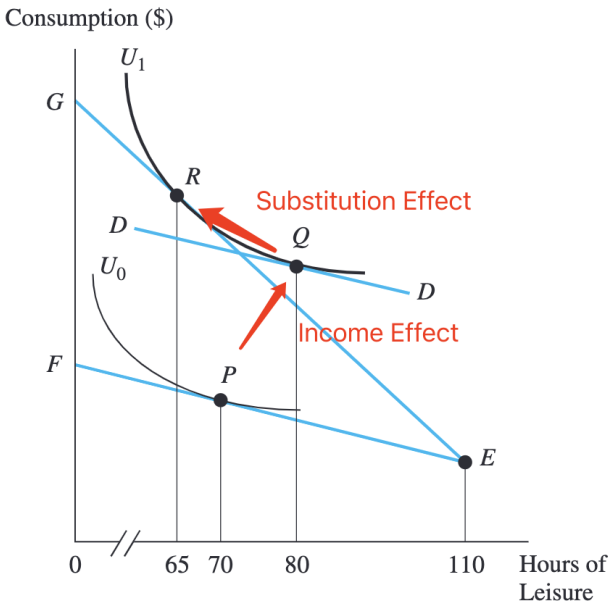
- Generally, *we assume leisure to be a normal good*, so its income effect implies: Income $\uparrow$, $L \uparrow, h \downarrow$

What Happens to Hours of Work When the Wage Changes? (Intensive Margin)

- The wage increase rotates the budget line around the endowment point
- Income Effect gives the change in the consumption bundle induced by the *additional income* resulting from the wage increase
  - $w \uparrow$, both $C, L \uparrow$, $h \downarrow$
- Substitution Effect illustrates the change to the worker's consumption bundle as the wage increases, holding utility constant
  - The substitution effect implies that an increase in the wage rate, holding real income constant, increases hours of work (leisure is more "expensive") $w \uparrow, h \uparrow$



(a) Income Effect Dominates



(b) Substitution Effect Dominates

- Summarise:

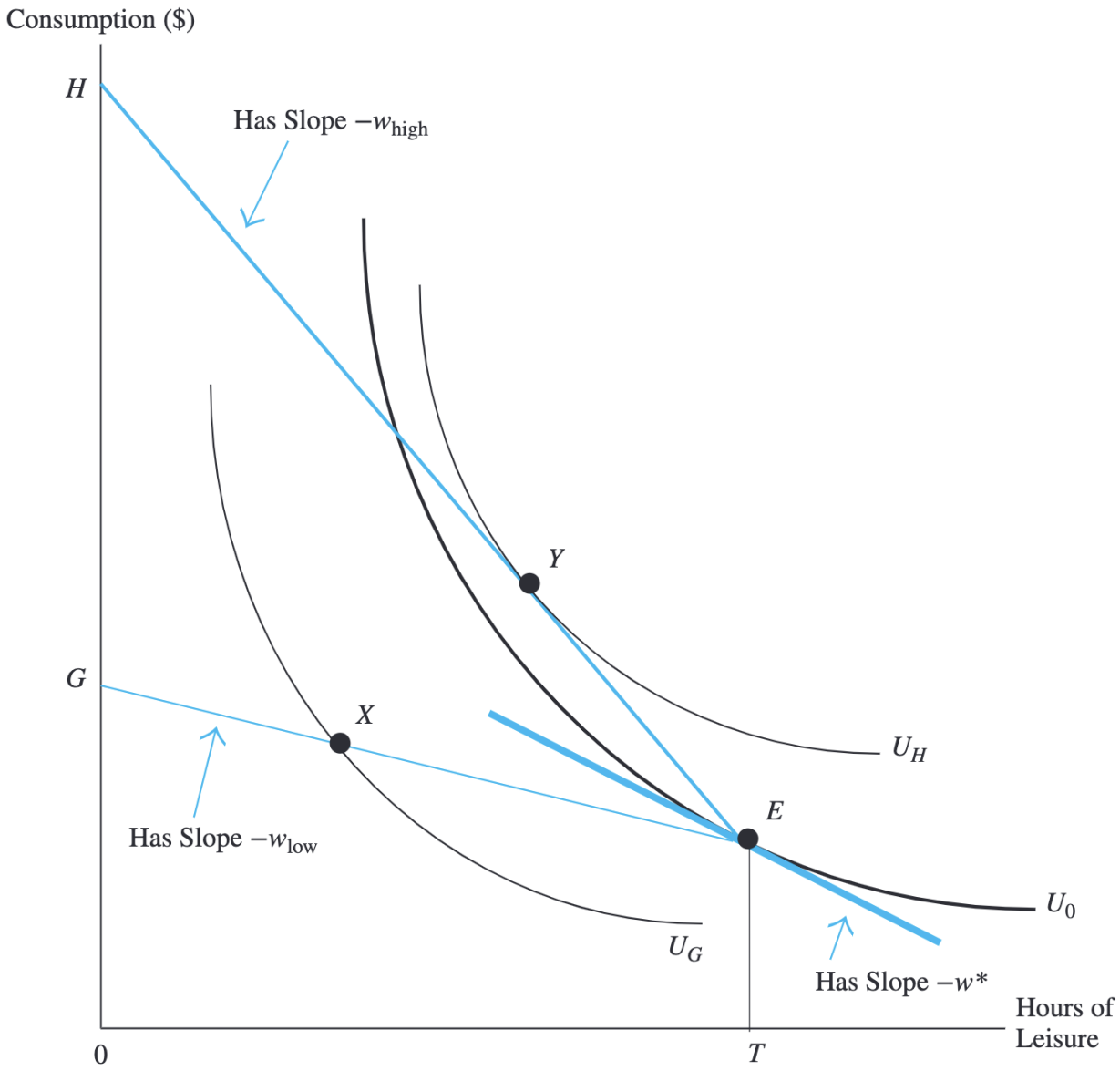
  - *An increase in the wage rate increases hours of work if the substitution effect dominates the income effect*

  - An increase in the wage rate decreases hours of work if the income effect dominates the substitution effect

  -

$$w \uparrow \Longrightarrow \begin{cases} h \uparrow & \text{, if substitution effect dominates} \\ h \downarrow & \text{, if income effect dominates} \end{cases}$$

2-6 To Work or Not to Work? (Extensive Margin)

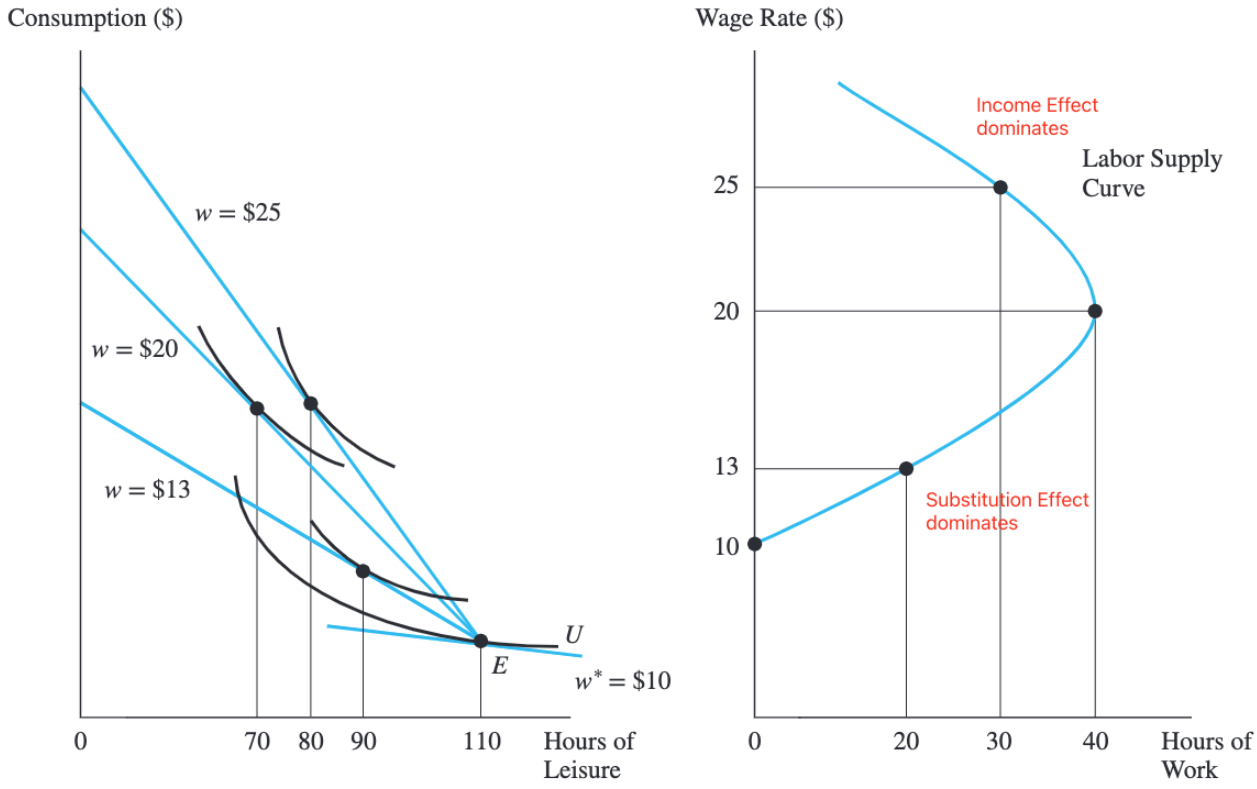


- Reservation Wage (w^*): The reservation wage gives the minimum increase in income that would make a person indifferent between remaining at the endowment point E and working that first hour.
  - It is given by the *absolute value of the slope of the indifference curve at point E* (MRS at endowment: $w^* = MRS(E) = \frac{MU_L}{MU_C}\Big|_{L=T,C=V}$).
  - Not work if $w < w^*$; work if $w > w^*$
  - $w \uparrow \implies LFPR \uparrow$
  - *Non-labour income* $\uparrow \rightsquigarrow$ *Reservation wage* $\uparrow$
- Only substitution effect works here, so there is no ambiguity

2-7 The Labor Supply Curve

- Labour Supply Curve: relation between hours of work and the wage rate

- *Backward-bending* labour supply



(*a*) Optimal Consumption Bundles

(*b*) Relation between Optimal Hours of Work and the Wage Rate

  - figure implies that *substitution effects dominate at lower wages and that income effects dominate at higher wages*

- The labor supply curve in the aggregate labor market is then given by *adding up* the hours that all persons in the economy are willing to work at a given wage. (adding up horizontally)
- Labour Supply Elasticity: responsiveness of hours of work to changes in the wage rate:

$$\sigma = \frac{\frac{\Delta h}{h}}{\frac{\Delta w}{w}} = \frac{\Delta h}{\Delta w}\frac{w}{h}$$

  - It gives the *percentage change in hours of work associated with 1 percent change in the wage rate*
  - *Sign* depends on which effect dominates:

$$\sigma \begin{cases} > 0 & \text{, if substitution effects dominate (upward sloping LS)} \\ < 0 & \text{, if income effects dominate (downward sloping LS)} \end{cases}$$

  - *Elastic/Inelastic*:

$$\text{LS is} \begin{cases} \text{Elastic} & \text{,if } |\sigma| > 1 \\ \text{Inelastic} & \text{,if } |\sigma| < 1 \end{cases}$$

  - Elastic: number of hours worked is very responsive to changes in the wage rate

2-8 Estimates of the Labor Supply Elasticity

- The typical study uses the sample of working men to correlate a particular person's hours of work with his wage rate and non-labour income.
- Generic regression model:

$$h_i = \beta w_i + \gamma V_i + covariates$$

  - h_i - number of hours that person i works
  - w_i - wage rate
  - V_i - non-labour income
  - $\beta = \frac{\Delta h_i}{\Delta w_i}$ holding V_i constant
    - $\beta < 0$ if income effects dominate; $\beta > 0$ if substitution effects dominate
  - $\gamma = \frac{\Delta h_i}{\Delta V_i}$ holding w_i constant
    - $\gamma < 0$ if leisure is a normal good
- *Elasticity of LS of men is estimated to be around -0.1*:
  - negative → income effects dominate
  - inelastic
- Elasticity of LS of women is estimated to be around 0.2 see Women's elasticity of labour supply

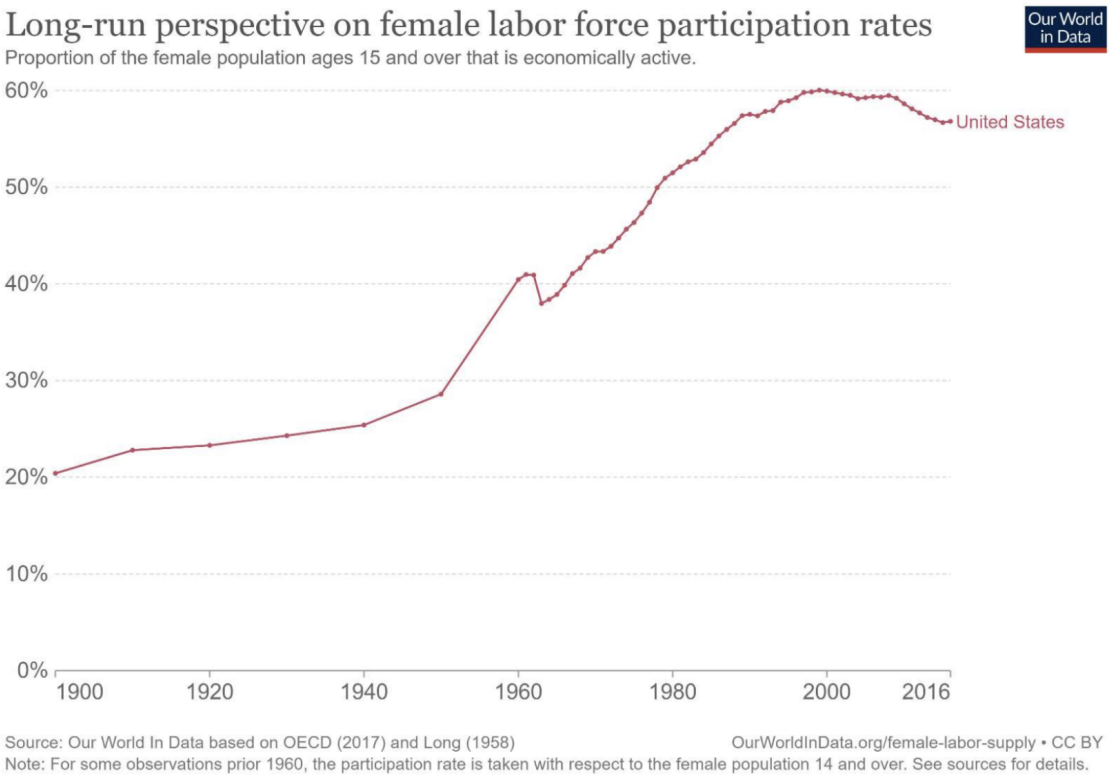
Problems with the Estimated Elasticities

- *Hours of work*
  1. *Span of the Time Period*
     - LS becomes more elastic the longer the time period over which the hours-of-worked variable is defined
       - LS is completely inelastic if h_i is defined for a given week
       - a but more responsive if h_i is defined for a year ($\hat{\sigma} \approx -0.1$ is based on this definition)
  2. *Measurement Error* → Biased estimates of σ
- *The Wage Rate*
  1. *Exaggeration of Income Effects* due to ME
     - Only observe annual wage, so we need to calculate the $\text{average hourly wage} = \frac{\text{annual wage}}{\text{annual working time}}$, so ME in h_i → ME in w_i
     - Overreport annual hours of work → artificially low w_i → spurious negative correlation between w_i, h_i
     - Underreport annual hours of work → artificially high w_i → also spurious negative correlation between w_i, h_i
  2. Our theoretical model focus *marginal wage rate* instead of the average wage rate calculated above
  3. *Selection Bias*: Wage rate is unobserved for people who are not working, and their decisions to work depends on w_i, V_i

- *Non-labour Income*
  1. *Endogeneity* of V_i due to a "taste for work" $\rightarrow$ *Positive Bias in Income Effect Estimates*
     - People prefer working more ($h_i \uparrow$) $\rightarrow$ higher total income $\rightarrow$ invest more $\rightarrow$ more capital gain $\rightarrow$ $Cov(V_i, u_i) > 0$ $\rightarrow$ spurious positive correlation between h_i, V_i (introduces positive bias in estimates of income effects)
     - Positive correlation between h_i, V_i could be: 1. leisure is inferior; 2. positive bias due to endogeneity
     - If we study random V_i shocks, estimate income effects < 0 ($V_i \uparrow h_i \downarrow$)

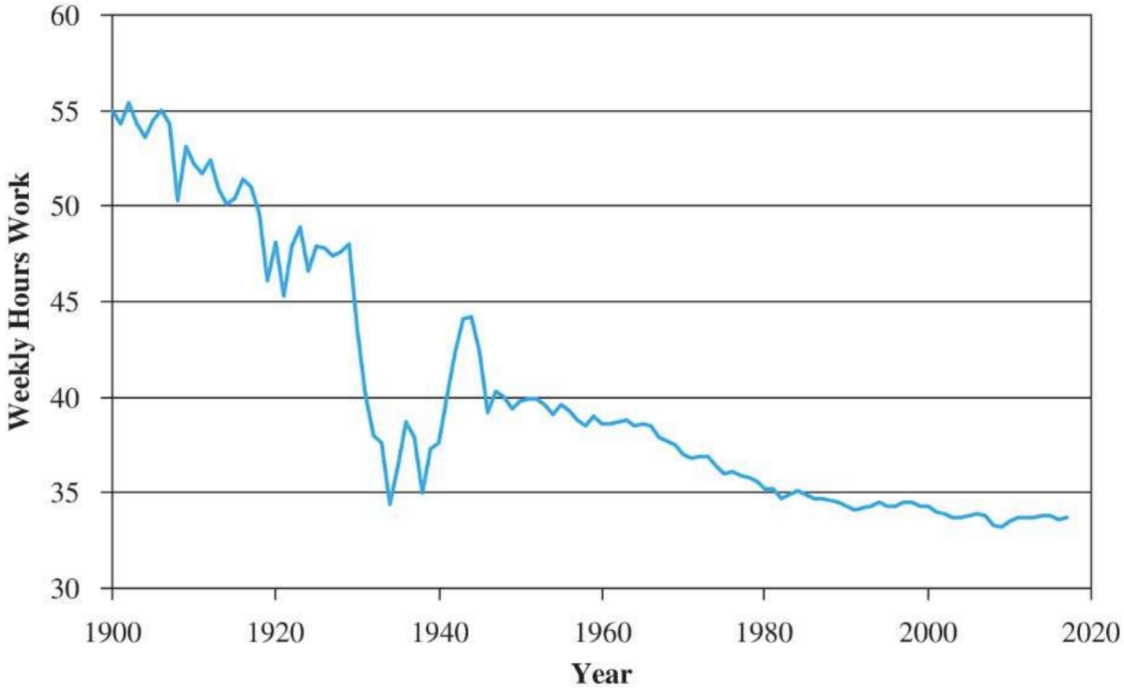
Lecture Notes

- 1 Introduction and Labour Supply I - A
- Key Difference between the Goods Market and the Labour Market:
  - Goods are not attributed to any particular person, but labour is from a particular individual
  - This justifies more frequent *government interventions* in the labour market. We need to consider more aspects: e.g. child labour, imperfect information, etc.
- Facts
  - Main data sources
    - Current Population Survey (CPS) in U.S.
    - Labour Force Survey in the UK
  - Higher female LFPR



  - but a lot of females are taking part-time jobs (childcare is a major factor)

- Decreasing Avg. Hours of Work



  - Potential reasons: regulations, higher productivity, labour force expansions, women entering the LF and taking part-time jobs

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Week 2: Labour Supply - Part II

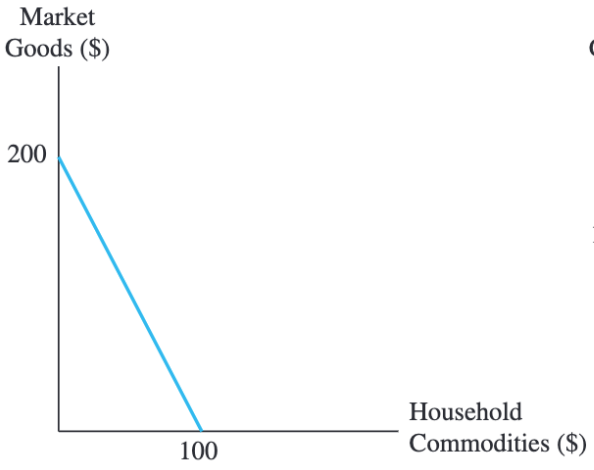
Textbook Ch.2 II: Labour Supply II

2-9 Household Production

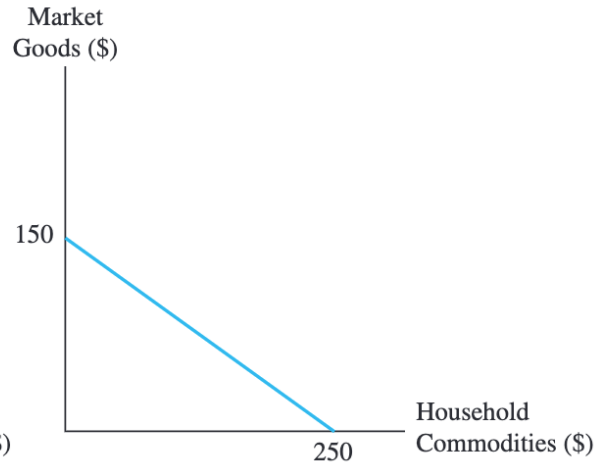
- Much of our time is devoted to producing commodities in the household / non-market sector
- Women allocate more hours to the household than men
- Household production makes us better off but does not lead to higher earnings

The Household Production Function

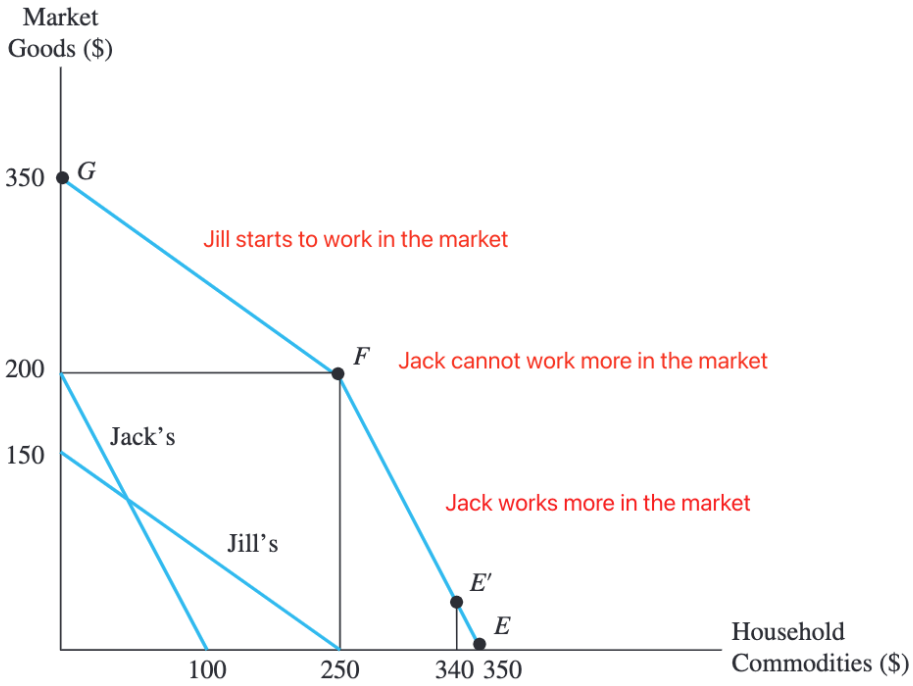
- The Household Production Function tells us how much *household output* a household (could be single / married couple) can generate for any given allocation of time



(*a*) Jack's Single Budget Line



(*b*) Jill's Single Budget Line



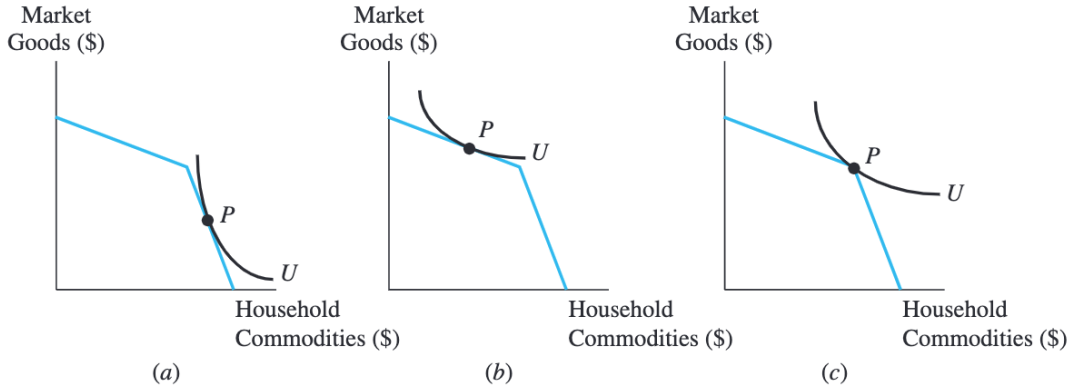
- Household production function is *kinked*
  - $E \to F$: Jack works more in the market
  - $F \to G$: Jack cannot supply more labour, so Jill begins to work in the market

Who Works Where?

- A utility-maximising household chooses the point that places the household on the highest possible indifference curve (the *tangent point*)

FIGURE 2-14 The Division of Labor in the Household

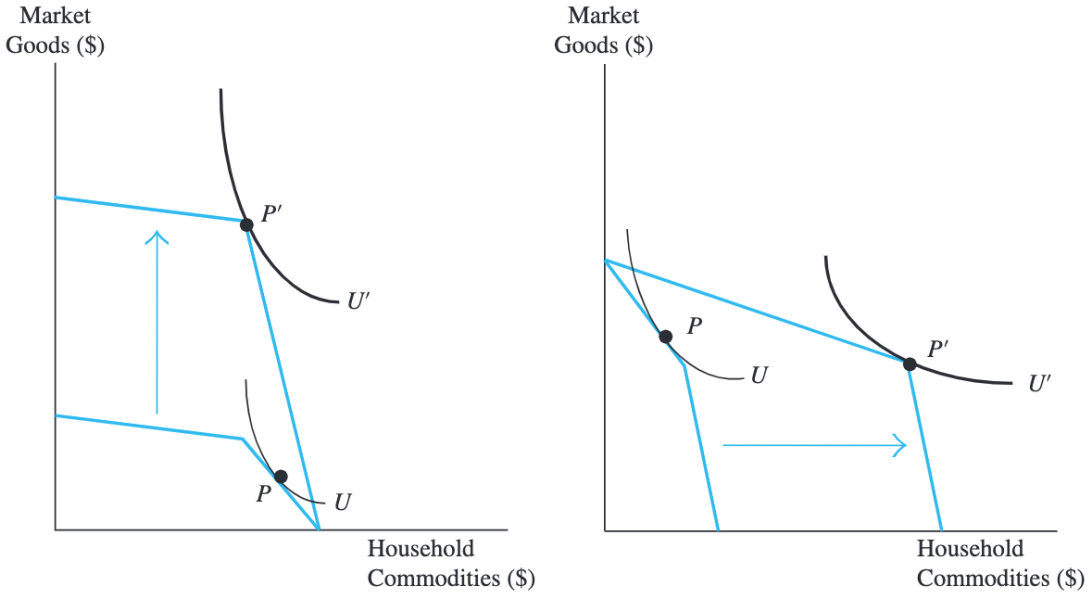
The indifference curve U is tangent to the opportunity frontier at point P. (a) Jill specializes in the household sector and Jack divides his time between the labor market and the household. (b) Jack specializes in the labor market and Jill divides her time between the two sectors. (c) Jack specializes in the labor market and Jill specializes in the household sector.



- *Relative aptitude* for household and market production determines the time allocation

FIGURE 2-15 Increases in Wage Rate or Household Productivity Lead to Specialization

(a) An increase in Jack's wage moves the household from point P to P' and Jack specializes in the labor market. (b) An increase in Jill's household productivity moves the household from point P to P' and Jill specializes in the household sector.



  - *A large increase in Jack's wage or a large increase in Jill's productivity in the household sector can lead to specialisation*

Trends in Female Labor Force Participation

- Total Time : $\begin{cases} \text{Leisure} \\ \text{Market Work} \\ \text{Household Production} \end{cases}$
- Explaining the increase in the female LFPR:
  - *Key Determinants*:
    - Increase in their wage rate
    - Increase in their productivity

    - Also:
        - Fall in the value of women's time in the household due to fewer children per household
        - Time-saving technological advances in household production
        - Changes in cultural and legal attitudes towards working women
- *Women's labour supply elasticity is estimated to be positive around 0.2*
    - Substitution effects dominate for working women
    - But still not very responsive
- (For men, this elasticity is around -0.1, see Men's elasticity)
- Female labour supply responds to economic factors mainly at the margin of deciding *whether or not to work*, rather than at the margin of deciding how many hours to work once in the labour force

2-10 Correlation versus Causation: Searching for Random Shocks

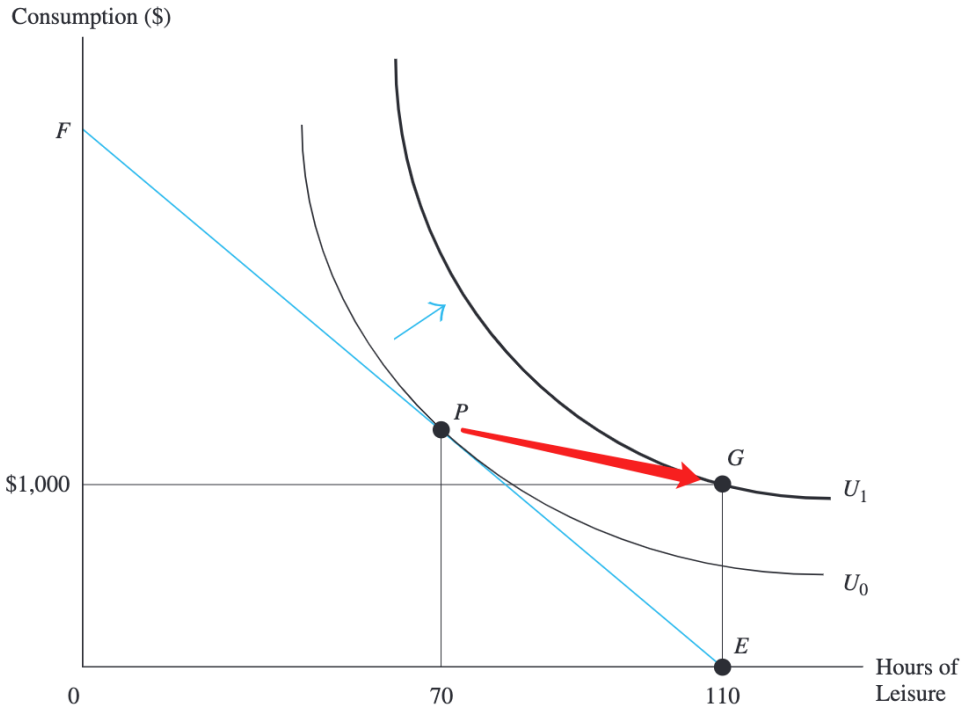
- The correlation between hours of work and non-labour income does not necessarily measure the income effect due to the endogeneity of Vi
    - Similarly, wage is also likely to be endogenous: a wage increase could be due to hard work in the past
- Therefore, researchers began to search for random shocks:
    - in non-labour income: winning a lottery (jackpot in U.S.): $V_i \uparrow, h_i \downarrow$
    - in wage rate: change in taxi fares: $w_i \uparrow$ miles drove$\downarrow$, estimated LS elasticity = -0.19 (income effects dominate and inelastic)
- Modern empirical research in labor economics follows this basic template of searching for random shocks that induce behavioural change
- An *important drawback*: *external validity*: are the results generalisable to a larger population?

2-11 Policy Application: Welfare Programs and Work Incentives

Cash Grants and Labor Supply

- Consider a simple programme: *$1000/month* for individuals remaining out of the labour force

FIGURE 2-16 Effect of a Cash Grant on Work Incentives
A take-it-or-leave-it cash grant of $1,000 per month moves the worker from point *P* to *G*, and she leaves the labor force.

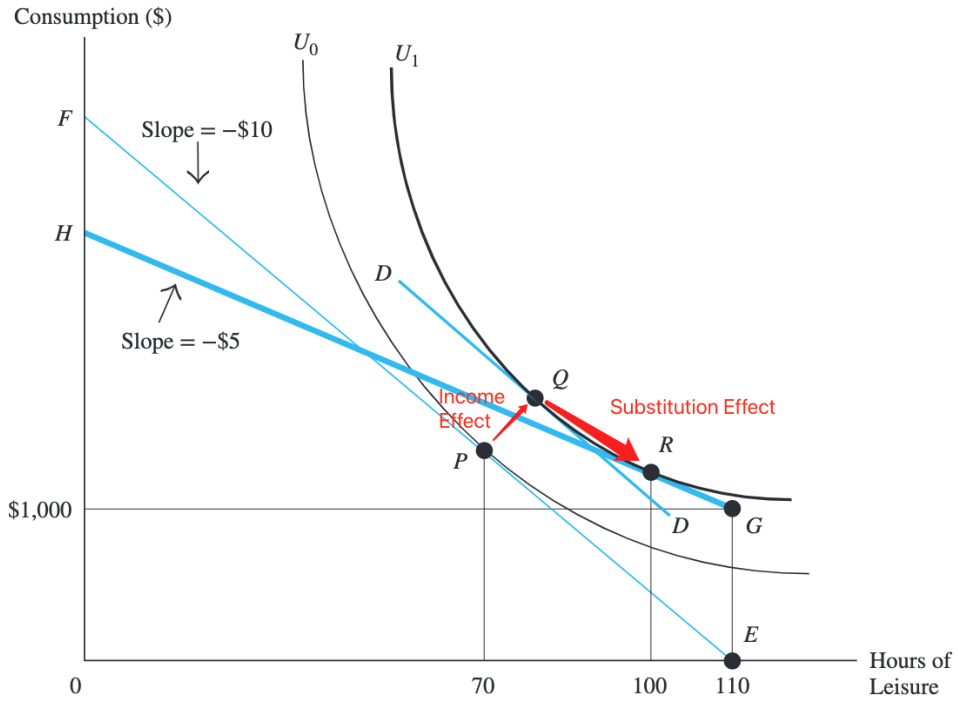


- This type of take-it-or-leave-it cash grant can induce many workers to drop out of the labour force
- Low-wage women are most likely to choose the welfare solution and drop out
  - this is not due to "work ethic": we implicitly assume that preferences are the same for low/high-wage workers; rather, it's because work incentives are reduced for low-wage workers as they are better off with the welfare programme than working

The Impact of Welfare (Grant+Tax) on Labor Supply

- To avoid the extreme disincentive illustrated above, real-world welfare programme typically allows individuals to stay employed, but the amount of the cash grant is often reduced as labour earnings increase
- Consider a welfare programme:
  - Not working: $1000/month
  - Working: $labour\ earning \uparrow 1, cashgrant\$ \downarrow \$0.5$
    - The government is actually taxing labour income at 50% rate (*actual wage rate*: $10/hour, *net wage*: $5/hour)
  - equals to cash grant + tax on labour earnings

FIGURE 2-17 Effect of a Welfare Program on Hours of Work
The welfare program in budget line HG gives the worker a cash grant of $1,000 and imposes a 50 percent tax on labor earnings. In the absence of welfare, the worker is at point *P*. The income effect resulting from the program moves the worker to point *Q;* the substitution effect moves the worker to point *R*. Both income and substitution effects reduce hours of work.



- The programme shifts the budget line in 2 ways:
  - Endowment point $E \rightarrow G$
  - Slope (cut by half): $-10 \rightarrow -5$
- Such kind of "cash grant + tax on labour earnings" welfare programme *must reduce hours of work*:
  - *Income effect*: increases demand for leisure and cause $w_i \downarrow$
  - *Substitution effect*: 50% tax $\rightarrow$ price of leisure is cut by half $\rightarrow$ increases demand for leisure $\rightarrow$ $w_i \downarrow$
- In conclusion:
  - "*Cash grant*" reduces both the probability of a person working and the number of hours worked
  - *Trying to recover some of the grants* as labour income $\uparrow$ effectively imposes a tax on labour income, reducing the price of leisure and further lowers the number of hours worked

Welfare Reform and Labor Supply (Empirical Evidence)

- AFDC $\rightarrow$ reduces labour supply
- States in U.S. are allowed to have different welfare programmes after 1996, which are exploited by many researchers to retrieve effects of the welfare programme from effects of other variables
- Several states also conducted large-scale experiments, and results often confirm theoretical predictions

- Some welfare programmes have "time limits":
  - a family may choose to "bank" its benefits to maintain eligibility in the future
  - this indeed discourages welfare participation rates of families with small children (families with adult offsprings are not eligible for the programme)

2-12 Policy Application: The Earned Income Tax Credit (EITC)

- Earned Income Tax Credit (EITC):

$$\text{Net Wage} = \begin{cases} 1.4 \times \text{Actual Wage} & ,if\ 0 \leq income < 14040 \\ \text{Actual Wage} & ,if\ 14040 \leq income < 18340 \\ 0.7894 \times \text{Actual Wage} & ,if\ 18340 \leq income < 45007 \\ \text{Actual Wage} & ,if\ 45007 \leq income \end{cases}$$

- This generates a kinked budget line:

FIGURE 2-18 **The EITC and the Budget Line (Not Drawn to Scale)**
In the absence of the tax credit, the budget line is given by *FE*. The EITC grants the worker a credit of 40 percent on labor earnings as long she earns less than $14,040. The credit is capped at $5,616. The worker receives this amount as long as she earns between $14,040 and $18,340. The tax credit is then phased out gradually. The worker's net wage is 21.06 cents below her actual wage whenever she earns between $18,340 and $45,007.

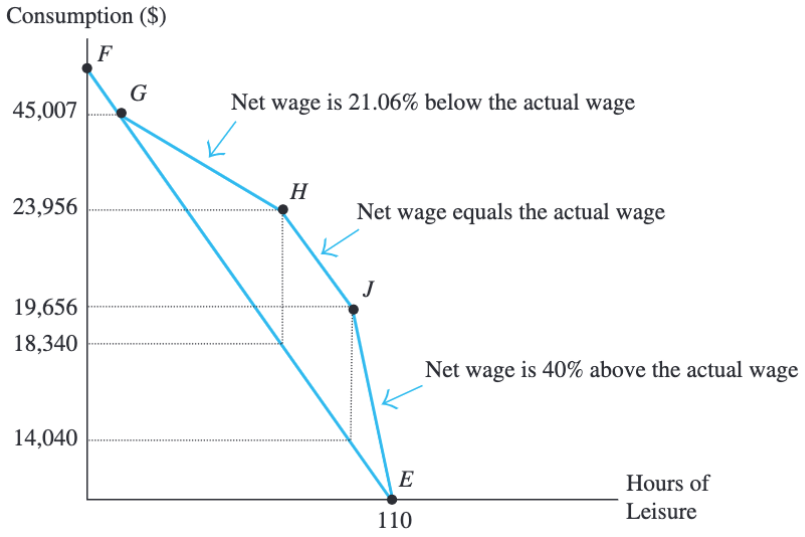


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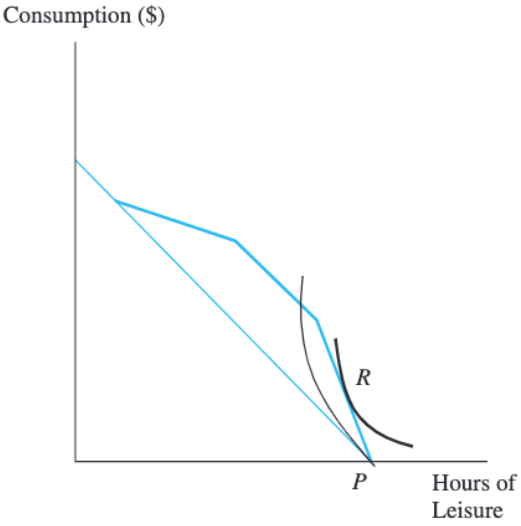
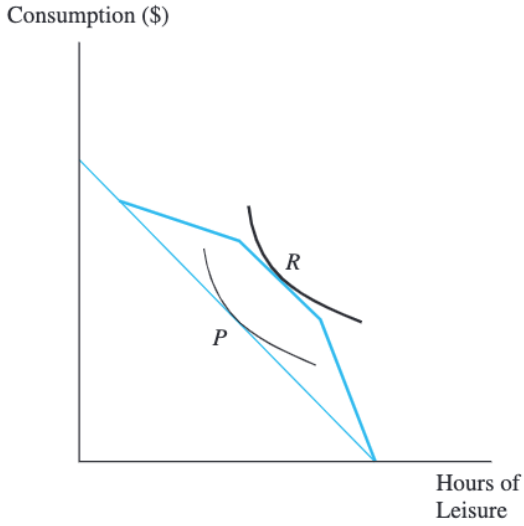
FIGURE 2-19 The Impact of the EITC on Labor Supply

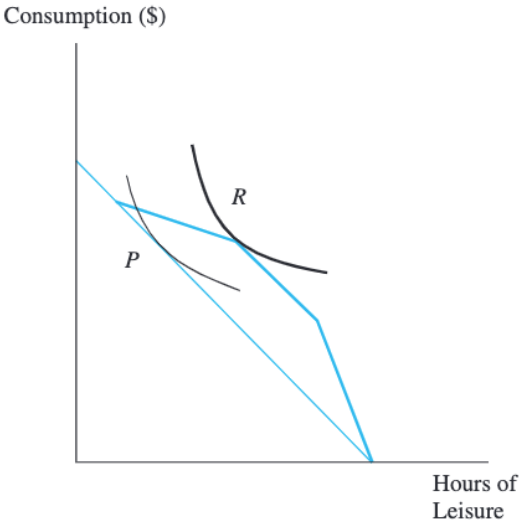
The EITC shifts the budget line, and will draw new workers into the labor market. In (*a*), the person enters the workforce by moving from point *P* to *R*. The impact of the EITC on the labor supply of persons who are already working is less clear. In the shifts illustrated in (*b*) and (*c*), the worker works fewer hours.



(*a*) EITC Draws Worker into Labor Market



(*b*) EITC Reduces Hours of Work



(*c*) EITC Reduces Hours of Work

- This has *2 distinct effects on labour supply*:
  - *Extensive Margin: Increases the number of workers* ($LFPR \uparrow$) because it increases the net wage for non-workers, making it more likely that the wage exceeds the reservation wage (2-19.a)
  - *Intensive Margin: Change the number of hours worked* by persons who would have been in the labour force even in the absence of the programme. It generates both income and substitution effects, so the overall direction is *ambiguous* (2-19.b/c)
- Empirical evidence confirms that EITC induces $LFPR \uparrow$
  - Using a Difference-in-Difference Estimator
    - Treatment group: unmarried women with children (eligible)
    - Control group: unmarried women without children (not eligible)

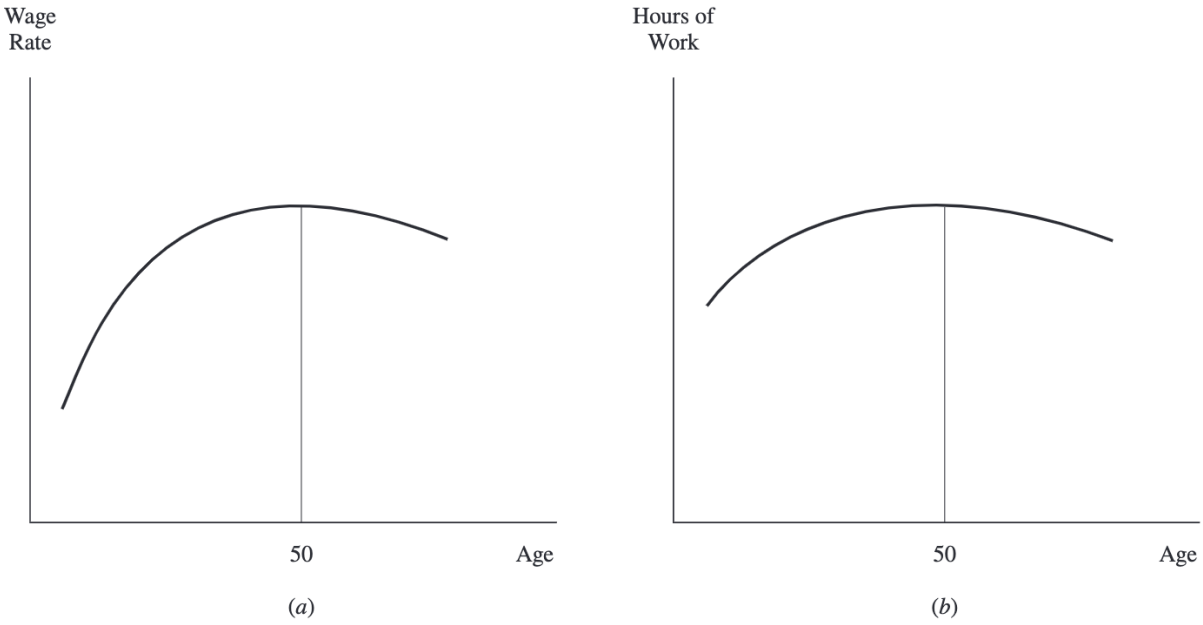
- Requirement: common trend (groups have to be comparable)

2-13 Labor Supply over the Life Cycle

Life Cycle LS Model

- The Intertemporal Substitution Hypothesis: people allocate their time over the life cycle so as to take advantage of changes in the price of leisure
- A typical worker's age-earnings profile

FIGURE 2-20 **The Life Cycle Path of Wages and Hours for a Typical Worker**
(*a*) The age-earnings profile of a typical worker rises rapidly when the worker is young, reaches a peak at around age 50, and then wages either stop growing or decline slightly. (*b*) The changing price of leisure implies that the worker will devote relatively more hours to the labor market when the wage is high and fewer hours when the wage is low.



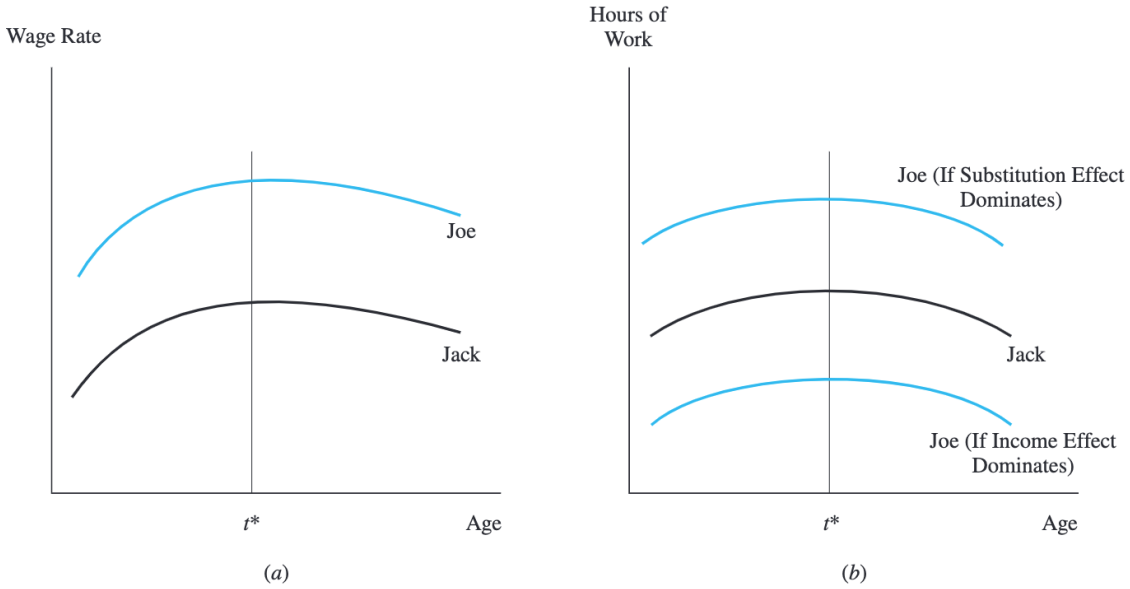
  - Wage / price of leisure is low for younger and older workers and is highest for prime-age workers
- Wage changes as part of the *aging process for a particular worker* is called an evolutionary wage change. We assume that workers perfectly expect their lifetime income, so *evolutionary wage change has no effect on lifetime income* (does not alter the lifetime opportunity set)
- We will generally find it optimal to concentrate on work activities in those years when the wage is high (e.g. 40-50) and to concentrate on leisure activities in those years when the wage is low (e.g. 20, 60).
  - Therefore, *for a particular worker*, hours of work and the wage rate should *move together*
- Comparison with the static model we discussed earlier:

Life Cycle LS	Static LS
Longitudinal (focus on a particular worker)	Cross-sectional (comparing different workers)
Wage increases at given ages	Wage increases

Life Cycle LS	Static LS
(Evolutionary wage change)	(Wage change)
Does not affect lifetime opportunity set	Expand lifetime opportunity set
Hours worked comoves with wage	Hours worked move in the opposite direction if income effects dominate; same direction if substitution effects dominate

- Hours of work over the *life cycle for 2 workers with different wage paths*
  - The difference in working hours will be affected by both income and substitution effects
  - Example:

FIGURE 2-21 **Hours of Work over the Life Cycle for Two Workers with Different Wage Paths**
Joe's wage exceeds Jack's at every age. Although both Joe and Jack work more hours when the wage is high, Joe works more hours than Jack only if the substitution effect dominates. If the income effect dominates, Joe works fewer hours than Jack.



    - Joe's income > Jack's income at every age
      - For each of them (longitudinally), hours worked will be high when wages are higher
      - Cross-sectionally, we don't know who works longer: Joe has a higher wage -> income effects ($w \uparrow h \downarrow$) and substitution effects ($w \uparrow h \uparrow$) are in opposite directions. If income effects dominate, Joe will work less

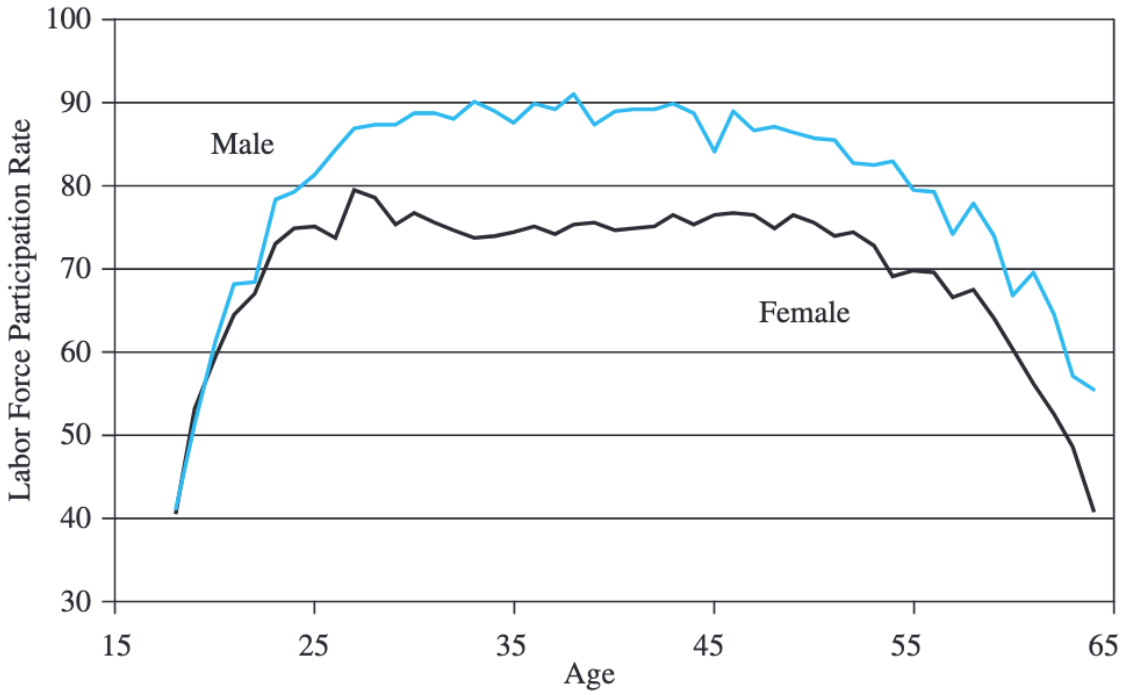
- *Life Cycle Approach and LFPR*
  - In each year of the life cycle, the worker will compare the reservation wage to the marker wage. If the reservation wage is constant, the person is more likely to enter the labour market in periods when the wage is high
    - LFPR tends to be low for young and old workers, high for prime-age workers
  - However, the reservation wage also varies with the life cycle -- e.g. the presence of small children in a household may increase the value of time spent on household production $\rightarrow$ reservation wage $\uparrow \rightarrow$ married women may quit the LF after the arrival of 1st child, and return later

Evidence of Life Cycle

- Evidence
- LFPR:

FIGURE 2-22 Labor Force Participation Rates over the Life Cycle, 2017

Source: U.S. Bureau of Labor Statistics, *Current Population Surveys,* Annual Social and Economic Supplement, 2017.

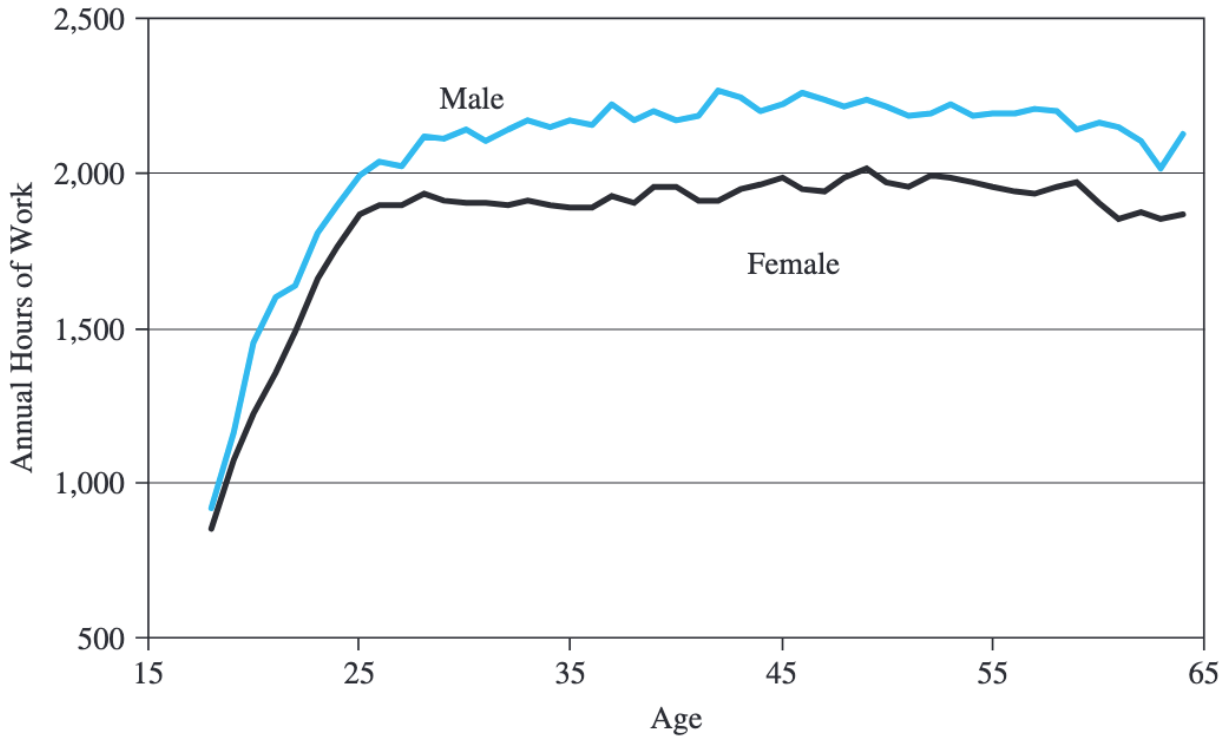


- Overall, the trends illustrated in the figure are consistent with the theoretical prediction that participation rates should be highest when the wage is high (that is, when workers are in their 30s and 40s).
- Decline is too steep for older ages (possibilities: health, disincentives, etc.)

- Hours worked:

FIGURE 2-23 Hours of Work over the Life Cycle, 2017

Source: U.S. Bureau of Labor Statistics, *Current Population Surveys,* Annual Social and Economic Supplement, 2017.



  - Consistent with LFPR / model prediction
  - Women peak later (probably due to childcare)

Estimation of Life Cycle Models (Intertemportal LS Elasticity)

- Estimation of Life Cycle Models (Intertemporal LS Elasticity)
- We need *longitudinal* data to track a specific individual over his/her lifetime to observe how w_i, h_i changes
  - Regression (FD):

$$\Delta H_{it} = \sigma \Delta w_{it} + controls$$

  - σ measure the Intertemporal Labour Supply Elasticity: the change in hours of work for a given person resulting from a particular change in his wage rate
- If we have *panel* data, we can stack individual regressions into (FE):

$$H_{it} = \sigma w_{it} + \sum_{i=1}^{N} \alpha_i F_i + controls$$

  - where F_i are individual dummies and α_i measure individual-specific *fixed effects* -- individual-specific and time-invariant factors determining each individual's hours of work (i.e. *idiosyncratic differences*)
- Estimated ILSE tends to be positive by numerically small

Labour Supply over the Business Cycle

- Labor Supply over the Business Cycle
- Worker also may adjust his labor supply to take advantage of changes in opportunities induced by *business cycles*.
- 2 Effects in Opposite Directions:
  - Added Worker Effect: *secondary workers* who are currently out of the labor market (such as mothers with small children) are affected by the recession because the main breadwinner becomes unemployed or faces a wage cut. As a result, family income falls and the secondary workers get jobs to make up the loss.
    - The added worker effect implies that the LFPR of secondary workers has a *countercyclical* trend (that is, it moves in a direction opposite to the business cycle): It rises during recessions and falls during expansions.
  - Discouraged Worker Effect: rather than continue a fruitless search for a job, these workers decide to wait out the recession and drop out of the labor force. The LFPR would then have a *pro-cyclical* trend: It falls during recessions and increases during expansions
- Empirically, there is evidence that the correlation between the LFPR of many groups and the aggregate unemployment rate is negative ($u \uparrow LFPR \downarrow$), so the *discouraged worker effect dominates*
- Then, should we count hidden unemployment in unemployment statistics?
  - Yes: Because the discouraged worker effect dominates, the official unemployment rate might be too low (understated during recessions)
  - No: According to our life cycle model those "discouraged workers" are optimising their time allocation: enjoy leisure when it's cheap to do so (wage is low during recessions), so they should not be counted in the unemployment statistics

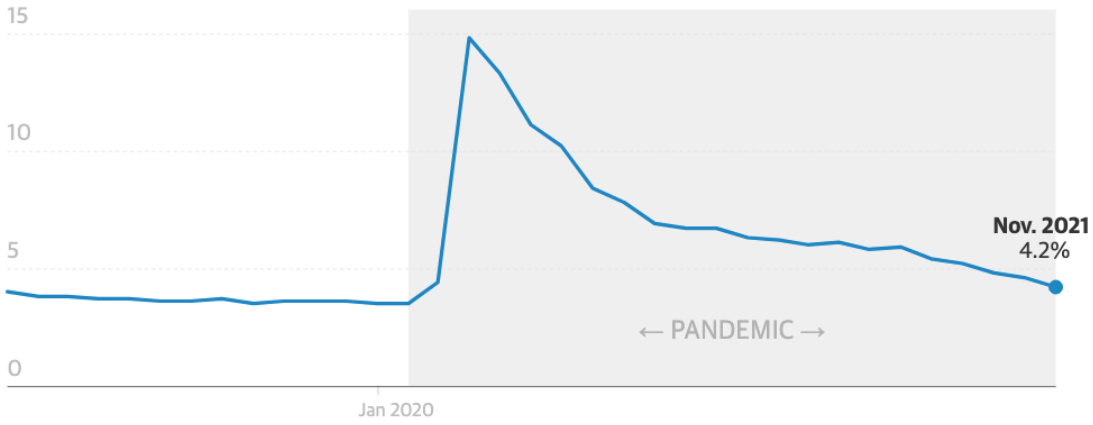
2-14 Policy Application: Disability Benefits and Labor Force Participation

- Question: Do the benefits encourage some persons who otherwise would have worked to try to enroll in the program and drop out of the labor force?
- Canadian experience:
  - DiD:
    - Control: Quebec Pension Program (benefit 2642$ $\uparrow$)
    - Treatment: Canada Pension Program (benefit 976$ $\uparrow$)
    - Estimate: the increased generosity of the disability program increased the proportion of men who did not work by 2.7 percentage points
- American experience:
  - Controlling for other factors, the employment rate of those applicants who happened to land a tougher examiner (harder to get benefits) was far higher than the employment rate of the applicants who landed an easier examiner

Reading 1: Quitting is just half the story: the truth behind the 'Great Resignation' (don't think this is important anyway...)

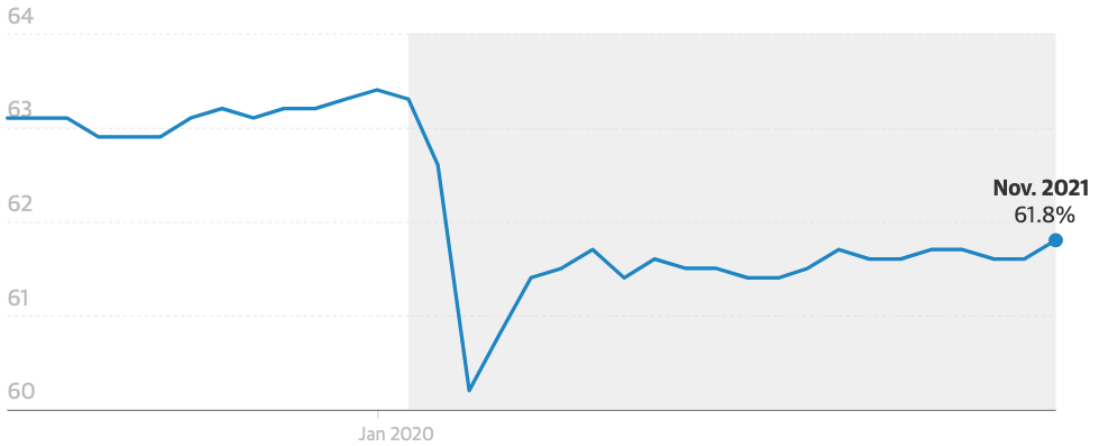
- 2 Quitting is just half the story - the truth behind the 'Great Resignation' - A
- 2021 was the year of the "Great Resignation" -- workers quit their jobs a historic rates
- Quitting, most economists will tell you, is usually an expression of optimism. Yet, 2021's quits happened against a larger economic picture that shows no confidence

Overall unemployment rate

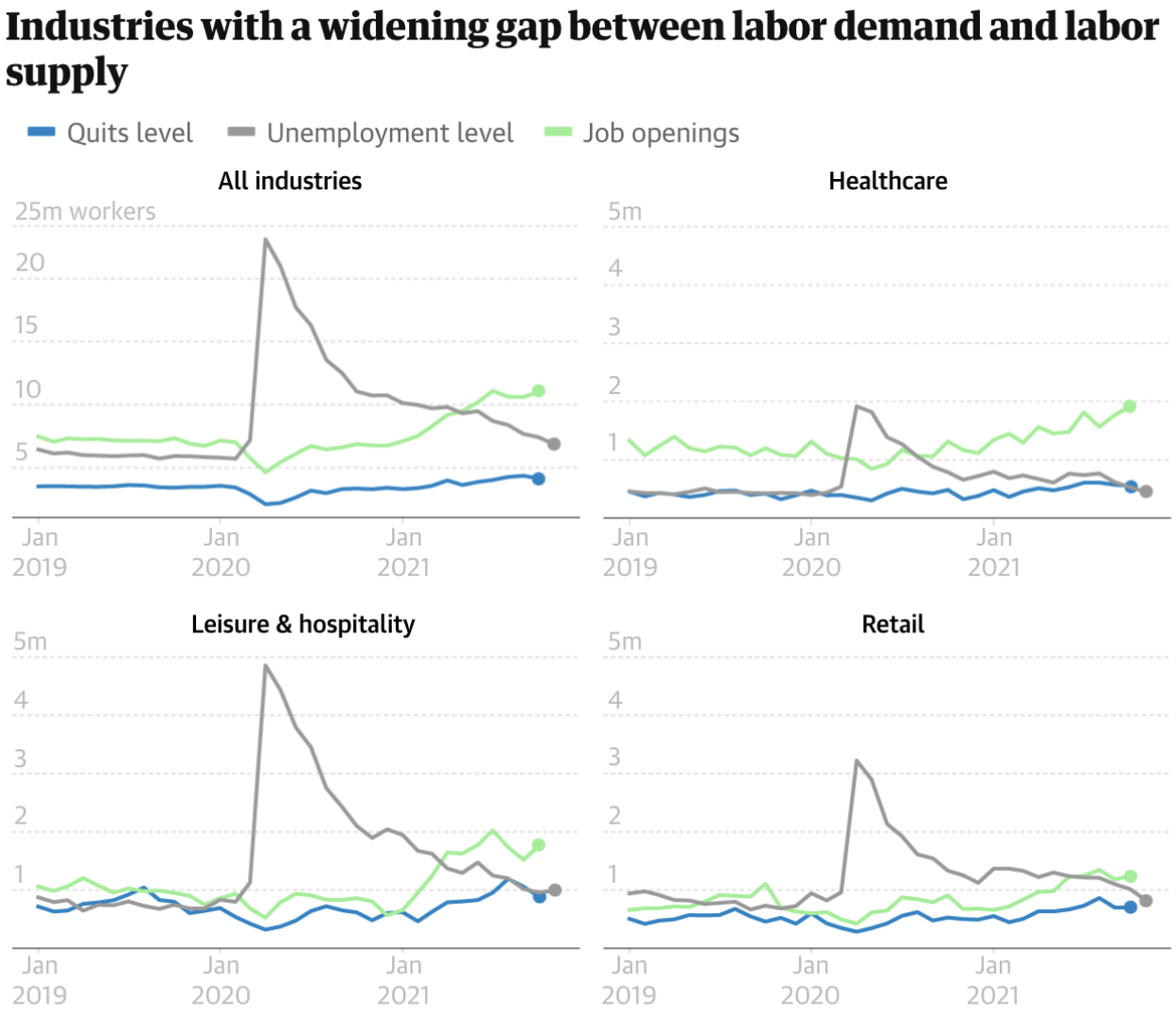


Source: US Bureau of Labor Statistics - Labor Force Statistics from the Current Population Survey. Data is seasonally adjusted.

Overall labor participation rate



- Unemployment rate reduced, LFPR increased but did not recover its pre-pandemic level
- Reasons for quitting are varied
  - Top reasons: *lack of adequate childcare and health concerns about Covid*
  - Other reasons: burnout, sympathy with the anti-work movement, search for better jobs
- Some industries are seeing higher rates of quitting than others: leisure and hospitality, retail and healthcare

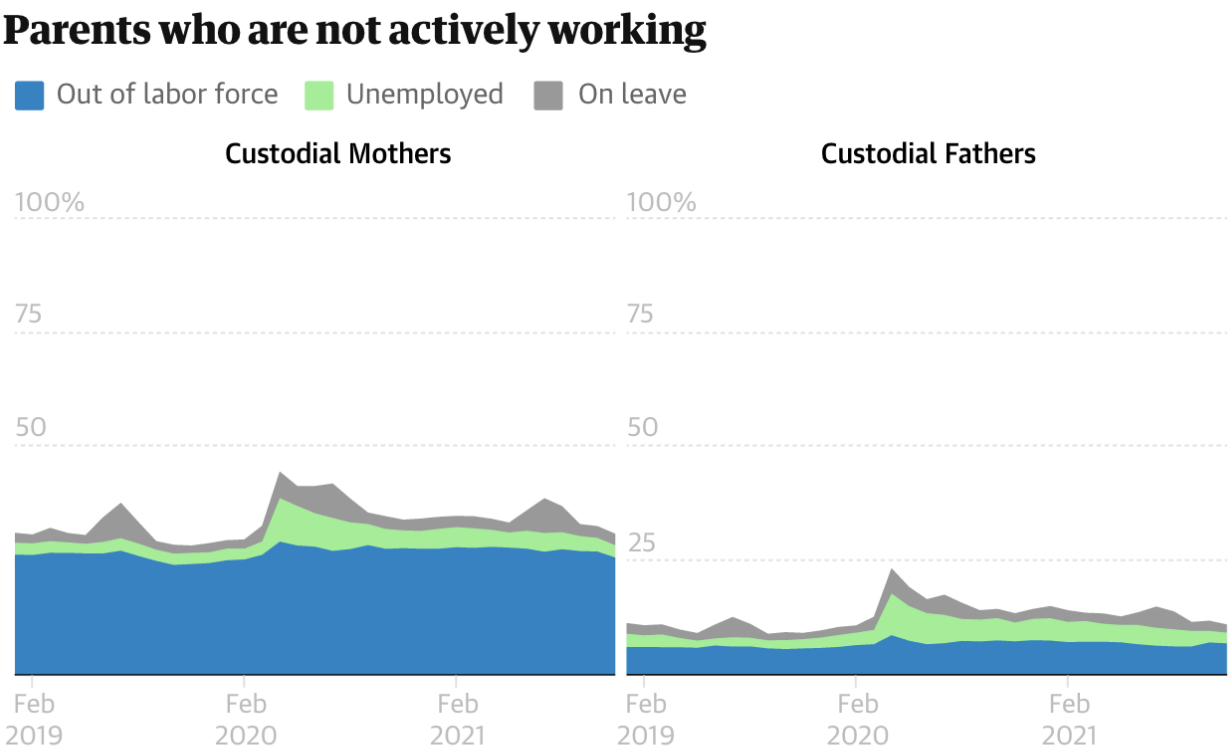


Guardian graphic. Source: US Bureau of Labor Statistics - Job Openings and Labor Turnover Survey. Data for individual industries are not seasonally adjusted.

    - Those are generally low-paying industries where there are now more job openings than workers – a gap has been widening

- Wage increases are moderating and that those changes mostly affected industries where many still struggle to make a living.
    - The recent trend towards higher pay exists in the context of decades of low-wage growth, as until recently, wages in the U.S. had stagnated

- Growing *gap between mothers and fathers* in how they engage in the labor market



Guardian graphic. Source: Data provided by Misty Heggeness, based on an analysis of the Current Population Survey, U.S. Census Bureau & Bureau of Labor Statistics. The data considers parents between the ages of 25 to 54, with school-age children (ages 5-17).

- "*Care insecurity*": parents' schedules are interrupted during Covid periods
- It is not so simple as to think that they would prefer not to work, but rather, that they *cannot afford to keep the jobs they have*.

Reading 2: Goldin, 2006 (AER): The Quiet Revolution That Transformed Women's Employment, Education, and Family (I wrote too much.. Probably only intro and summary are needed)

I. Evolutionary and Revolutionary Phases

- Women's modern economic role emerged in the United States in four distinct phases. The first three were evolutionary; the last was revolutionary.
  - The revolution was a "quiet" one

Distinctions between "Evolution" and "Revolution": 3 Aspects of Women's Choice and Decisions

- *Horizon* - whether at the time of human capital investment, a woman perceives that her lifetime labour force involvement will be intermittent and brief (evolutionary) or long and continuous (revolutionary)
- *Identity* - whether a woman finds individually in her job (evolutionary), occupation, profession, or career (revolutionary)
  - Those in the evolutionary phases married early enough that their adult identity was formed after marriage, whereas those in the revolutionary phase married late enough that their identity formation could precede marriage

- *Decision Making* - whether labour force decisions are made as a "secondary worker" who optimises taken her husband's labour market decisions as given (evolutionary) or fully jointly (revolutionary)
- The author focus on horizon and identity

Indicators of the Outcome

- *Evolution*
  - Labour force participation
  - Related series on annual hours of work and full-time work
- They *gradually change*
- The increase in participation and the greater number of hours worked by women was a critical prerequisite for the transition from the evolutionary to the revolutionary phase, but itself is not revolutionary
- *Revolution*
  - Expectations of future employment by teenaged girls
  - the determinants of life satisfaction
  - various investments in human capital
  - earnings relative to comparable men
  - labour force participation of women with infants
  - lifetime labour force participation, the age at first marriage
  - the fraction of one's life spent married
- Each of these series contains *a sharp break* or inflection point signifying social change. These inflection points, moreover, are remarkably coincident

II. The Three Phases of Evolutionary Change and the Birth of Modern Labor Economics

- The shifts from one phase to the next were due to various exogenous changes
- Each of the phases produced different magnitudes for the two key parameters of labour supply: the *own-wage (compensated) elasticity* and the *income elasticity* of the Slutsky equation
  - When considerable social stigma existed concerning the paid work of wives:
    - income effect was large (and negative).
    - substitution effect was small
    - $\rightarrow$ increased demand could do little to increase paid employment, and higher incomes for husbands operated in the opposite direction
  - the substitution elasticity of labour supply eventually grew $\uparrow$ and the income effect (in absolute value) shrank $\downarrow$
    - $\rightarrow$ a rather elastic female labour supply function
    - $\rightarrow$ LFPR$\uparrow$

- Evolutions → advances of Labour Economics:
  - focus on labour market → labour supply and decisions made by families and households

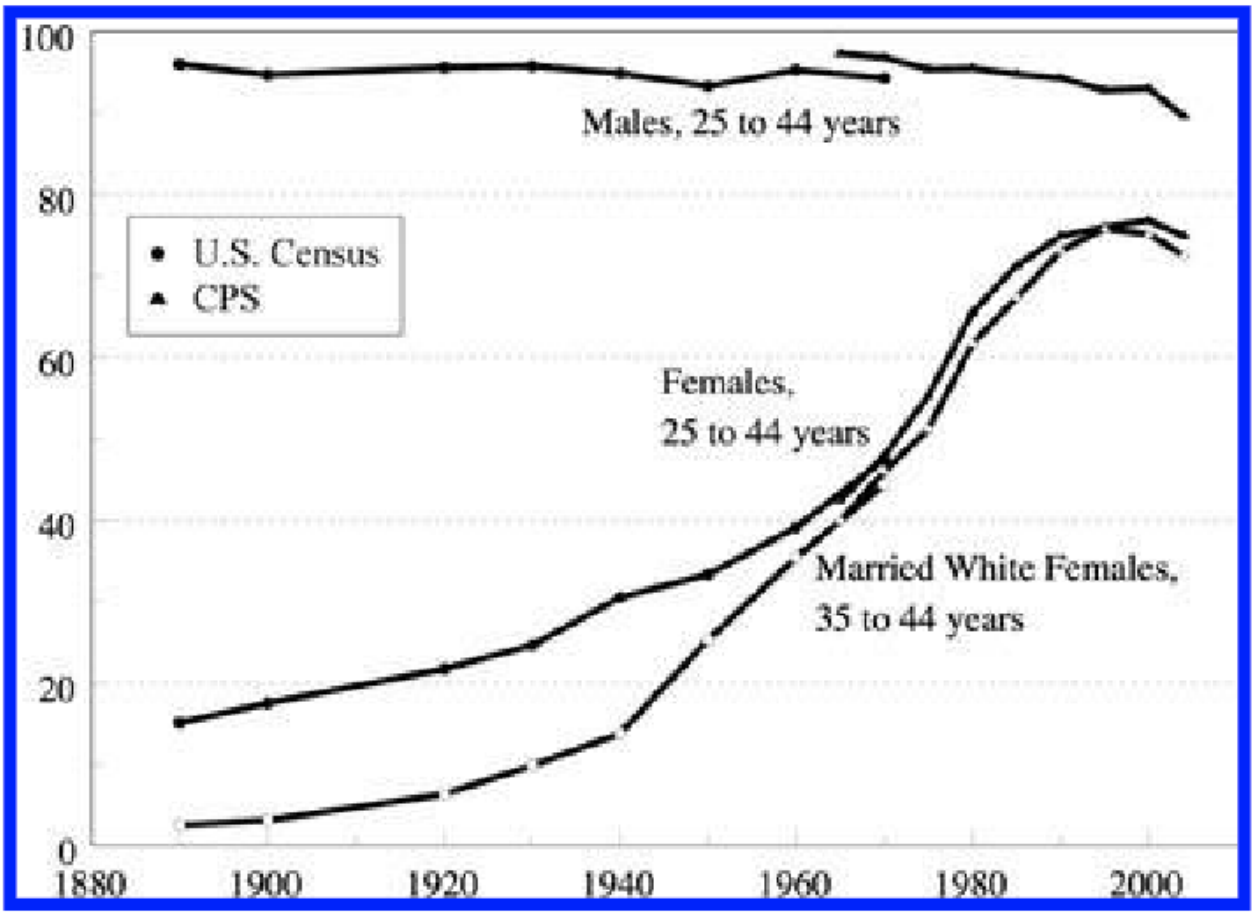


FIGURE 1. LABOR FORCE PARTICIPATION RATES FOR FEMALES AND MALES BY AGE AND MARITAL STATUS: 1890 TO 2004

-

A. Phase I: Late-Nineteenth Century to the1920s—The Independent Female Worker

Background

- Female workers in the labour market
  - were young and unmarried
  - had little or no learning
  - often from low-income house-holds and those headed by a foreign-born individual
- Working conditions were inferior → social stigma regarding working wives → women exited the workforce at marriage
- the large (negative) income effect from increased husbands' income greatly exceeded the small (positive) substitution effect from increased wives' earnings
  - Evidence: the average married woman worker was less educated than the population average

- $\Longrightarrow$ a very inelastic LS function

Changes and Reasons

- Women LFPR $\uparrow$!
- Inelastic LS $\Longrightarrow$ Increase in women LFPR from 1890-1930 must be induced by
  - shifts in labour supply
  - large negative income effect due to husbands' wage $\downarrow$
- Modern labour economics was nascent at this time
- The women's movement at this time:
  - the first generations of college women
  - the drive for the franchise
- $\Longrightarrow$ optimism from Abbott and Ely
  - but actually the "revolution" would take another 75 years

B. Phase II: 1930s to 1950 —Easing the Constraints on Married Women's Work

Changes

- Women LFPR $\uparrow$ and Married Women's LFPR $\uparrow$
- Reasons: mostly exogenous
  - Most important ones
    - Demand for office and other clerical worker $\uparrow$ since the early 1900s
    - New information technologies
    - High school enrollment and graduation $\uparrow$
  - and bars to hiring married women were eliminated after 1940s (accepted)
- $\rightarrow$ prior to marriage, young women entered nicer, cleaner, shorter-hour, and thus more "respectable" jobs; they could remain unemployed after marriage
- $\rightsquigarrow$ *income effect declined*
  - reason: work for women became more accepted (especially by their husbands)
- $\rightsquigarrow$ *substitution effect increases*
  - reasons:
    - rise of part time jobs (flexibility)
      - $\rightarrow$ participation $\uparrow$ while hours did not change much
    - complete diffusion of modern, electric household technologies
      - $\rightarrow$ reservation wage $\downarrow$ and women LS elasticity $\uparrow$

Comparing Phase I and II

- 1st part of Phase II is similar to Phase I: women LFPR $\uparrow$ mainly due to supply shifts (as LS is very inelastic)

- 2nd part of Phase II: both women labour supply and *demand* contributed (as LS became more elastic)
  - demand will be even more important in Phase III

Impacts on Labour Economics

- labor economists analysed female labor supply decisions in the context of the *family unit*, rather than the individual, and questioned the influence of husband's income on wife's "gainful employment.

C. Phase III: 1950s to 1970s—Roots of theRevolution

Changes

- LFPR ⇑ for nearly all groups of women
- Women LS Elasticity ⇑
  - income effect ↓ as work for married women became more acceptable
  - The average married working woman by the 1940s was more educated than the average married woman in the population, a reverse of previous observation and another indication that the substitution effect had begun to swamp the income effect
- Reasons:
  - Creation of scheduled part-time employment
  - Great acceptance of married women and almost complete end of marriage bars
- Most of the increase in female LFPR and hours of work during Phase III was *demand driven*
  - The demand function for labour increased rapidly over a relatively stable and *highly elastic female labor supply* function

Limitations

- Married women were still the secondary earners, taking the labor supply decisions of their husbands as given
- Human capital continued to increase, but the investments occurred mainly off the job informal education or vocational training, rather than on the job
- Women still expect to have intermittent employment, not a career

Impact on Labour Economics

- Clarence Long (1958): inconsistency/paradox between cross-sectional and time-series data on women LFPR:
  - Cross-section: substantial negative effects from increases in husband's income
  - Time-series: women LFPR ↑ while husbands' income also ↑
- Jacob Mincer (1962): the inconsistency/paradox is a data issue
  - estimates using individual-level cross-sections are biased

    - using city-level data instead, there's no paradox:
        - substitution effect $\gg$ income effect
        - As real incomes rose, LFPR of married women increased even though the earnings of women relative to those of men advanced only slightly
- Gary S. Becjer: Major advances in labour economics: analyse the family as the optimising unit

III. The Quiet Revolution—Phase IV: Late 1970s to the Present

A. Revolutionary Indicators

- Only small increase in LFPR of married women
- LFPR is not a reliable indicator of a social and economic revolution
- Indicators: horizon, identity, and decision making
    - turning points are strikingly similar by cohort
    - the series, taken together, present a logical progression
- Expanded Horizons
    - Women more accurately anticipated their future work lives and planned for careers rather than jobs

1. Expectations
    - The revolutionary phase began with cohorts born in the late 1940s who were teen-agers in the mid-1960s
    - Data: National Longitudinal Survey (NLS): expectations of paid employment at 35

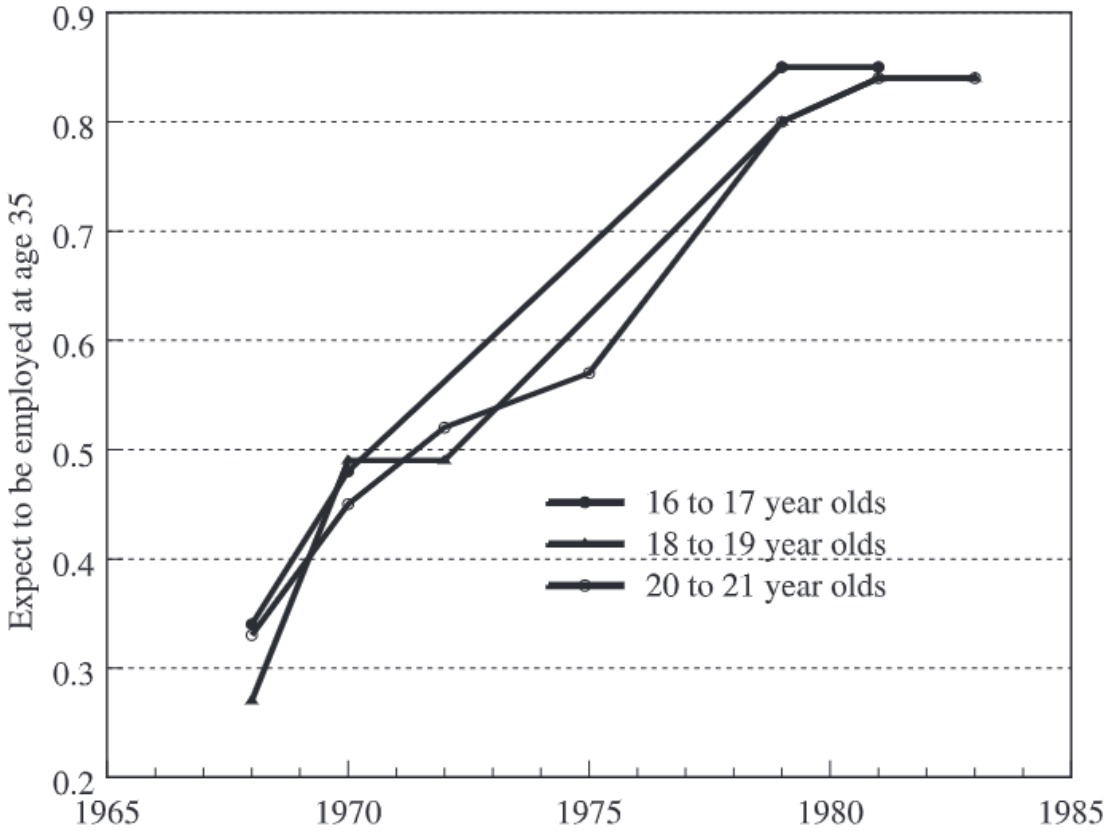


FIGURE 2. EMPLOYMENT EXPECTATIONS OF FEMALE YOUTH BY AGE: 1967 TO 1984

-
- Rate expected to be employed ↑

2. Revised expectations → Continue with College and to Graduates
    - In the 1970s and 1980s, girls began to take more college preparation courses in high school and narrowed the gap between girls and boys in science and math course

- → females greatly increased their college attendance and graduation rates

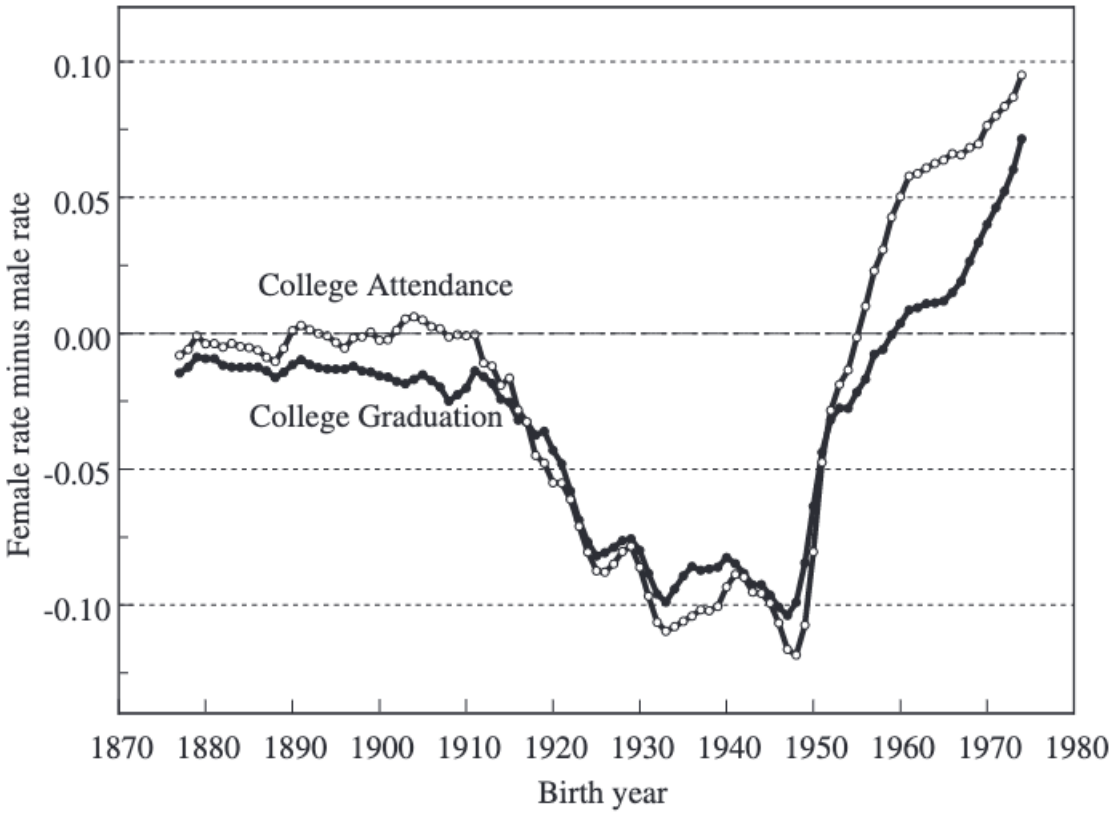


FIGURE 3. FEMALE MINUS MALE COLLEGE ATTENDANCE AND GRADUATION RATES: BIRTH COHORTS, 1877 TO 1974

- age at first marriage continued to climb

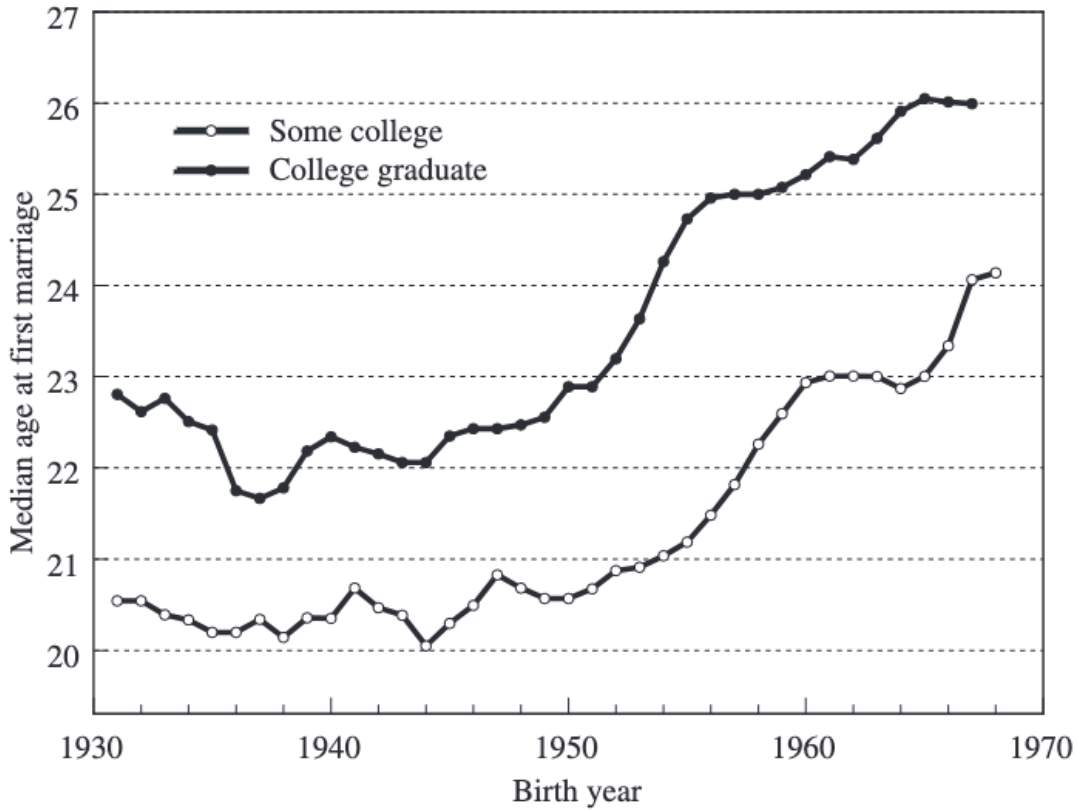


FIGURE 4. MEDIAN AGE AT FIRST MARRIAGE FOR BIRTH COHORTS OF FEMALE COLLEGE GRADUATES AND ATTENDEES: 1931 TO 1968 BIRTH YEARS

- close the gap with men with regard to college majors
  - Women's majors shifted from those that were"consumption" related to those that were "in-vestment" related

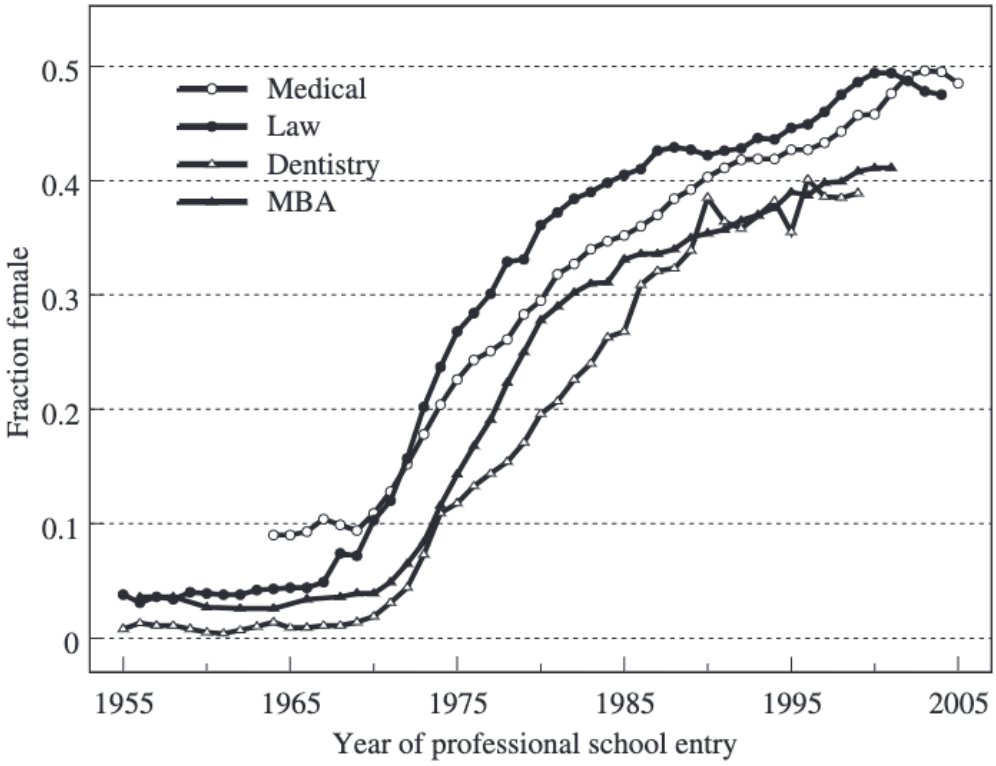


FIGURE 5. FRACTION FEMALE AMONG FIRST-YEAR STUDENTS IN PROFESSIONAL PROGRAMS: 1955 TO 2005

3. With longer and more informed horizons → years of accumulated job experience increased and the returns to job experience increased as well (increased more than men)

- Altered Identities
  - More women *retained their surname* upon marriage, particularly among those who had advanced degrees
  - Beginning in the early 1970s, women placed *greater emphasis* on coworker recognition and career success in the factors they believed would be important to their personal satisfaction, and they placed far less emphasis on their concern with others.
    - similar to their male counterparts
  - Working became *part of identity* → Less elastic women LS
    - Both income and substitution elasticities decreased substantially in (absolute) magnitude for all education groups of women in the 1980s and again in the 1990s
      - Income elasticity ↓ following its trend
      - Substitution elasticity ↓ reversing its previous trend
    - This reflects that women see employment as part of a long-term career: working is a part of their identities
      - → women became *stickier* in labour force
    - Applies to all kinds of women

- Relative Earnings and Occupations
  - Expanded horizon + Altered identity → young women became more prepared and determined for careers
  - → greater job experience and more market-relevant skills
  - → Earnings↑ and Occupations shifted:

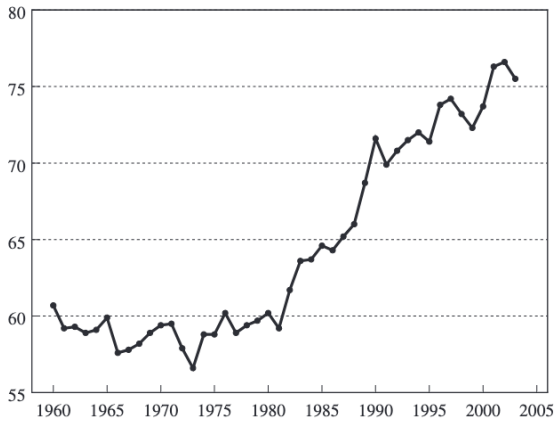


FIGURE 7. WOMEN'S EARNINGS AS A PERCENTAGE OF MEN'S EARNINGS: 1960 TO 2003

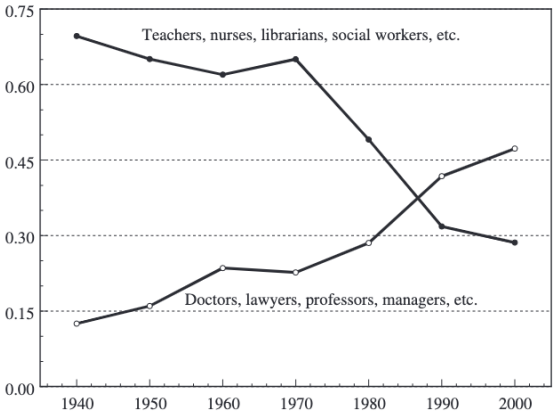


FIGURE 8. OCCUPATIONS OF COLLEGE GRADUATE WOMEN, 30 TO 34 YEARS OLD: 1940 TO 2000

  - Even within cohorts, earnings of women ↑ compared with men, suggesting that the revolution diffused to middle-age cohorts (partly due to anti-discrimination legislations)

B. What Caused the Revolution?

- Phase III: LD↑ and LS was relatively elastic, but many women were caught by surprise (wrong anticipation, and hence not much educational advancement, etc.)
- But the next generation observed the large increase in LFPR and in full-time work of their predecessors. They extrapolated and form more accurate expectations for their futures. In doing so they were better prepared to invest in human capital → more educated with valuable majors

- They also postponed marriage and divorce → fraction of time spent married↓

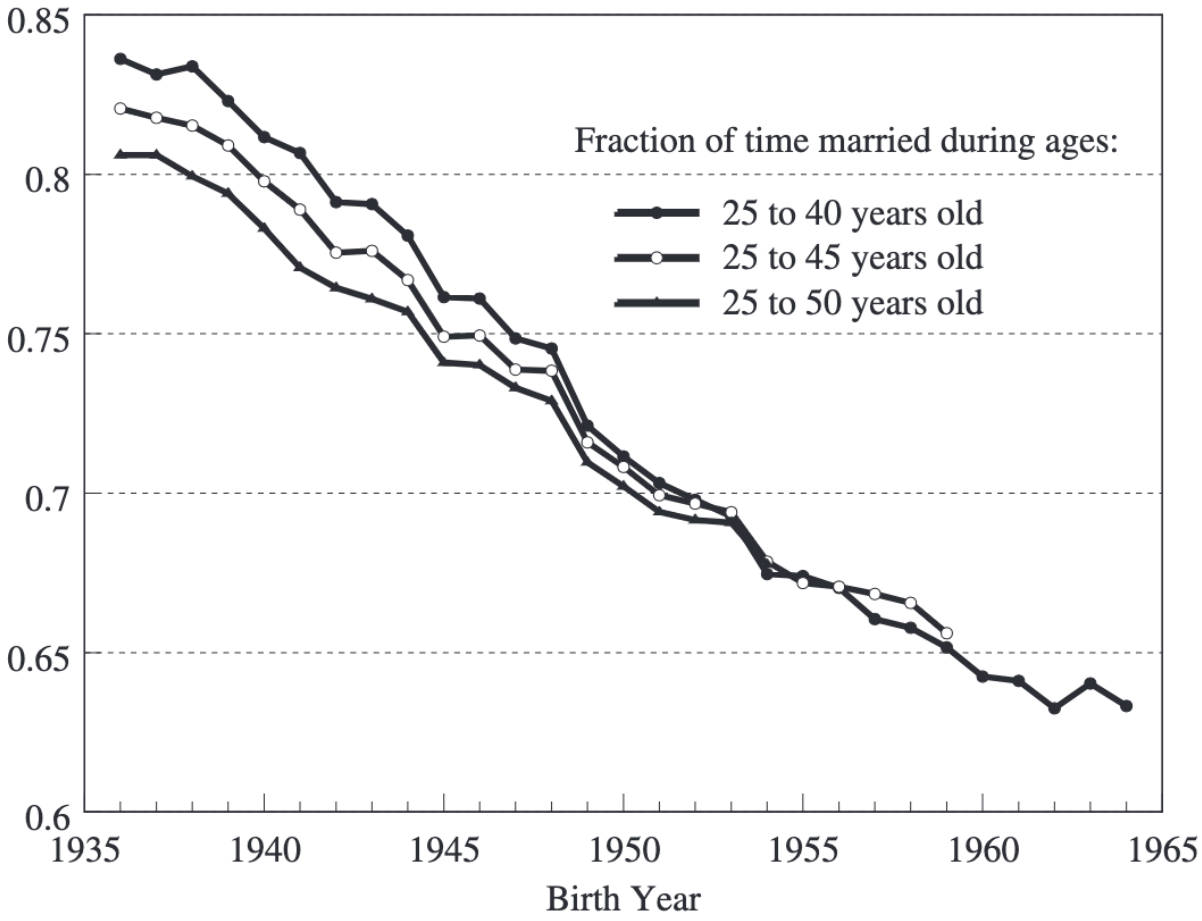


FIGURE 9. FRACTION OF YEARS SPENT MARRIED FOR ALL WOMEN

  - enabled them to take formal education
  - economic independence → identity shift:
    - family/household-centered → career oriented
    - and many formed their identities before marriage and family
- Another reason for marriage delay: the diffusion of contraceptive pills
  - Aided by changes in state laws, the pill diffused to young, single women

IV. Has the Quiet Revolution Stalled?

A. Is There a "Natural Rate" of Female Labor Force Participation?

- LFPR for women of almost all ages, education levels, and marital statuses seem to have levelled off (stopped increase) since around 1990
- Some type of "natural rate"of female labour force participation has been reached?
  - (whether the natural rate is lower than some had thought it would be?)
- Whether data support this argument depends on the particular age group examined
  - For *women in their 30s*, the natural rate is not yet reached, despite the levelling off of LFPR -- the demographics is still changing

- Probability of having a young kid↑ (child burden↑) but LFPR remains stable
  - $\Longrightarrow$ Their participation is still expanding (not yet at a natural rate)
- these women appear to be committed to the labor force probably because they were in the labor force far longer before they married, in-vested more in formal and informal training, and shaped their identities before having children

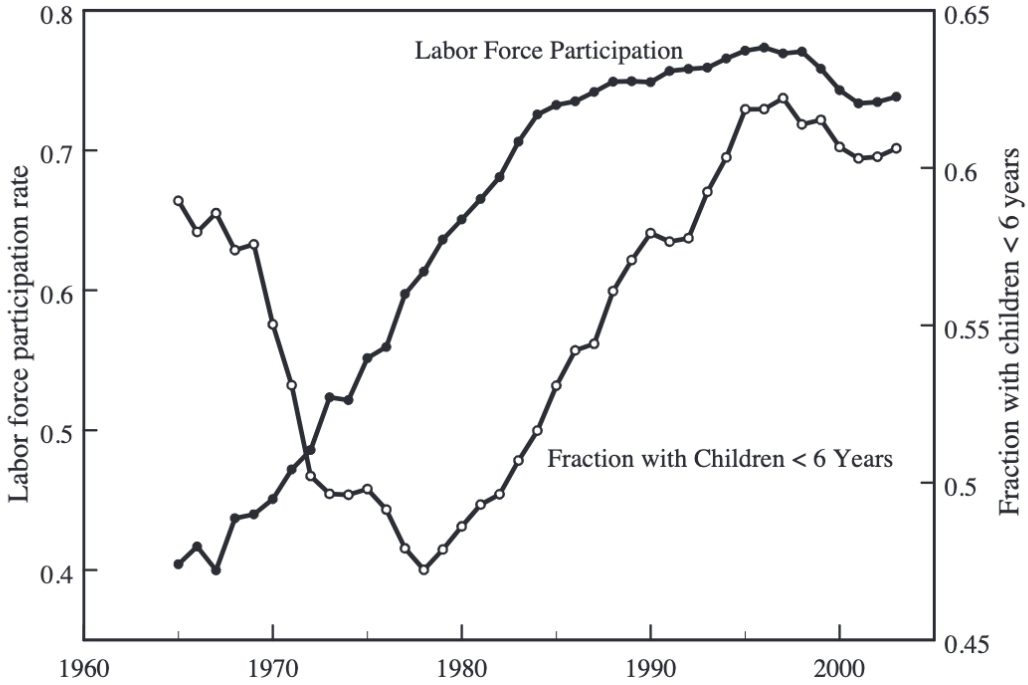


FIGURE 10. LABOR FORCE PARTICIPATION AND FRACTION WITH YOUNG CHILDREN FOR 33- TO 37-YEAR-OLD MARRIED, COLLEGE GRADUATE WOMEN: 1962 TO 2004

- *For women in their 20s*, a natural rate might have been reached since 1990
  - LFPR high and table (90%, nearly the same as their male counterpart)
  - Child burden also stable

B. Opting Out of the Revolution?

- *Opt Out:* conscious decision made by (usually highly educated) women to be fleeing the labour force for the comforts of home and family and the identities of mother and wife
- To evaluate the opt-out assertion requires data to
  - be longitudinal or retrospective of a sufficient timespan because individuals may change their mind
  - include a large number of female and male graduates from top-ranked institutions of higher education because opting out applies mostly to them, and we need males for comparison
- College and Beyond dataset meets those requirements
- The sum of all out-of-work spells for women during their first 15 years after graduation was *remarkably short*. (Slightly larger than those for comparable men, but still very small)

    - Children were the most important factor, and its effect was non-linear (↑ as children ↑)
        - Children's effect is the opposite for men: children↑ spell↓
    - Women with advanced degrees had much shorter spells with/without children
- Conclusion: Evidence from the Current Population Surveys (CPS) and the College and Beyond dataset *does not indicate* that college graduate women, particularly those from selective institutions, have opted out.
    - The most recent generation cannot be yet judged (because they just started their path), but their perceptions do not change much

V. Three Evolutions, the Quiet Revolution, and Beyond: A Summary

- *Evolution Phase I*: late 19th century - 1920s
    - few adult and married women were in the labor force. The income elasticity of female labor supply was large (and negative) and the substitution elasticity of labor supply was small. Virtually all change in participation had to come from shifts in labor supply.
- *Evolution Phase II*: 1930s - 1950s
    - The income elasticity decreased considerably in (absolute) magnitude with the arrival of nice jobs that reduced the stigma surrounding married women's work outside the home and with the increase in high school attendance and graduation rates that made nice work a possibility for many young women.
    - The substitution effect increased substantially with the reduction in weekly hours (and days) of work, the initial stirrings of part-time work, and the rapid diffusion of the electric household
    - Also the influence of WWII
- *Evolution Phase III*: 1950s - 1970s
    - Women labour supply was rather elastic and demand ⇑ due to part-time work ↑ (suitable for married women)
    - → women LFPR⇑
    - but this was not correctly expected by women; jobs were still not careers; and their skillset was not commensurate with their eventual life cycle labour force participation
- *Quiet Revolution*: 1970s - present
    - Who
        - Set off by the generation born in the late 1940s and preceded by the following generations
    - 3 Factors
        - The young began to extrapolate to their own lives, possibly influenced by the resurgence of feminism that encouraged them to think independently

    - Contraceptive innovation known as the pill. Aided by changes in state laws, the pill diffused to young, single women
    - The enormous increase in divorce in the 1960s
  - Effects
    - → marriage delay → a far smaller fraction of a woman's life would be spent married
    - meanwhile, able to predict what their future lifetime employment better → increased their investments in formal schooling, majored in career-oriented subjects, and continued on to professional and graduate schools
  - Consequences
    - Longer horizon
    - Altered identity
    - Income and substitution effects of labor supply changed once again, mainly in the 1980s and 1990s:
      - No longer was women's labor supply highly elastic. It was influenced even less than before by husband's earnings.
    - The earnings of women rose relative to those of men
    - Occupations changed from more traditional ones to "nontraditional"
  - And this revolution did not go backward (at least no evidence)

Week 3: Labour Demand

Textbook Ch.3 Labour Demand

- Labour demand is a derived demand (from the demand for firms' products)

3-1 The Production Function

- Firm's Production Function -- how much output is produced by any combination of labour and capital:

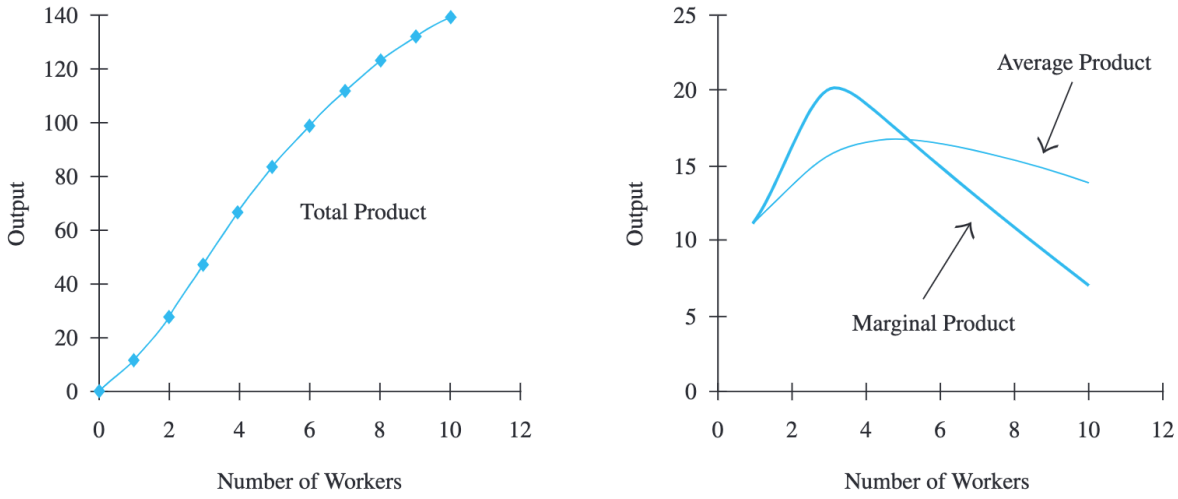
$$q = f(E, K)$$

  - E: number of employee-hours hired by the firm
  - K: capital
- 2 restrictive assumptions:
  - Ignore employee-hours distinction and refer to E as the number of workers hired
  - The production function ignore the difference between workers (e.g. they may indeed have different productivities, but we ignore such difference)

Marginal Product and Average Product

- Marginal Product of Labour MP_E gives the change in output resulting from hiring an additional worker, holding constant all other inputs
  - 有这个工人的output - 没这个工人的ouput
- Marginal Product of Capital MP_K gives the change in output resulting from a one-unit increase in the capital stock, holding constant all other inputs

FIGURE 3-1 The Total Product, Marginal Product, and Average Product Curves
(*a*) The total product curve gives the relationship between output and the number of workers hired by the firm, holding capital fixed. (*b*) The marginal product curve gives the output produced by each additional worker and the average product curve gives the output per worker.



  - The marginal product of labour curve gives the slope of the total product curve -- the rate of change in output as more workers are hired
  - The marginal curve lies above the average curve when the average curve is rising, and the marginal curve lies below the average curve when the average curve is falling
- Law of Diminishing Returns: the marginal product of labour eventually declines
- Average Product of labour AP_E is the amount of output produced by the average worker:

$$AP_E = \frac{q}{E}$$

Profit Maximization

- Firm's Profit:

$$\text{Profits} = \underbrace{pq}_{Revenue} \underbrace{-wE - rK}_{Costs}$$

  where:
  - p is the price of output
  - w is the wage rate (the cost of hiring an additional employee-hour)
  - r is the price of capital
- A perfectly competitive firm does not have market power and takes price as given (exogenous), so they maximise their profits by choosing the amount of labour E and capital K

- Both labour market and goods market are competitive

3-2 The Short Run (Fixed Capital)

- Short Run: a time span short enough that firms' capital stock cannot be change (i.e. constant at K_0)
- Value of Marginal Product of labour is the dollar increase in revenue generated by an additional worker, holding capital constant:

$$VMP_E = p \times MP_E$$

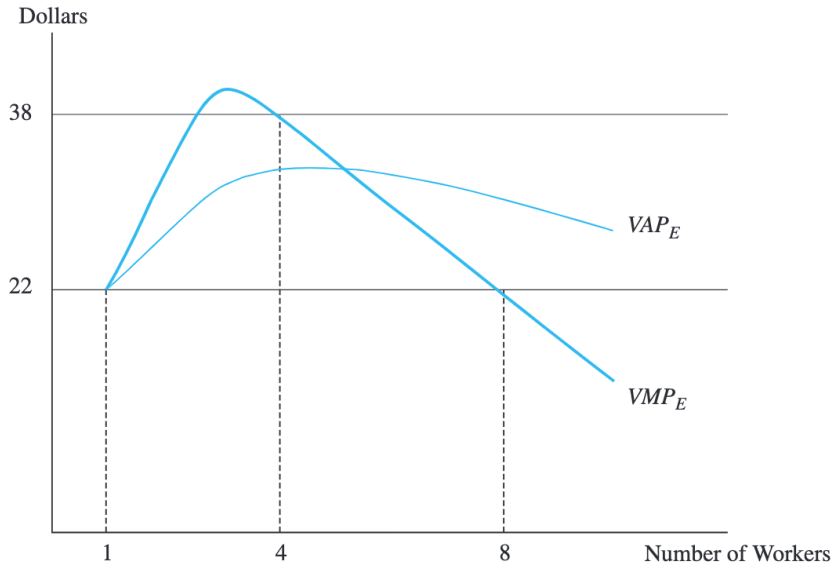
- Value of Average Product of labour is the dollar value of output per worker:

$$VAP_E = p \times AP_E$$

  - since price p is constant here, the VMP/VAP curve have the same shapes as MP/AP curve

Firm's SR Optimisation: Marginal Productivity Condition

FIGURE 3-2 The Firm's Hiring Decision in the Short Run
A firm hires workers up to the point where the wage rate equals the value of marginal product of labor. If the wage is $22, the firm hires eight workers.



- Optimisation/Marginal Productivity Condition:

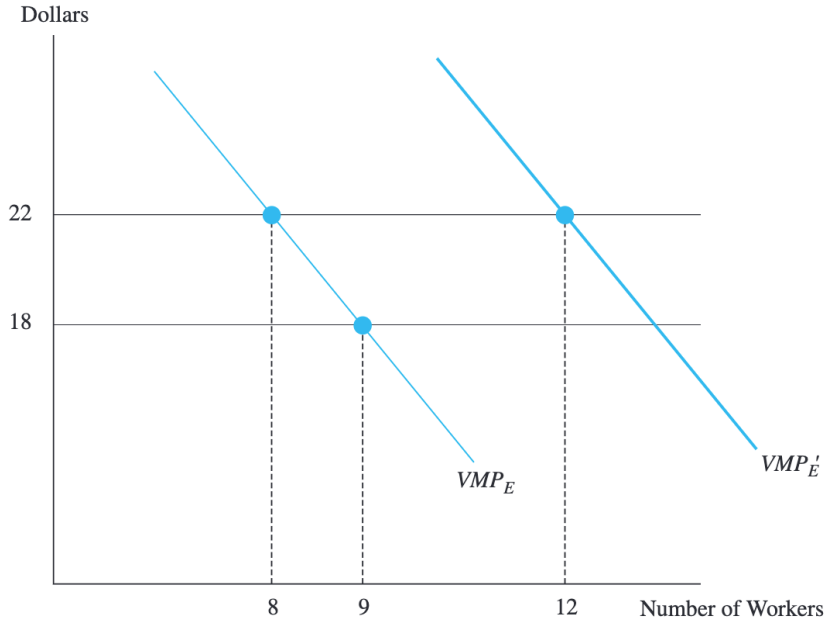
$$w = VMP_E = p \times MP_E$$

- Caveat: 这个交点得是在*VMP的下降段*，而不是上升段
  - 比如上图中E=1时$w = VMP_E$，但是显然应该雇佣更多
- We only consider the segment of VMP curve that is *downward sloping and below VAP* because:
  - on upward sloping VMP → not optimising
  - w above the VAP → negative profit → firm exits (not optimising)

SR Labor Demand Curve for a Firm

- Short-run Demand Curve for Labour: what happens to the firm's employment as the wage changes, holding capital constant

FIGURE 3-3 The Short-Run Demand Curve for Labor
Because marginal product declines, the short-run demand curve for labor is downward sloping. A drop in the wage from $22 to $18 increases employment. An increase in the price of the output shifts the value of marginal product curve upward and increases employment.



- The *SR demand curve for labor is given by the value of marginal product (VMP) curve*.
  - Because $VMP_E \downarrow$ as more $E \uparrow$, it must be the case that a fall in the wage increases the number of workers hired.
- *Output price* $\uparrow$ - $VMP_E \uparrow$ - $E \uparrow$
  - 上图中的$VMP_E \rightarrow VPE_{\dot{E}}$
- SR Labour Demand curve will also be influence by the level of capital K

SR Labor Demand Curve in the Industry

FIGURE 3-4 The Short-Run Demand Curve for the Industry
Each firm in the industry hires 15 workers when the wage is $20. If the wage falls to $10, each firm hires 30 workers. If all firms expand, the output of the industry increases, reducing the price of the output and reducing the value of marginal product, so the labor demand curve of each individual firm shifts slightly to the left. At the lower price of $10, each firm hires only 28 workers. The industry demand curve is not given by the horizontal sum of the firms' demand curves (*DD*), but takes into account the impact of the industry's expansion on output price (*TT*).

- We *cannot simply adding up* individual firms to get the LD Curve of the industry.
  - Reason: if all firms expand output at the same time, price of the output $p \downarrow$, so $VMP_E \downarrow$ and the firm will not expand employment as much
- $\rightarrow$ Industry's LD curve will be *steeper (less elastic)* than the aggregation of individual firms' LD curve
- Short-run Elasticity of Labour Demand is defined as the percentage change in SR employment E_{SR} resulting from a one percent change in the wage (*at the industry level*):

$$\delta_{SR} = \frac{\frac{\Delta E_{SR}}{E_{SR}}}{\frac{\Delta w}{w}} = \frac{\Delta E_{SR}}{\Delta w}\frac{w}{E_{SR}}$$

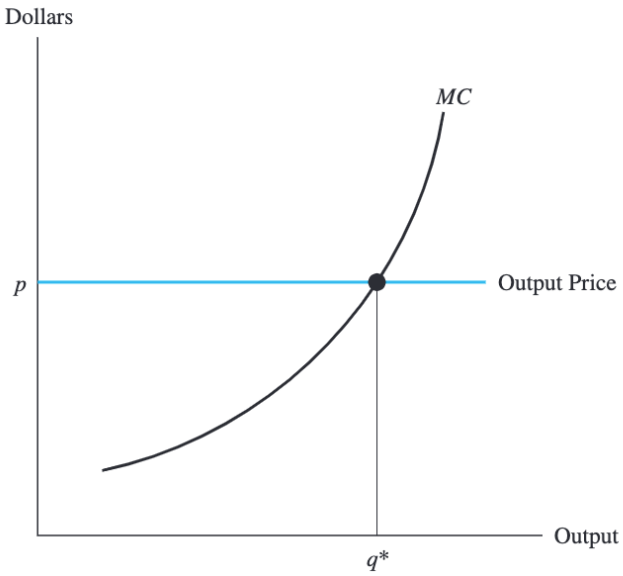
- Because SR LD is downward sloping, the SR elasticity of LD must be negative
-

$$\text{LD is } \begin{cases} \text{elastic} & \text{, if } |\delta_{SR}| > 1 \\ \text{inelastic} & \text{, if } |\delta_{SR}| < 1 \end{cases}$$

Alternative Interpretation of the Marginal Productivity Condition

- Alternative derivation: from firm's *goods market optimisation*

FIGURE 3-5 **The Firm's Output Decision**
A profit-maximizing firm produces up to the point where the output price equals the marginal cost of production. This profit-maximizing condition is identical to the one stating that firms hire workers up to the point where the wage equals the value of marginal product.



- Marginal Productivity Condition: the stopping rule that a profit-maximising firm produces up to the point its *marginal cost* equals the *marginal revenue* of *an additional unit of output*
- In our context: $MC = w \times \frac{1}{MP_E}$ and $MR = p$
- Thus, the marginal productivity conditions is:

$$\underbrace{w \times \frac{1}{MP_E}}_{MC} = \underbrace{p}_{MR} \iff w = \underbrace{p \times MP_E}_{VMP_E}$$

which is the same as optimisation condition base on labour hired

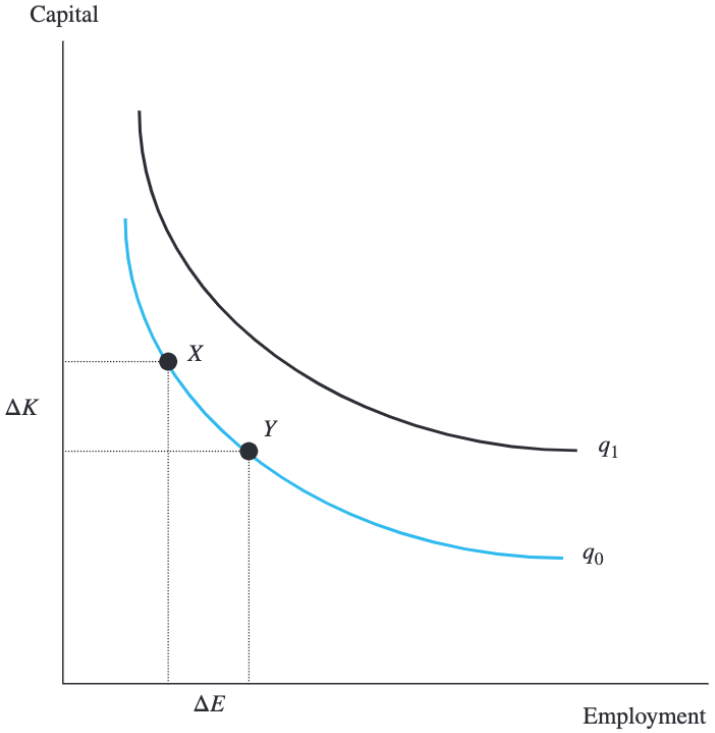
3-3 The Long Run (Flexible Capital)

- In the LR, firms choose both employment E and capital K to maximise profits.

Isoquants

- An Isoquant gives the combinations of labour and capital that produce the same level of output
  - "Indifference curves" of prduction fucntions

FIGURE 3-6 Isoquant Curves
All capital–labor combinations along a single isoquant produce the same level of output. The input combinations at points X and Y produce q_0 units of output. Input combinations that lie on higher isoquants produce more output.



- *Properties of isoquants*
  - must be downward sloping
  - do not intersect
  - higher isoquants are associated with higher levels of output
  - convex to the origin
- The slop of an isoquant is the *negative* Marginal Rate of Technical Substitution:

$$Slope = \frac{\Delta K}{\Delta E} = -\frac{MP_E}{MP_K},\ MRTS = \left|-\frac{MP_E}{MP_K}\right| = \frac{MP_E}{MP_K}$$

  - Convex isquants imply a *diminishing* MRTS (flatter isoquant) as the firm substitutes more labour for capital ($E \uparrow K \downarrow \implies MRTS \downarrow$)

Isocosts

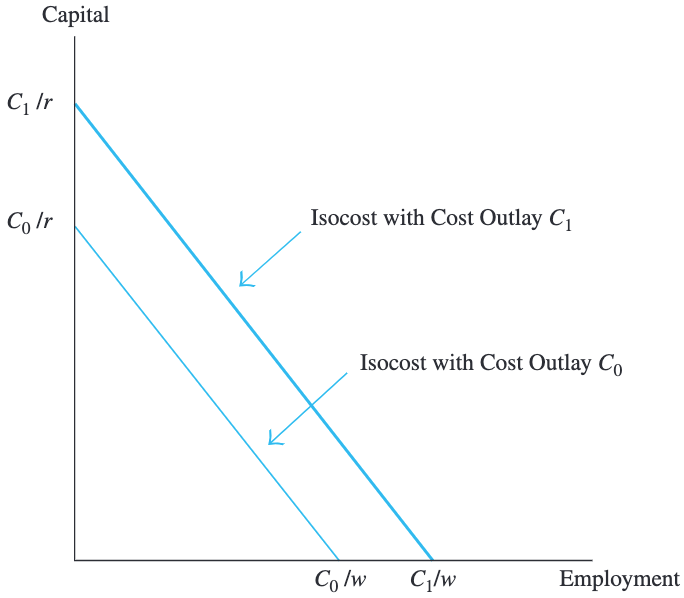
- An Isocost gives all combinations of labour and capital that costs the same for a firm:

$$K = \frac{C}{r} - \frac{w}{r}E$$

  - Intercept: $\frac{C}{r}$; slope: $\frac{w}{r}$
- A firm's cost of production $\rightarrow$ isocost:

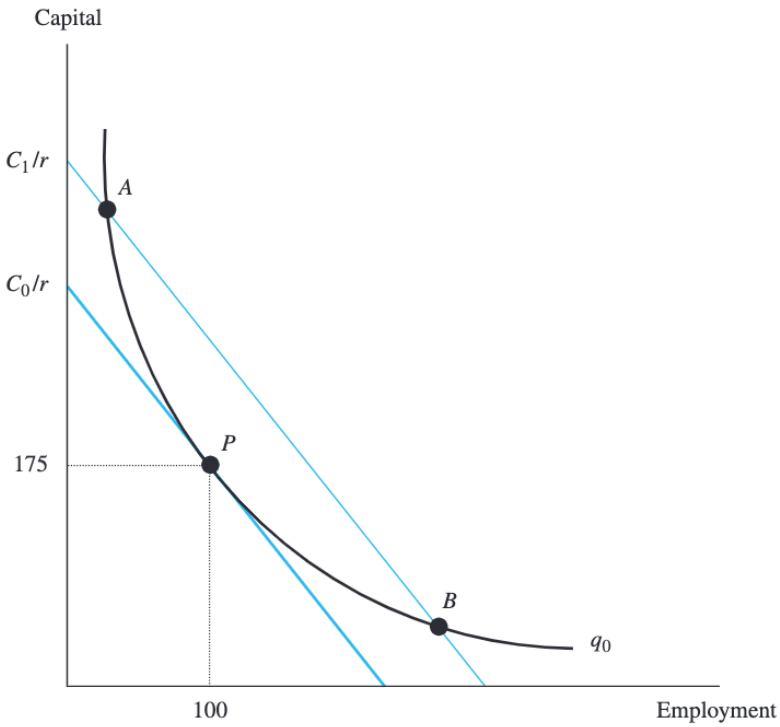
$$C = wE + rK \rightarrow K = \frac{C}{r} - \frac{w}{r}E$$

FIGURE 3-7 **Isocost Lines**
All capital–labor combinations along a single isocost curve are equally costly. Capital–labor combinations on a higher isocost curve are costlier. The slope of an isocost equals the ratio of input prices ($-w/r$).



Cost Minimization: Tangency of Isoquant and Isocost

FIGURE 3-8 The Firm's Optimal Combination of Inputs
A firm minimizes the cost of producing q_0 by using the capital–labor combination at point *P*, where the isoquant is tangent to the isocost. All other capital–labor combinations (such as those in points *A* and *B*) lie on a higher isocost.



- Profit-maximising firms must minimise their cost *given a particular output level* q_0: the firm will choose the *tangent point* of the isocost and isoquant (lowest isocost line that can generate q_0 units of output)
- Tangency Condition for cost minimisation:

$$\text{Slope of Isoquant} = \text{Slope of Isocost} \iff \underbrace{\frac{MP_E}{MP_K}}_{MRTS} = \underbrace{\frac{w}{r}}_{\text{Ratio of input prices}}$$

  - This implies that MRTS = Ratio of Input Prices and:

$$\frac{MP_E}{w} = \frac{MP_K}{r}$$

    which means the last dollar spent on labour should generate as much output as the last dollar spent on capital

- *LR Profit Maximisation and Cost Minimisation*: A profit-maximising firm must minimise its cost at any output level q_0, and it must choose the output level q^* that maximise its profit

  - In other word, a profit-maximising firm in LR must satisfy the Marginal Productivity Conditions for both labour and capital:

$$MC = MR \implies \begin{cases} w = p \times MP_E & \text{for labour} \\ r = p \times MP_K & \text{for capital} \end{cases}$$

  - Those 2 conditions implies the tangency condition for cost minimisation
  - Profit Maximisation $\implies$ Cost Minimisation

- *Cost minimisation is a prerequisite for profit maximisation / Profit maximisation implies cost minimisation*

3-4 LR Demand Curve for Labor

- Initial Profit-Maximising Point:
  - Output is at its optimum: $p = MC$
  - Cost minimising: $\underbrace{\frac{MP_E}{MP_K}}_{MRTS} = \underbrace{\frac{w}{r}}_{\text{Ratio of input prices}}$

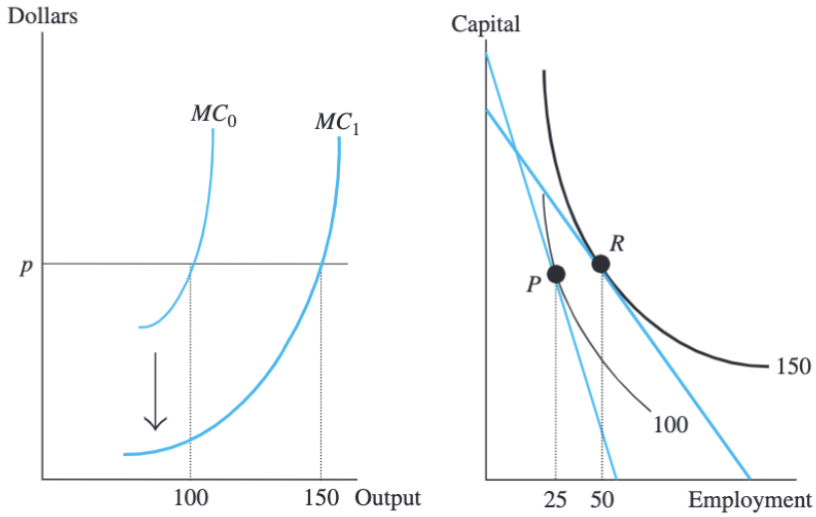
Effects of Wages: Will the Firm Expand if the Wage Falls?

- $$w \downarrow \implies \begin{cases} E \uparrow \\ K \text{ ambiguous} \end{cases}$$
- see next section

Substitution and Scale Effects

- Overall

FIGURE 3-10 **Impact of Wage Reduction on Output and Employment of a Profit-Maximizing Firm**
(*a*) A wage cut reduces the marginal cost of production and encourages the firm to expand (from producing 100 to 150 units). (*b*) The firm moves from point *P* to point *R*, increasing the number of workers hired from 25 to 50.

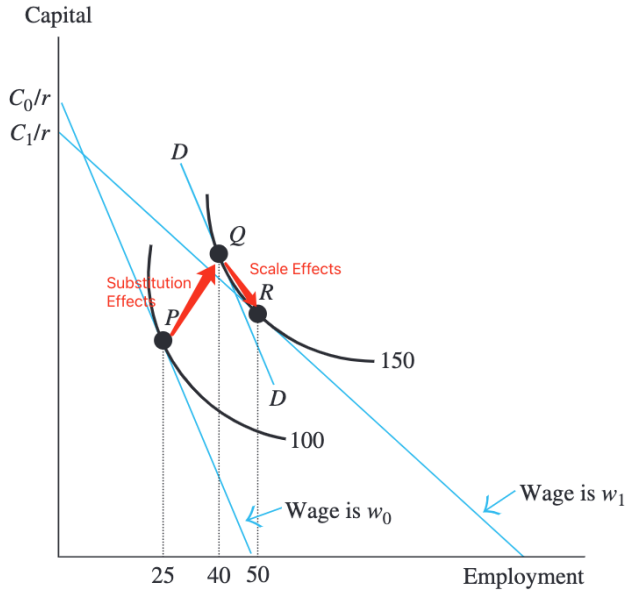


(*a*) Firm's Output Decision (*b*) Firm's Hiring Decision

- Decomposition

FIGURE 3-11 Substitution and Scale Effects

A wage cut generates substitution and scale effects. The scale effect (the move from point P to point Q) encourages the firm to expand, increasing the firm's employment. The substitution effect (from Q to R) encourages the firm to use a more labor-intensive method of production, further increasing employment.



- $w \downarrow$ reduces the price of labour relative to capital, encouraging the firm to substitute to more labour-intensive production (substitution effect); it also reduces the MC, encouraging the firm to expand (scale effect)
- Decompose $P \to R$ in 2 Stages:

  - Scale Effect ($P \to Q$) indicates what happens to the demand for the firm's inputs as the firm *expands production*, holding input prices constant.

  - As long as both capital and labour are normal inputs, the scale effect increases both employment and capital stock:

$$\text{Scale Effect}: w \downarrow \begin{cases} E \uparrow \\ K \uparrow \end{cases}$$

  - Substitution Effect ($Q \to R$): indicates what happens to the demand for the firm's inputs as the wage (relative to capital rent) changes, holding output constant.

  - (Isocost will be flatter) Substitution effect must increase employment and decrease the demand for capital:

$$\text{Substitution Effect}: w \downarrow \begin{cases} E \uparrow \\ K \downarrow \end{cases}$$

  - Overall effects:

$$w \downarrow \begin{cases} q \uparrow \text{ (always)} \\ E \uparrow \text{ (always)} \\ K \begin{cases} \uparrow & \text{, if scale effects dominate} \\ \downarrow & \text{, if substitution effects dominate} \end{cases} \end{cases}$$

- Another example: *if the cost of capital increases*

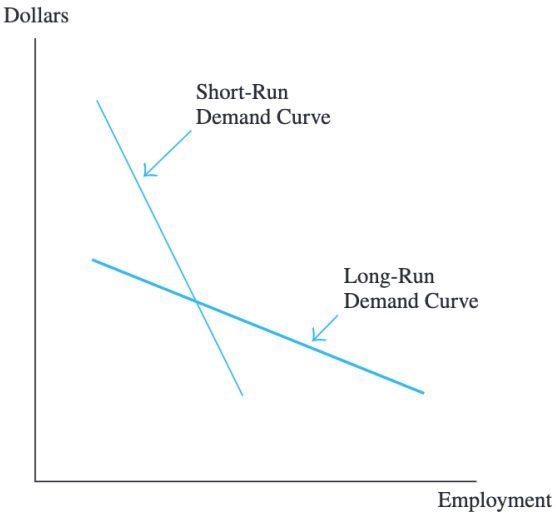
$$r \uparrow \begin{cases} q \downarrow \text{ (always)} \\ K \downarrow \text{ (always)} \\ E \begin{cases} \downarrow & \text{, if scale effects dominate} \\ \uparrow & \text{, if substitution effects dominate} \end{cases} \end{cases}$$

- Long-run Elasticity of Labour Demand δ_{LR} measure the responsiveness of changes in LR employment E_{LR} to changes in the wage:

$$\delta_{LR} = \frac{\frac{\Delta E_{LR}}{E_{LR}}}{\frac{\Delta w}{w}} = \frac{\Delta E_{LR}}{\Delta w} \frac{w}{E_{LR}}$$

  - This must be negative because LR LD is downward sloping.
- *LR and SR Labour Demand*

FIGURE 3-12 **The Short- and Long-Run Labor Demand Curves**
In the long run, the firm can take full advantage of the economic opportunities introduced by a change in the wage. The long-run demand curve is more elastic than the short-run demand curve.



  - *LR LD is always more elastic (flatter) than SR LD*
    - An important principle in economics states that consumers and firms can respond more easily to changes in the economic environment when they face fewer constraints.
    - In SR, the firm is constrained by a fixed capital stock K_0, so it's difficult to change its scale; In LR, both K, E can be changed, so the firm can fully take advantage of changes in w

Estimates of the Labor Demand Elasticity

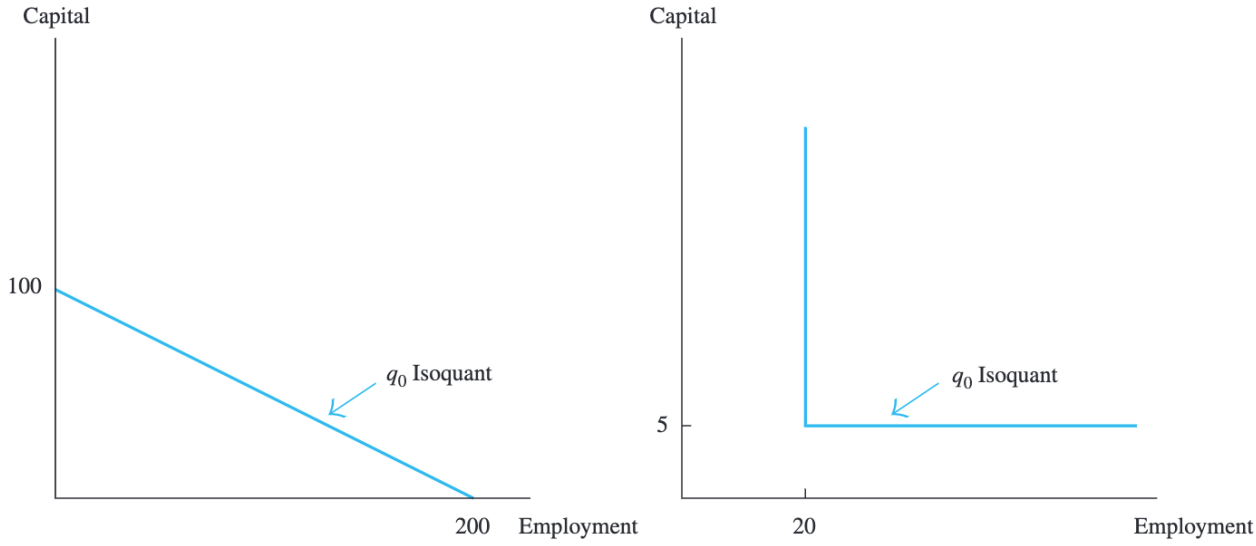
- Similar issues as Estimating LS Elasticities
- Most estimates indicate that LD is downward sloping
- Consensus:
  - *SR LD Elasticity δ_{SR} lies between -0.4 and -0.5*
  - *LR LD Elasticity $\delta_{LR} \approx -1$*

- $\frac{1}{3}$ due to substitution effects; $\frac{2}{3}$ due to scale effects

3-5 Elasticity of Substitution

- Size of substitution effects depend on the curvature of the isoquant

FIGURE 3-13 **Isoquants When Inputs Are Either Perfect Substitutes or Perfect Complements**
Capital and labor are perfect substitutes if the isoquant is linear (so that two workers can always be substituted for one machine). The two inputs are perfect complements if the isoquant is right-angled. The firm then gets the same output when it hires 5 machines and 20 workers as when it hires 5 machines and 25 workers.



(*a*) Perfect Substitutes (*b*) Perfect Complements

- Perfect Substitutes: when 2 inputs have a constant MRTS; their isoquant will be a straight line (3-13.a)
  - $\rightarrow$ large substitution effects
- Perfect Complements: isoquant between any 2 inputs is right angled (output depends only on the lower input, adding more of the other input does not increase the output) (3-13.b)
  - $\rightarrow$ no substitution effects
- Elasticity of Substitution: gives the percentage change in the capital/labor ratio resulting from a 1 percent change in the relative price of labor, holding output constant:

$$\sigma = \frac{\text{Percentage change in } \frac{K}{L}}{\text{Percentage change in } \frac{w}{r}}$$

  - $\sigma \uparrow$ Substitution Effects$\uparrow$
    - Perfect substitutes: $\sigma = \infty$
    - Perfect complements: $\sigma = 0$

3-6 Marshall's Rules of Derived Demand: What Makes Labor Demand Elastic?

- Marshall's Rules of Derived Demand: Labour demand in the industry is *more elastic* when:
  - Elasticity of substitution between labour and other inputs$\uparrow$

- Elasticity of demand for the output↑
- Labour's share of total cost↑
- Supply elasticity of other factors of production↑

Union Behavior

- Unions want to make LD inelastic, so when they seek wage increases, $w\uparrow$ will cause less workers to be laid off
- Actions examples:
  - resist tech advances that increase the elasticity of substitution between labor and capital
  - limit the availability of goods that compete with the output of unionised firms
  - rises the prices of other inputs (make the share of labour cost small)

3-7 Factor Demand with Many Inputs

- Many inputs
- Production function:

$$q = f(x_1, x_2, x_3, \ldots, x_n)$$

- Define the marginal product of the ith input, or MP_i, as the change in output resulting from a one-unit increase in that input, holding constant the quantities of all other inputs
- A profit-maximising firm will still ensure that:

$$w_i = p \times MP_i$$

- As long as we assume that the law of diminishing returns holds, all of the key results derived in the case of a two-factor production function continue to hold:
  - short-run and long-run demand curves for each input are downward sloping
  - long-run demand curve is more elastic than the short-run demand curve
  - a wage change generates both a substitution effect and a scale effect
- Cross-Elasticity of Factor Demand gives the percentage change in the demand for input i resulting from a one percent change in the wage of input j:

$$\delta_{ij} = \frac{\%\Delta x_i}{\%\Delta w_j}$$

  - $\delta_{ij} > 0 \implies w_j\uparrow$ Demand for $i\uparrow \implies$ Substitutes (3-14.a)
  - $\delta_{ij} < 0 \implies w_j\uparrow$ Demand for $i\downarrow \implies$ Complements (3-15.b)

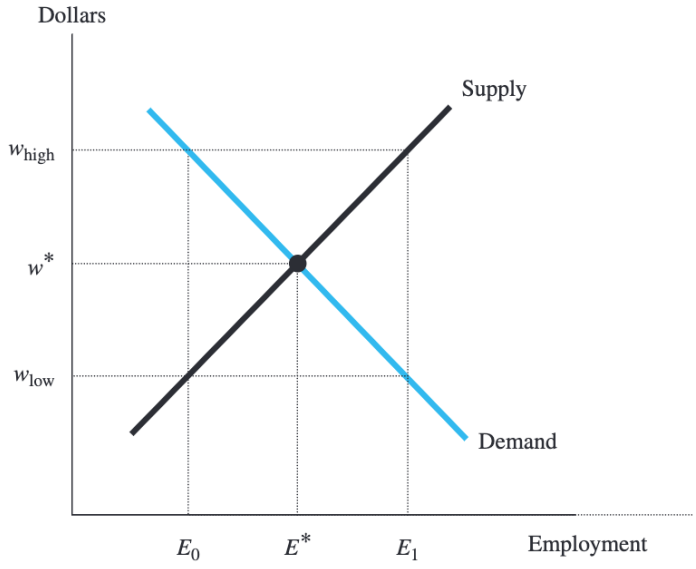
FIGURE 3-14 **The Demand Curve for Input *i* Responds to a Price Increase in Input *j***
(*a*) The demand curve for input *i* shifts up if the two inputs are substitutes. (*b*) The demand curve for input *i* shifts down if the two inputs are complements.

(*a*) inputs are *i* and *j* are substitutes (*b*) inputs *i* and *j* are complements

- Capital-Skill Complementary Hypothesis: unskilled labour and capital are substitute; skilled labour and capital are complements
  - Price of machine $\downarrow \Longrightarrow$ Demand for skilled labour$\uparrow$; Demand for unskilled labour$\downarrow$
  - Policy implication: an investment tax credit $\rightarrow$ lower cost of capital $\rightarrow$ spur investment but harm less-skilled workers

3-8 Overview of Labor Market Equilibrium

FIGURE 3-15 **Wage and Employment Determination in a Competitive Market**
In a competitive labor market, equilibrium is attained where supply equals demand. The equilibrium wage is w^* and E^* workers are employed.



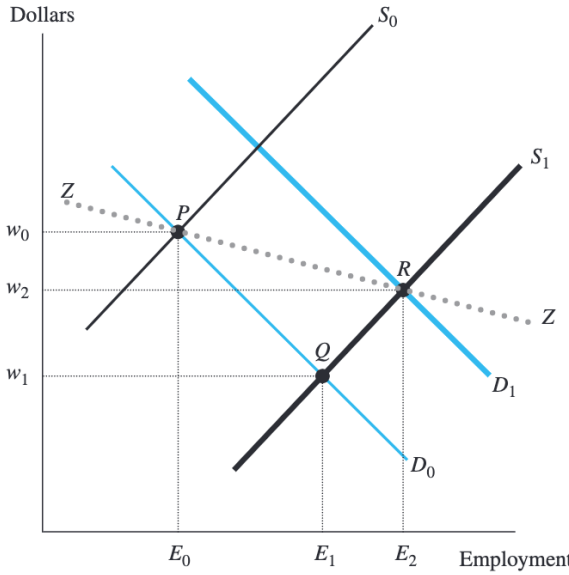
- LS is upward sloping: assume substitution effects dominate income effects
- LD is downward sloping
- $w > w^* \rightarrow$ surplus; $w < w^* \rightarrow$ shortage

- At equilibrium: The number of workers who are looking for work exactly equals the number of workers that employers want to hire.
  - Conflicting interests between employers and workers are balanced

3-9 Rosie the Riveter as an Instrumental Variable

- Estimating LD and LS curves
- If we can move only one curve a time, we can trace out the other
- However, in reality, LS and LD often move together. The resulting equilibrium wage and employment will be *endogenous* due to *simultaneity*.

FIGURE 3-16 Shifts in Supply and Demand Curves Generate Observed Wage and Employment Data
The market is initially in equilibrium at P, and we observe wage w_0 and employment E_0. If only the supply curve shifts, we can observe w_1 and E_1, and the available data lets us to trace out the labor demand curve. But if both the supply and demand curves shift, we observe w_2 and E_2, and the available data trace out the curve ZZ, which does not provide any information about either the supply or the demand curve.



- To estimate LD, we need an instrumental variable for LS: a factor that shifts LS without affecting LD, so we can *trace out* the LD
- *Rosie the Riveter* as IV for LS to estimate LD for females
  - Rosie the Riveter: during WWII, men were withdrawn from LF to serve in the army, and females entered the LF
  - Male mobilisation (enrolment in the army) rates were different from state to state due to
    - Different fractions of farmers
    - Different fractions of the black
  - Thus, mobilisation rate provides an IV that shifts female LS differently in different states
  - *Reduced-form*: reg percentage change in female employment ($\%\Delta F$) on mobilisation rate (Z)
    - estimate: 1-point increase in the state's mobilisation rate increased female labor supply by 2.62 percent
  - *First-stage*: reg percentage change in female wage ($\%\Delta w_F$) on mobilisation rate (Z)

    - estimate: 1-point increase in the mobilisation rate led to a 2.58 percent drop in the female wage.
  - Estimated LD Elasticity for females (Reduced-form/First-stage):

$$\hat{\delta} = \frac{\%\Delta F}{\%\Delta w_F} = \frac{2.62}{-2.58} = -1.07$$

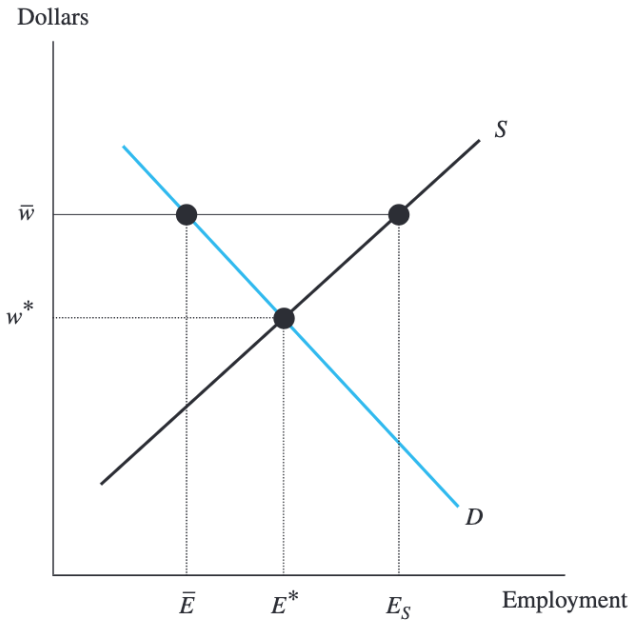
  - can be expanded to control for other factors that might shift the labor supply or labor demand curves differently in different state
- *Validity of the IV* is crucial: the IV can only shift one curve at a time
  - In the Rosie the Riveter example, mobilisation rate is a valid IV only if:
    - interstate difference in mobilisation rates generated different female LS, but was not correlated with LD: $VMP_F = p \times MP_F$

3-10 Policy Application: The Minimum Wage

Standard Model

- an important characteristic of the federal minimum wage in U.S.: It is not indexed to inflation or productivity growth.
  - the economic impact of minimum wages declines the longer it has been since it was last raised
- Standard model for minimum wage

FIGURE 3-19 **The Impact of the Minimum Wage on Employment**
A minimum wage set at $\overline{w}$ forces employees to cut employment (from E^* to $-\bar{E}$). The higher wage also encourages ($E_S - E^*$) additional workers to enter the market. The minimum wage, therefore, creates unemployment.



  - Minimum wage↑ → Unemployment rate↑
    - The increase in unemployment rate will be bigger if LS/LD becomes more elastic

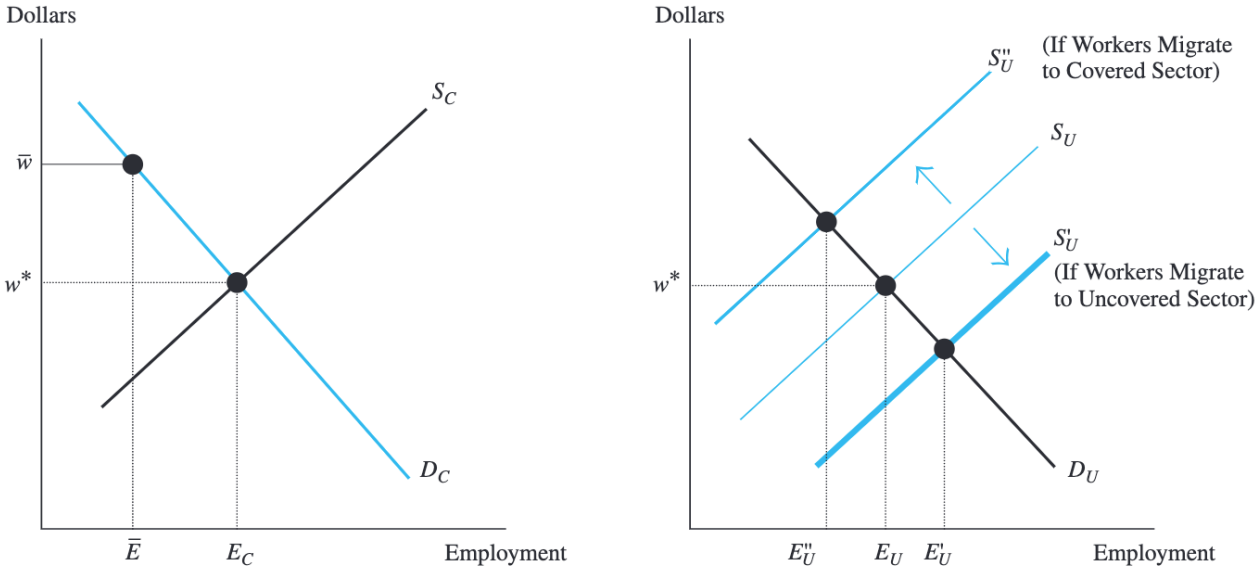
Issue 1: Compliance with the Minimum Wage Law

- In reality, the rate of noncompliance with the minimum wage is high due to triviality of penalties

Issue 2: The Covered and Uncovered Sectors

- The minimum wage may not cover all workers, but a part of them

FIGURE 3-20 **The Impact of the Minimum Wage on the Covered and Uncovered Sectors**
If the minimum wage applies only to jobs in the covered sector, the displaced workers might move to the uncovered sector, shifting the supply curve to the right and reducing the uncovered sector's wage. If it is easy to get a minimum-wage job, workers in the uncovered sector might quit their jobs and wait in the covered sector until a higher-paying job opens up, shifting the supply curve in the uncovered sector to the left and raising the uncovered sector's wage.



(*a*) Covered Sector (*b*) Uncovered Sector

- MW in the covered sector could induce *movement of workers* across sectors:
  - If workers move uncovered sector $\rightarrow$ covered sector (to seek chance of getting a higher wage), then in the uncovered sector: $w \uparrow E_U \downarrow$
  - If workers move covered sector $\rightarrow$ uncovered sector (laid off workers in the covered sector seek new jobs), then in the uncovered sector: $w \downarrow E_U \uparrow$
- Migration would stop when the expected wage was exactly the same in the covered and uncovered sectors:

$$\underbrace{(\pi \times \bar{w}) + [(1-\pi) \times 0]}_{E[w] \text{ in the covered sector}} = \underbrace{w_U}_{E[w] \text{ in the uncovered sector}}$$

$$\Longrightarrow \pi\bar{w} = w_U$$

  - Factors affecting the probability of finding a job in the covered sector (π) determine the direction of flow:
    - If π is high, uncovered $\rightarrow$ covered
    - If π is low, covered $\rightarrow$ uncovered

Evidence

- MW moves firms along the SR LD, so we can use corresponding data to identify LD elasticity

- Correlating changes in teenager employment with real minimum wage: estimated LD elasticity around -0.1 ~ -0.3
- Beginning in the late 1990s, labour economists questioned that result
  - Some studies concluded that *MW↑ might not reduce employment*
- Famous *New Jersey - Pennsylvania Natural Experiment*
  - MW↑ in NJ, but not in Penn
  - Uses Difference in Difference estimator
  - Estimated LD elasticity: +0.7
  - Rejects our simple demand-supply model
  - Potential reasons:
    - data noise / sampling error (from telephone survey)
    - fast-food industry may not be representative
    - timing of comparisons (not yet adjusted to the new equilibrium)

The Seattle Minimum Wage Debate

- MW increased from $11 to $13 in Seattle
- University of Washington team
  - use individual-level admin data
  - DiD with synthetic control method (constructing a representative control group)
  - Results: hour worked by low-wage workers ↓ 10%, number of low-wage jobs ↓ 5%
- UC Berkeley team
  - use city-level data and focus on food service industry only
  - Results: no effects on employment
- Lesson: in a perfectly competitive labour market, debate over the employment impact of MW is a debate over the elasticity of LD
  - no effect on employment $\iff$ elasticity of LD $= 0$
  - empirical research in labour economics in "elastic" -- subject to different data sources and different methods
  - highly affected by politics

Reading: Acemoglu et al. - 2004 - Women, War, and Wages The Effect of Female Labor

- *Section II is skipped* (as instructed by the lecturer)

I. Introduction

Main Strategy

- economists know relatively little about how female labor force participation affects the structure of male and female wage

    - Increased labor participation of women is driven by both supply and demand factors
    - exogenous variation in female LS is needed
- *Rosie the Riveter*: Use female labor force participation before and after World War II (WWII) as a source of plausibly exogenous variation in female labor supply
    - Women were drawn into LF as men mobilised to serve in the army
    - Exploit differences in state WWII mobilisation rates, as well as components of these mobilisation rate differences that are plausibly exogenous to other labor market outcomes, to study women's labor supply
- Women worked substantially more in 1950—but not in 1940—in states with greater mobilisation of men during the war
    - Women continued to work in greater numbers after 1947, presumably because employment during the war changed their preferences, opportunities, and information about avail-able work
- Causal effect of the WWII-induced increase in female labor supply on female and male wages:
    - Strong negative relationship between female wage growth over the 1940s and WWII mobilisation rates
    - Negative relationship between male wages growth and WWII mobilisation rates as well, but the slope of the relationship is considerably less steep

2 Challenges and Responses

- 2 major challenges for our interpretation:
    - First, high- and low-mobilisation states may differ in other unobserved dimensions, and these factors may account for the differential cross-state growth in female labor supply during the 1940s.
    - Second, mobilisation of men for war may have had a direct effect on labor demand in the postwar years, distinct from its impact on female labor supply.
- we provide evidence to suggest that those 2 issues are not the primary source of our findings.
    - Regarding the first issue:
        - results robust to including a variety of aggregate characteristics of state
        - no systematic variations before and long after WWII
    - Regarding the second issue:
        - no significant drop in men LFPR after WWII ($\rightarrow$ no trouble reentering the LF)
        - both men and women's wage growth rates were lower in high-mobilisation states ($\rightarrow$ no systematic difference between male and female LD)
    - no relation-ship between state WWII mobilisation rates and wage growth between1950 and 1960

Main Findings

- Exploiting the differential growth in female employment between 1940 and 1950 related to cross-state differences in WWII mobilisation, we estimate the impact of female employment on earnings level by gender and education. Our main findings are as follows:

1. *Greater female labor supply reduces female wages*. A 10 percent increase in female labor supply relative to male labor supply lowers female wages by 7–8 percent, implying a labor demand elasticity of -1.2 to -1.5.
2. *Greater female labor supply also reduces male wages*. A 10 percent increase in relative female labor supply typically lowers male earnings by 3–5 percent.
3. The combination of these two findings indicates that *male and female labor inputs are imperfect substitutes*, with an elasticity of substitution of around 3.
4. The impact of female labor supply on male earnings is not uniform throughout the male earnings distribution. *Women drawn into the labor market by the war were closer substitutes for men at the middle of the skill distribution than for those with either the lowest or highest education*

- Those are short-run elasticities, long-run relationships could be quite different

III. Data Sources and OLS Estimates

IV. Mobilization for World War II

V. WWII Mobilization and Female Labor Supply

VI. The Impact of Female Labor Supply on Earnings

VII. Conclusion

- Investigating the effects of increased female LF participation on the structure of wages requires a source of variation in female employment that is *orthogonal to the demand for both female and male labour*
- Differential extent of mobilisation for WWII across U.S. states provides a useful source of variation to identify the effects of women's labor force participation on a range of labor market outcomes
- In 1950 women participated more in states in which a larger fraction of working-age men served in the military during the mid-1940s
    - Such difference in female LS does not seem to be accounted for by other cross-state differences or possible demand factors and is not present in the pre-1940 or post-1950 data
    - $\rightarrow$ interpret shift in female labour supply induced by the mobilisation for the war
- Using this source of variation, we estimate the effect of greater female participation on female and male wages, returns to education, and wage inequality among men
- IV/TSLS Results:

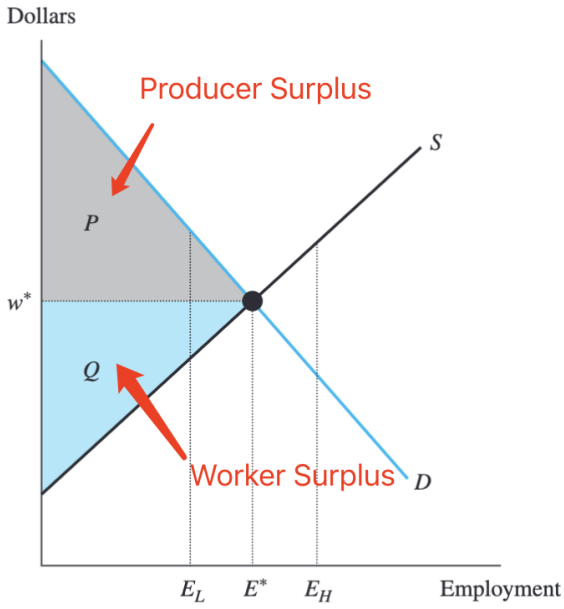
- Contrary to the OLS estimates (Simultaneity bias)
- Female LD curve is downward sloping with an elasticity of -1.0 ~ -1.5
- *Men and women are close but far from perfect substitutes*
- *Women were not the closest substitutes for the lowest-education men, but for high school graduate men*

Week 4: Labour Market Equilibrium

Textbook Ch.4 Labour Market Equilibrium

4-1 Equilibrium in a Single Labor Market

FIGURE 4-1 **Equilibrium in a Competitive Labor Market**
The labor market is in equilibrium when supply equals demand; E^* workers are employed at a wage of w^*. The triangle P gives the producer surplus; the triangle Q gives the worker surplus. A competitive market maximizes the gains from trade, or the sum $P + Q$.



- The market set competitive wage w^* and employment E^*
  - each firm hires up to the point $w^* = MP_L$
  - the sum of the number of all workers hired $= E*$
- There is no unemployment in a competitive labor market.
  - At the market wage w^*, the number of persons who want to work equals the number of workers firms want to hire. Persons who are not working are also not looking for work at the going wage.

Efficiency

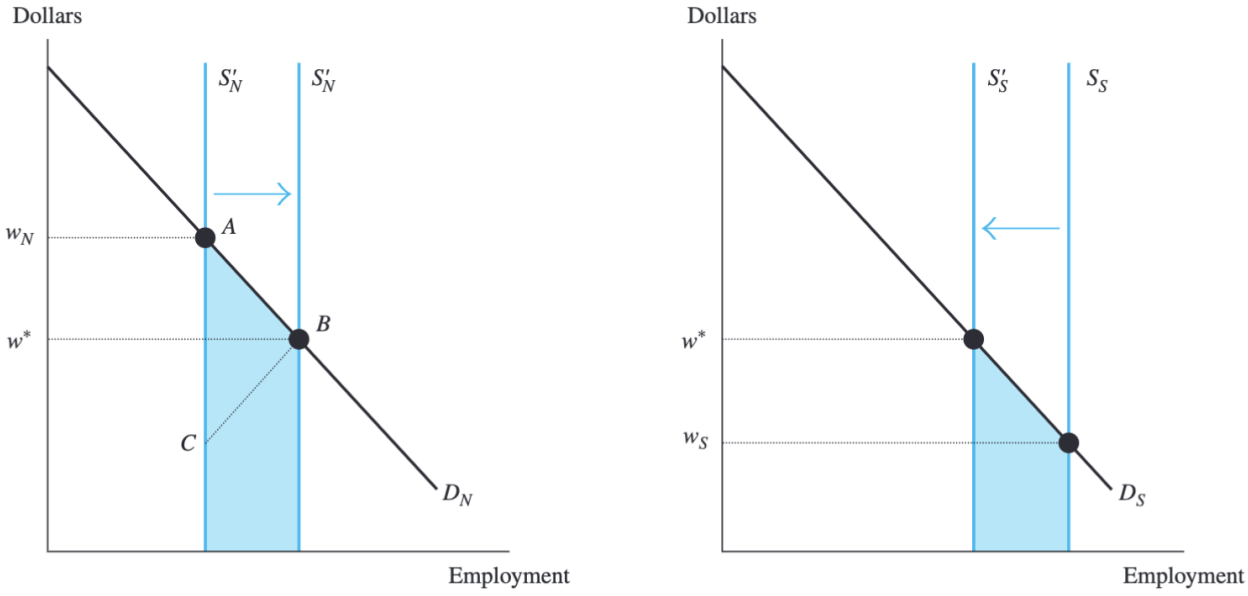
- Producer Surplus: LD is the VMP curve of labour → area under the LD is the value of total product, and each worker receives w^* → profit accruing to firms / producer surplus is the area P

- Worker Surplus: Height of LS measures the reservation wage of workers, and they all receive w^* in equilibrium $\rightarrow$ worker surplus is the are Q
- *Gains from Trade = Producer Surplus + Consumer Surplus = P+Q*
- *Competitive marker maximises the total gains from trade accruing to the economy*
- Efficient Allocation: an allocation of persons to firms that maximises the total gains from trade in the labour market
  - A competitive equilibrium generates an efficient allocation of labour resources

4-2 Equilibrium across Labor Markets

- Single Wage Property: *As long as either workers or firms are free to enter and exit labor markets, therefore, a competitive economy will be characterised by a single equilibrium wage*
- Example of adjustment by migration (LS adjustment)

FIGURE 4-2 Competitive Equilibrium in Two Labor Markets Linked by Migration
The wage in the northern region (w_N) exceeds the wage in the southern region (w_S). Southern workers want to move north, shifting the southern supply curve to the left and the northern supply curve to the right. In the end, wages are equated across regions (at w^*). The migration reduces the value of output in the South by the size of the shaded trapezoid in the southern labor market and increases the value in the North by the size of the larger shaded trapezoid in the northern labor market. Migration increases the value of aggregate output by the triangle *ABC*.



(*a*) The Northern Labor Market (*b*) The Southern Labor Market

- Could also be done by the movement of firms (LD adjustment)

Efficiency Revisited

- The single wage property implies an efficient allocation of labor resources across markets
- Because this implies $VMP_L = w^*$ are equalised across markets
- In reality:
  - Many studies suggest that regional wage differences in the United States (as well as in other countries) indeed narrow over time

- Evidence of *wage convergence*: negative correlation between the rate of wage growth and initial wages

Wage Convergence across Countries

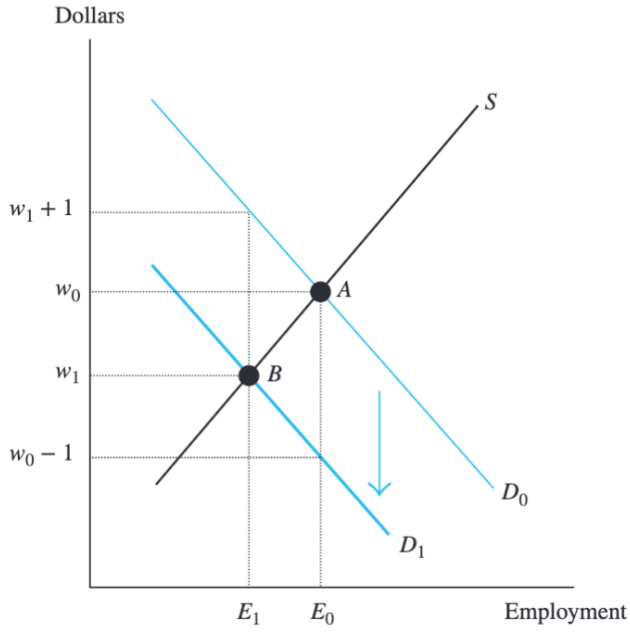
- NAFTA likely created distinct groups of winners and losers in the American and Mexican economies
- Although increased trade inevitably affects the distribution of income within and across countries, our analysis of labor market efficiency implies that the total income of the countries is maximised when economic opportunities are equalised.

4-3 Policy Application: Payroll Taxes and Subsidies

- Always consider *effective costs/wages* when considering payroll taxes

Tax on Firms

FIGURE 4-4 A Payroll Tax Imposed on Firms
A payroll tax of $1 imposed on employers shifts down the demand curve (from D_0 to D_1). The tax cuts the wage that workers receive from w_0 to w_1 and increases the cost of hiring a worker from w_0 to $w_1 + 1$.

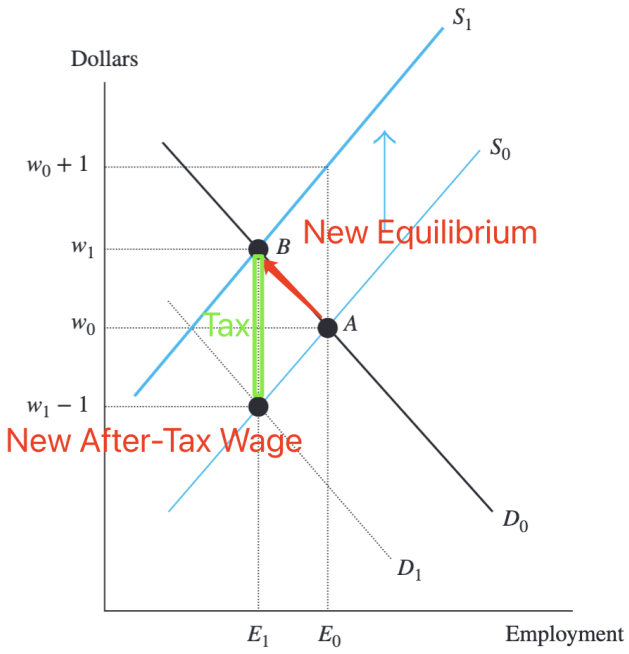


- Tax: *$1 per employee-hour, paid by firms*
- Effects:
  - LD shift down by $1
    - employers take into account the total cost of hiring labor when they make their hiring decisions (1 + wage)
  - The payroll tax moves the labor market to a new equilibrium (point B in the figure).
    - The number of workers hired declines to E_1. The equilibrium wage rate—the wage rate actually received by workers—falls to w_1, but the total cost of hiring a worker rises to $w_1 + 1$
  - *(Incidence/burden of) Tax is shared by employers and employees*

Tax on Workers

- *In a competitive labour market, it does not matter whether the tax is imposed on workers or firms (effective costs for firms / effective wages for workers will be the same in two situations).*
  - The impact of the payroll tax on wages and employment is the same regardless of who bears the legal burden of paying the tax

FIGURE 4-5 A Payroll Tax Imposed on Workers
A payroll tax imposed on workers shifts the supply curve to the left (from S_0 to S_1). The payroll tax has the same impact on the equilibrium wage and employment regardless of who it is imposed on.



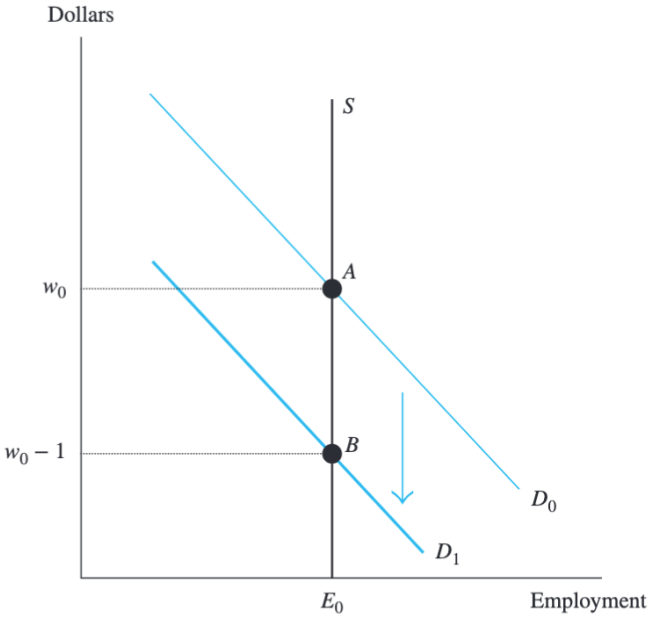
- Tax: *$1 per hour, paid by workers*
- Effects:
  - LS shifts up by $1
  - The labor market equilibrium then shifts from A to B.
  - At the new equilibrium, workers receive a wage of w_1 dollars from the employer, and total employment falls to E_1
  - Because the worker must pay a $1 tax per hour worked, the actual after-tax wage falls from w_0 to $w_1 - 1$ (same as the previous situation)
- A payroll tax imposed on workers, therefore, leads to the *same changes in labor market outcomes* as the payroll tax imposed on firms.
  - Both taxes reduce the take-home pay of workers; both increase the cost of an hour of labor to the firm; and both reduce employment

When Will the Payroll Tax Be Shifted Completely to Workers?

- If *LS is perfectly inelastic*, then tax will be *completely shifted to workers*
  - Mirror case: if LD is perfectly inelastic, then tax will be completely shifted to firms

FIGURE 4-6 Inelastic Supply and a Payroll Tax Imposed on Firms

A payroll tax imposed on the firm is shifted completely to workers when the labor supply curve is perfectly inelastic. The wage is initially w_0. The \$1 payroll tax shifts the demand curve to D_1, and the wage falls to $w_0 - 1$.

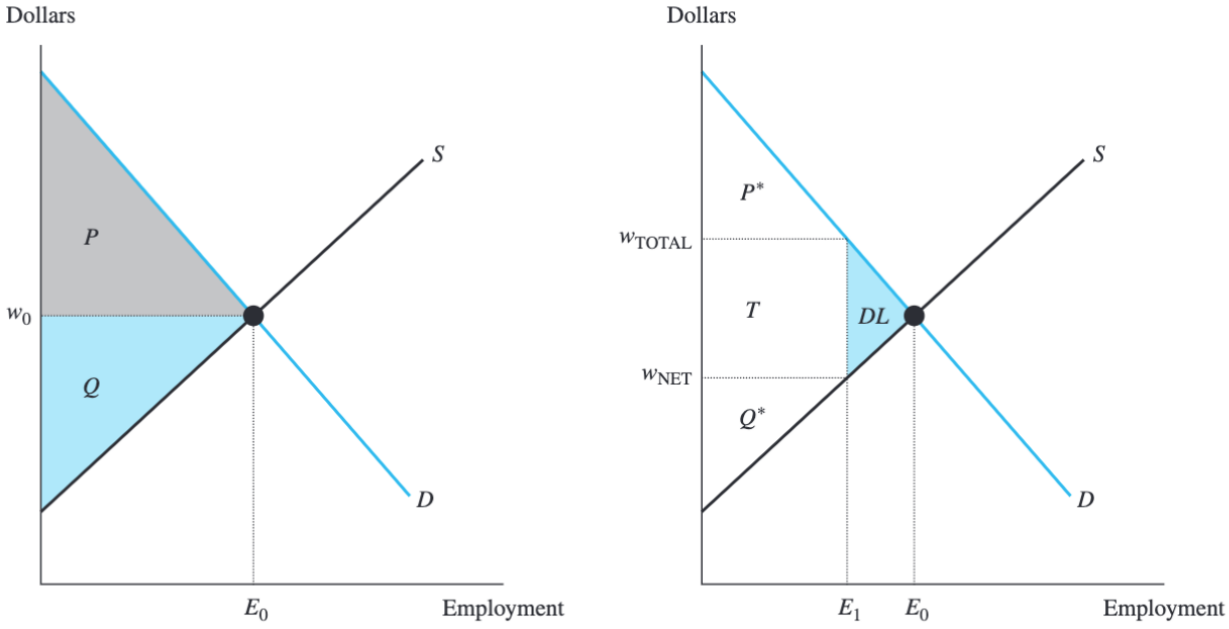


- *The more inelastic the LS, the greater the fraction of the payroll taxes that workers end up paying*
- Male LS is inelastic, and male workers pay around 90% of payroll taxes
- *谁更inelastic就要付更多tax，所以elastic好*

Deadweight Loss

FIGURE 4-7 Deadweight Loss of a Payroll Tax

(*a*) In a competitive equilibrium, E_0 workers are hired at a wage of w_0. The triangle P gives the producer surplus and Q gives the worker surplus. The total gains from trade equal $P + Q$. (*b*) The payroll tax reduces employment to E_1; raises the cost of hiring to w_{TOTAL}; and reduces the worker's take-home pay to w_{NET}. The triangle P^* gives the producer surplus; the triangle Q^* gives the worker surplus; and the rectangle T gives the tax revenues. The net loss to society, or deadweight loss, is given by the triangle DL.



(*a*) No-Tax Equilibrium (*b*) Payroll Tax Equilibrium

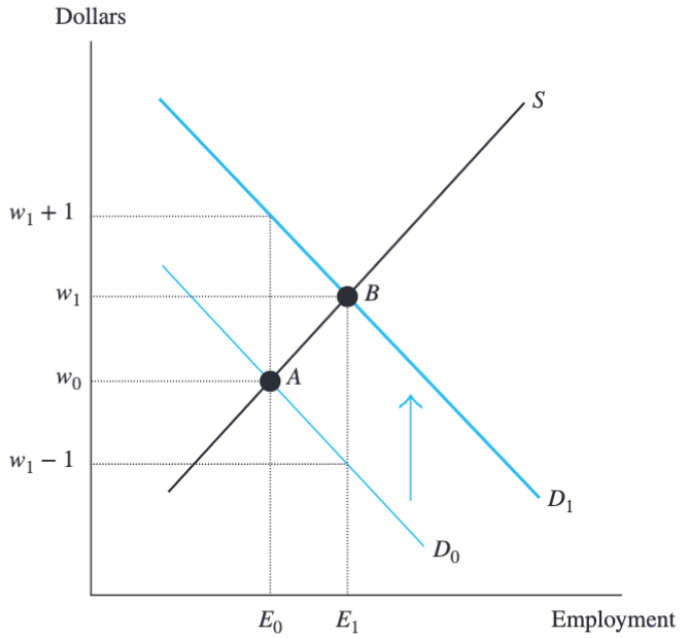
- After-tax equilibrium:

- P^*: producer surplus
- Q^*: consumer surplus
- T: tax revenue
- DL: deadweight loss

- Deadweight Loss / excess burden measures the value of gains forgone due to the tax

Employment Subsidies

FIGURE 4-8 **The Impact of an Employment Subsidy**
An employment subsidy of \$1 per worker hired shifts the demand curve from D_0 to D_1, increasing employment. The wage that workers receive rises from w_0 to w_1. The cost of hiring falls from w_0 to $w_1 - 1$.



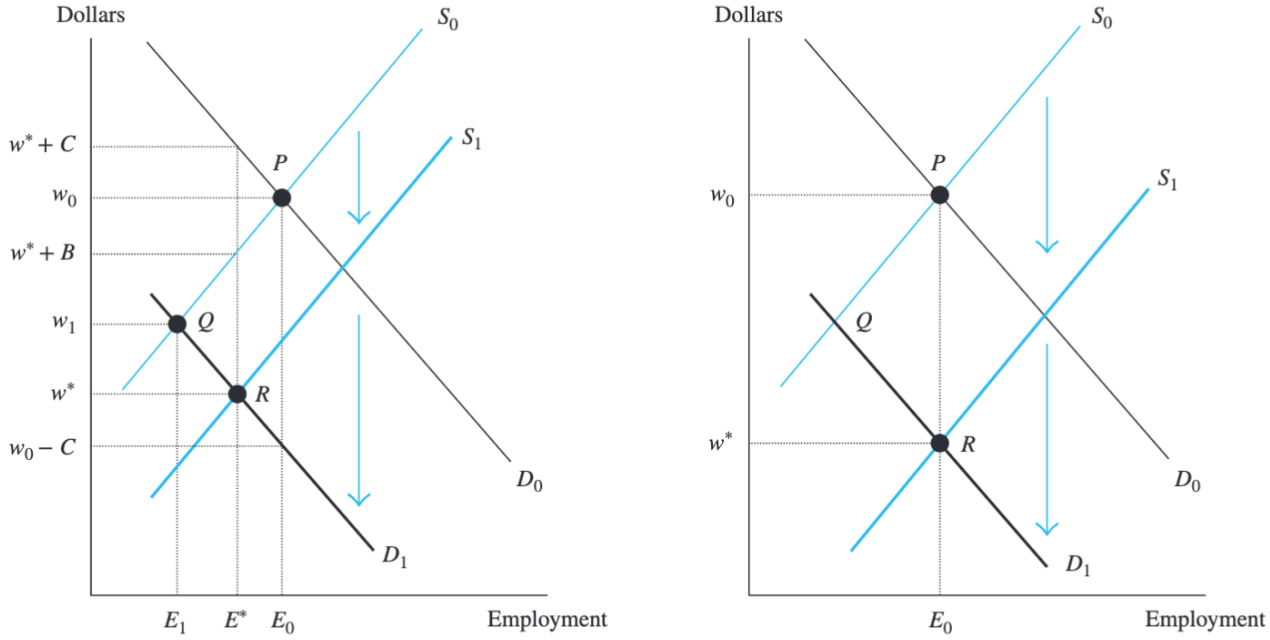
- Same as a negative payroll tax
- Effects are the same regardless subsidising firms or workers

4-4 Policy Application: Mandated Benefits

- Mandated Benefits: the government mandates that firms need to provide certain benefits to workers

FIGURE 4-9 The Impact of a Mandated Benefit

(*a*) It costs firms C dollars to provide a mandated benefit, shifting the demand curve from D_0 to D_1. Workers value the benefit only by B dollars, so the supply curve shifts down by less. Employment at the new equilibrium (point R) is higher than would have been the case if the firm had been assessed a payroll tax of C dollars (point Q), but lower than in a no-tax equilibrium (point P). (*b*) When the cost of providing the mandate equals the worker's valuation, the resulting equilibrium replicates the competitive no-tax equilibrium in terms of employment, total cost of hiring workers, and total compensation received by workers.



(*a*) Cost of Mandate Exceeds Worker's Valuation

(*b*) Cost of Mandate Equals Worker's Valuation

- Mandated Benefit: cost the firm $C per worker
- Scenario 1: Workers attach *no value* to the benefit
  - $P \rightarrow Q$
  - this is the same as a payroll tax of $C on the firm (LD shift down by $C)
- Scenario 2: Workers *attach a lower value $B* to the benefit
  - $P \rightarrow R$
  - LD shifts down by $C, LS shifts down by $B
  - Decrease in employment will be smaller
- Scenario 3: Workers *attach the same value as the cost $C*
  - $P \rightarrow R$ in 4-9(b)
  - LD, LS shift down by $C
  - No change in employment
  - No deadweight loss
- *As long as the mandated benefit provides some value to workers, the mandated benefit is preferable to a payroll tax because it leads to a smaller cut in employment*

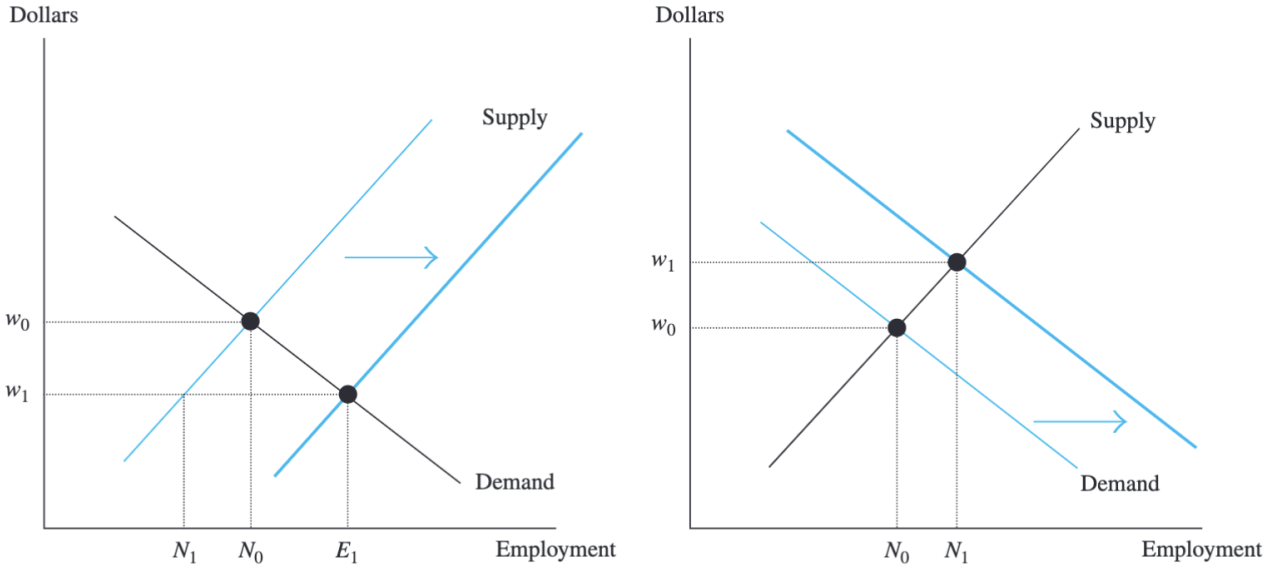
Obamacare and the Labor Market

- SKIPPED

4-5 The Labor Market Impact of Immigration

SR Impact of Immigration

FIGURE 4-10 The Short-Run Impact of Immigration
(*a*) *Perfect substitutes.* The two groups compete in the same labor market. Immigration shifts the supply curve to the right. The wage falls from w_0 to w_1 and total employment increases from N_0 to E_1. The number of natives who work at the lower wage drops from N_0 to N_1. (*b*) *Complements.* The two groups do not compete in the same labor market. Immigration makes natives more productive, shifting up the demand curve even though capital is fixed. Both the native wage and native employment increase.



- (*a*) Perfect Substitutes (*b*) Complements

- If immigrants and natives are *perfect substitutes*
  - Immigration → LS shifts up → wage decreases and employment increases, but the employment of natives decreases from $N_0 \rightarrow N_1$ (4-10.(a))
- If migrants and natives are *complements*
  - Immigration → $VMP_{natives}$ increases → LD shifts up → both wages and employment increase

SKIPPED

4-6 The Immigration Surplus

- SKIPPED

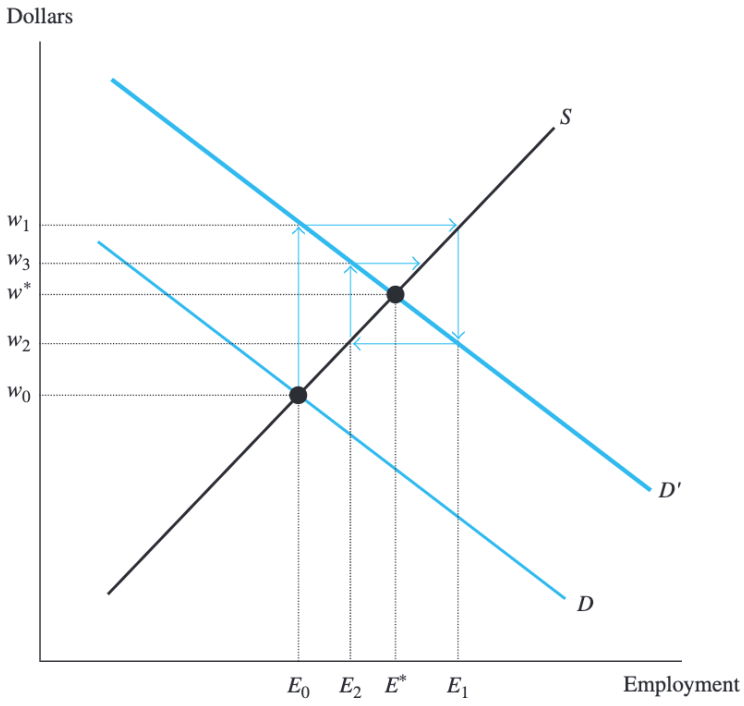
4-7 Policy Application: High-Skill Immigration

- SKIPPED

4-8 The Cobweb Model

- 2 Assumptions:
  - Takes time to produce new labour supply
  - People decide whether to specialise in this industry according to current conditions in that industry
    - Inherent uncertainty (hard to forecast) forces decision makers to place too heavy a weight on the wages they currently observe, helping generate cobwebs

FIGURE 4-19 The Cobweb Model in the Market for New Engineers
The initial equilibrium wage is w_0. The demand for engineers shifts to D', and the wage will eventually increase to w^*. Because new engineers are not produced instantaneously and because students might misforecast future opportunities, a cobweb is created as the labor market adjusts to the increase in demand.



- Fluctuate between periods of excess supply and demand
- The cobweb model creates a cobweb around the equilibrium point as the engineering labor market adjusts to the initial demand shock. The entry wage exhibits a systematic pattern of booms and busts as the market slowly drifts toward its long-run equilibrium wage w^* and employment E^*

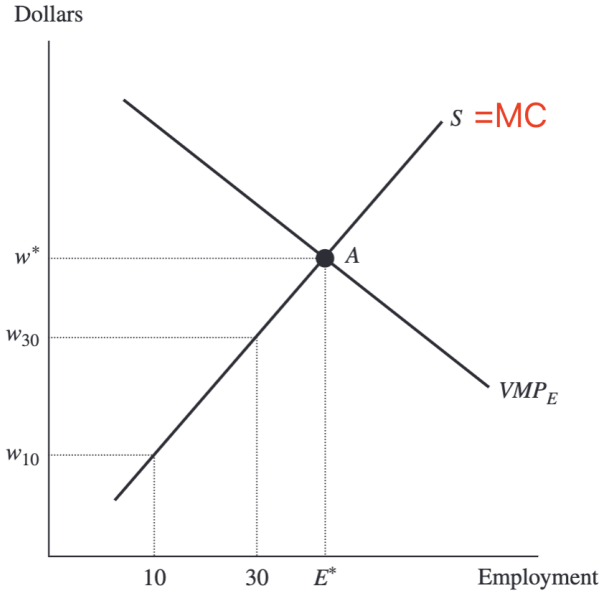
4-9 Monopsony

Introduction

- A monopsony is a firm that faces an upward-sloping LS curve.
  - a monopsonist must pay higher wages in order to attract more worker

Perfectly Discriminating Monopsonist

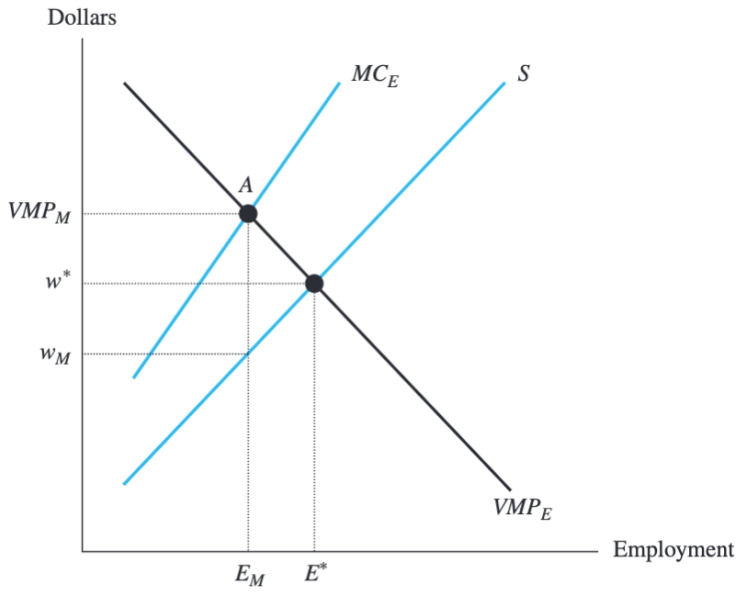
FIGURE 4-20 The Hiring Decision of a Perfectly Discriminating Monopsonist
A perfectly discriminating monopsonist faces an upward-sloping supply curve and can hire different workers at different wages. The labor supply curve gives the marginal cost of hiring. Profit maximization occurs at point *A*. The monopsonist hires the same number of workers as a competitive market, but each worker gets paid his reservation wage.



- A perfectly discriminating monopsonist has market power, and can *pay different wages to different workers*
  - *The LS curve is the same as the marginal cost curve for labour*
  - LS still equals to VMP_E
- Equilibrium:
  - Still $VMP_E = MC_E$
  - EmploymentL E^* is the same as perfectly competitive labour market
  - Wage: w^*, however, is *not the competitive wage*.
    - It is instead the wage that the monopsonist must pay to attract the last worker hired. *All other workers receive lower wages*, with each worker receiving her reservation wage.
  - Same equilibrium point as the competitive situation, but all surplus are allocated to the firm

Nondiscriminating Monopsonist

FIGURE 4-21 The Hiring Decision of a Nondiscriminating Monopsonist
A nondiscriminating monopsonist pays the same wage to all workers. The marginal cost of hiring exceeds the wage, and the marginal cost curve lies above the supply curve. Profit maximization occurs at point A; the monopsonist hires E_M workers and pays them a wage of w_M.



- A non-discriminating monopsonist has market power, but must *pay all workers the same wage*, regardless of the worker's reservation wage
  - Marginal cost of labour curve (MC_E) is upward sloping, rises even faster than the wage, and lies above the supply curve
- Equilibrium
  - *Caveat: First decide on employment ($VMP_E = MC_E \implies$ intersection of MC/LD), then pay wages according to the LS curve (w_M)*
  - *Employs fewer workers* than in a perfectly competitive labour market.
  - *Monopsony wage w_M is less than the competitive wage w^* and also less than the VMP_M*
    - $w_M < w^*, w_M < VMP_M$

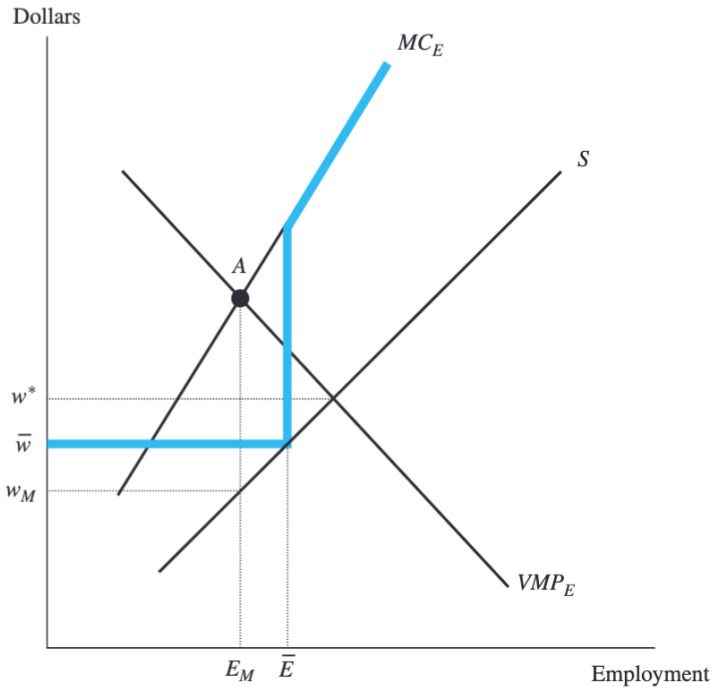
Some Math about Monopsony

- Suppose labour E is the only input of production $q(E)$
- For monopsonists, wage is an increasing function of employment $w(E)$
- Profit: $p \cdot q(E) - w(E) \cdot E$
- Maximisation:

$$VMP_E = p \times \underbrace{q'(E)}_{MP_E} = \underbrace{w'(E) \times E + w(E)}_{MC_E}$$

Monopsony and the Minimum Wage

FIGURE 4-22 The Minimum Wage in a Nondiscriminating Monopsony
The minimum wage may increase both wages and employment when imposed on a monopsonist. A minimum wage set at $\overline{w}$ increases employment to $\overline{E}$.



- The imposition of a minimum wage in a nondiscriminating monopsony can *increase both wages and employment*
- Initial equilibrium: point A
- Minimum wage: $\bar{w}$
- Effects:
  - New kinked MC curve (blue)
  - Wage increases: $w_M \rightarrow \bar{w}$
  - Employment increases: $E_M \rightarrow \bar{E}$
  - No unemployment: everyone who is looking for a job at the minimum wage $\bar{w}$ can find one
- Optimal minimum wage: w^*
  - This completely eliminates the power of monopsonists and retrieve the perfectly competitive welfare
- This may explain the positive employment effect of MW on fast-food industry
  - fast-food industry can be viewed as a monopsony in terms of employing low-skilled teenage labor.

Do Many Firms Have Upward-Sloping Labor Supply Curves?

- *Many firms in seemingly competitive markets could have some degree of monopsony power*
- Individual firms might have some monopsony power (upward sloping LS curve) even when there are many firms competing for the same type of labor.
  - *Cost of switching jobs*
    - $\rightarrow$ imperfect mobility between jobs

- *Harder to monitor workers as a firm expands*
  - $\rightarrow$ pay higher wages as expanding to prevent shirking
- *Workers value specific amenities provided by particular firms*

Week 5: Human Capital and Education

Textbook Ch.6 Education

6-1 Education in the Labor Market: Some Stylized Facts

- NN

6-2 Present Value

- The Present Value of a payment of y dollars received t years from now:

$$PV = \frac{y}{(1+r)^t}$$

  where r is the *interest rate* or the *discount rate*
  - discount rate depends on the 1. market interest rate 2. time preference

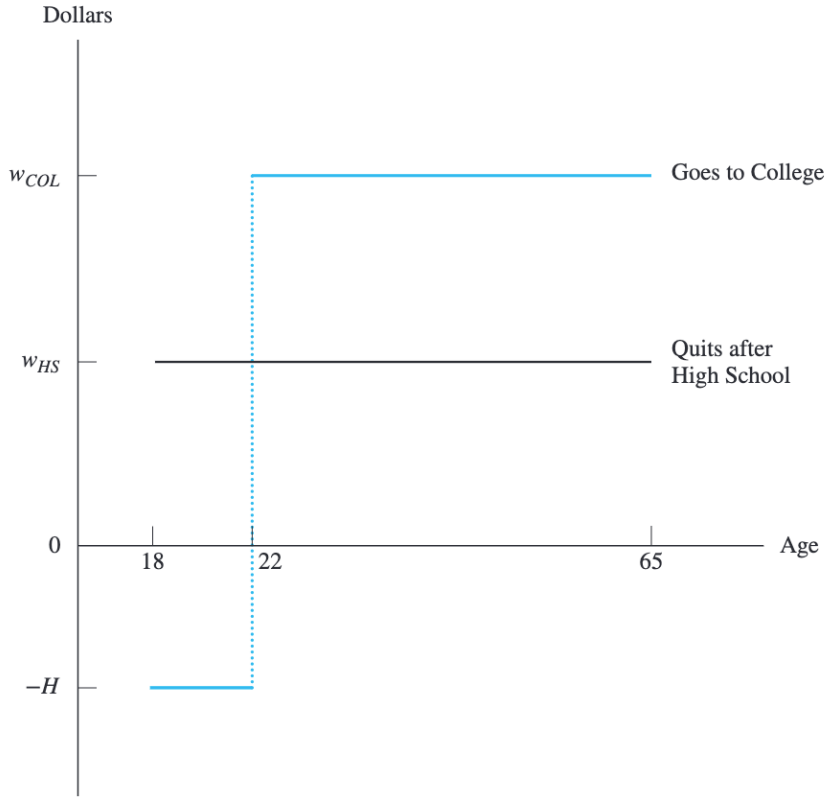
6-3 The Schooling Model

Age-Earning Profile

- Assume that students acquire the education level that maximises the present value of lifetime earnings.

- Age-earning profile

FIGURE 6-1 Potential Earnings Streams Faced by a High School Graduate
A student who quits school after getting his high school diploma can earn w_{HS} from age 18 until retirement. If he goes to college, he forgoes these earnings and incurs a cost of H dollars for 4 years and then earns w_{COL} until retirement.



  - H is the cost of tuition
  - A college education forces the student to forgo some earnings. This is the opportunity cost of going to school.

Present Value of Age–Earnings Profiles

- A student's schooling choice maximises the present value of lifetime earnings. He attends college if the *PV attending college > the PV of just finishing high school*:

$$PV_{COL} > PV_{HS}$$

where:

- $PV_{HS} = \underbrace{w_{HS} + \frac{w_{HS}}{(1+r)} + \frac{w_{HS}}{(1+r)^2} + \frac{w_{HS}}{(1+r)^3}}_{\text{Opportunity Cost for College}} + \frac{w_{HS}}{(1+r)^4} + \dots$
- $PV_{COL} = \underbrace{-H - \frac{H}{(1+r)} - \frac{H}{(1+r)^2} - \frac{H}{(1+r)^3}}_{\text{Direct Cost}} + \frac{w_{COL}}{(1+r)^4} + \dots$

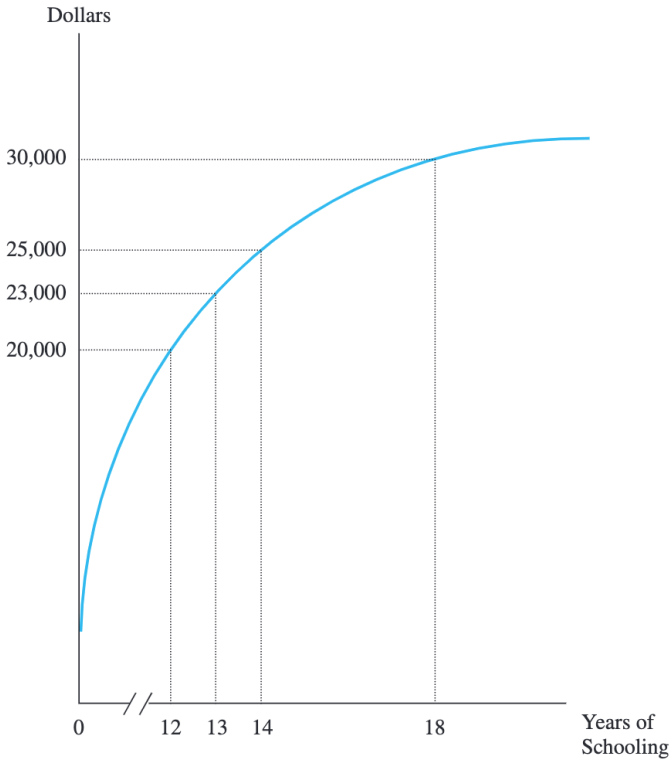
- Rate of discount r plays a key role in determining whether a student goes to school or not ($r \uparrow \implies$ Less likely to attend college)
  - Discount rare depends on the market interest rate and the individual's time preference

The Wage–Schooling Locus

- More than 2 education options

- wage–schooling locus gives the salary that employers are willing to pay for every level of schooling

FIGURE 6-2 The Wage–Schooling Locus
The wage–schooling locus gives the salary that a particular worker would earn if he has a particular level of schooling. If the worker is a high school graduate, he earns $20,000 annually. If he has 1 year of college, he earns $23,000.



  - Wages are determined by the LS/LD of workers with particular education levels, but they are constant from the perspective of workers
  - Important properties:
    - Upward sloping
    - Slope is the additional earnings from an extra year of schooling
    - Concave (diminishing marginal return ($MRR \downarrow$))

The Marginal Rate of Return to School

- (Marginal) Rate of return to school (MRR) is the percentage change in earnings from 1 more year of schooling:

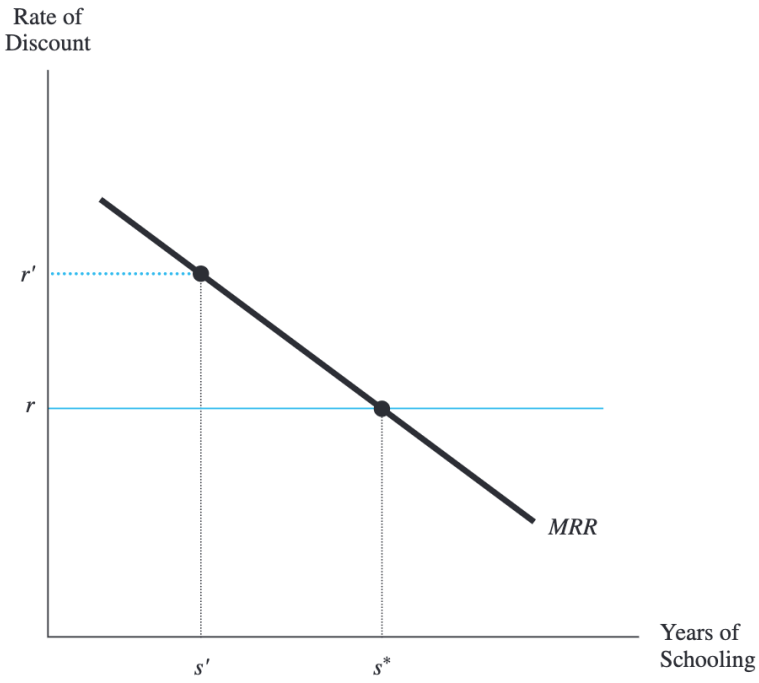
$$MRR = \frac{\Delta w}{w}$$

- It must decline as schooling $\uparrow$ because the wage-school locus is concave

The Schooling Decision

FIGURE 6-3 The Schooling Decision

The *MRR* schedule gives the marginal rate of return to school, or the percentage increase in earnings resulting from an additional year of school. A student maximizes the present value of lifetime earnings by equating the marginal rate of return with the rate of discount. A worker with discount rate r goes to school for s^* years.



- Schooling Decision: *PV of earnings is maximised when*:

$$MRR = r$$

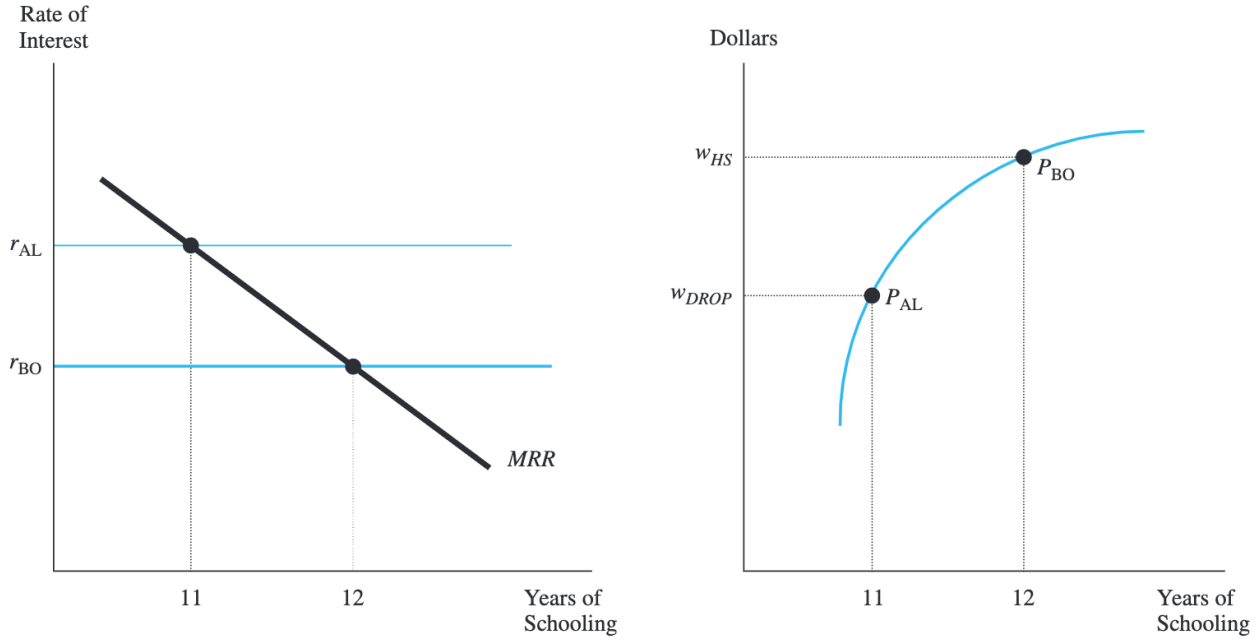
i.e. *marginal rate of return to school = discount rate*

6-4 Education and Earnings

- 2 factors that lead to education and wage differentials in our model:
  - *Rate of discount* (r): ←different *time preferences*
    - *Discount rate* $r \uparrow$, *Year of schooling* $\downarrow$, $w \downarrow$
  - *MRR* curves (Different education-wage locus): ← different *ability*
    - *Ability*↑, *MRR curve*↑, *Year of Schooling*↑, $w \uparrow$

Differences in the Rate of Discount

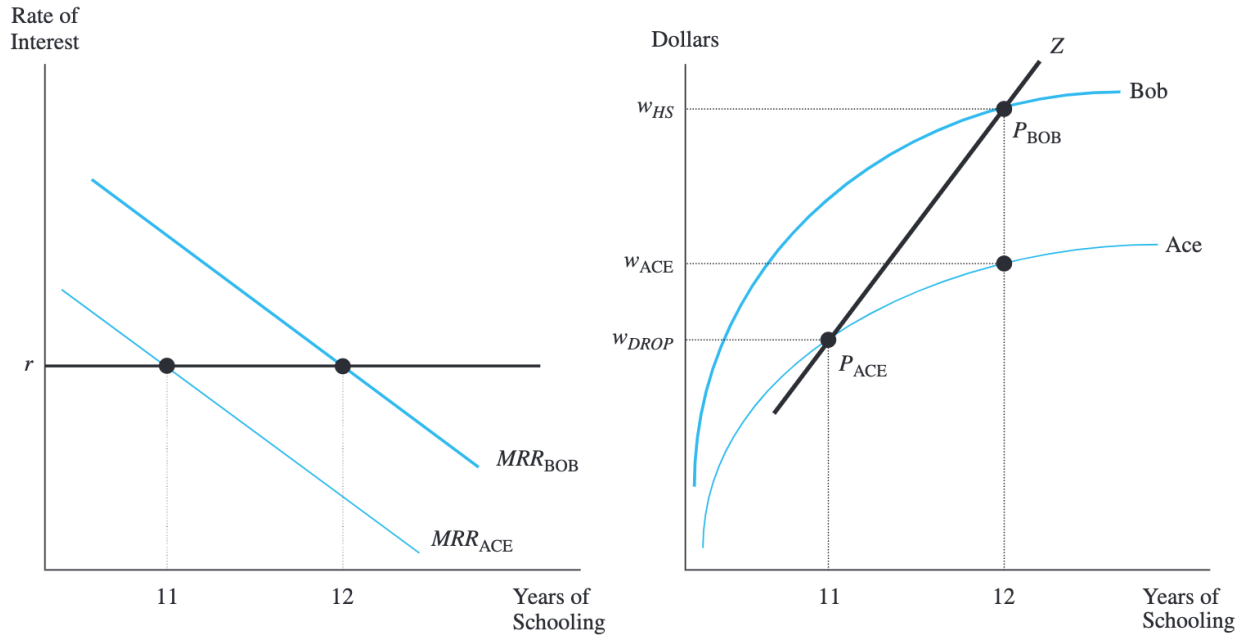
FIGURE 6-4 Schooling and Earnings When Workers Have Different Rates of Discount
Al has a higher rate of discount (r_{AL}) than Bo (r_{BO}), so that Bo graduates from high school but Al drops out. Al chooses point P_{AL} on the wage–schooling locus and Bo chooses point P_{BO}. The observed data on wages and schooling trace out the common wage–schooling locus of the workers.



- *Discount rate r ↑, Year of schooling ↓, w ↓*

Differences in Ability

FIGURE 6-5 Schooling and Earnings When Workers Have Different Ability
Ace and Bob have the same discount rate *r*, but the workers face a different wage–schooling locus. Ace drops out of high school and Bob gets a high school diploma. The wage differential between Bob and Ace (or $w_{HS} - w_{DROP}$) arises both because Bob goes to school for one more year and because Bob is more able. This wage differential does not tell us by how much Ace's earnings would rise if he were to complete high school (or $w_{ACE} - w_{DROP}$).



- A higher level of ability (B has higher ability than A in the graph above)
  - Shifts up the education-wage locus
  - Assumed to shift MRR to the right
    - 2 effects in opposite directions: higher opportunity cost, and higher gain from education

        - Assume earnings gain from an additional year of schooling outweighs the higher opportunity cost
- In summary, *Ability*↑, *MRR curve*↑, *Year of Schooling*↑, w ↑
- Thus, observed education-earning data cannot be used directly to estimate the education-earning locus or the MRR

Ability Bias

- Ability Bias: (shown by line Z in graph 6-5) Since *education is endogenous* (both education and wage are correlated with ability / people *self-select* into educational groups), we cannot simply compare observed difference in wages of different educational groups

6-5 Estimating the Rate of Return to School

- We would like to include ability in our regression, but it is typically not observed:

$$\log w_i = bs_i + \alpha A_i + controls$$

    - where
        - s_i: years of education
        - A_i: ability

Twin Studies

- *Twins* tend to have the same ability, so we can run a regression based on difference between twins:

$$\Delta \log w_j = b\Delta s_j + controls$$

- But twins may also have different abilities

Instrumental Variables

- *IVs* are typically from schooling legislation
    - e.g. quarter of birth
        - People born after Sept (last quarter). get less education in U.S. because the entrance date is fixed, whiled dropout is determined by age
    - 1968 riot in France caused higher college entrance

6-6 Policy Application: School Construction in Indonesia

- NN

6-7 Policy Application: The Education Production Function

- Education Production Function:

$$Y = f(x_1, x_2, x_3, \ldots)$$

  where Y is some measure of student achievement, and x's represent the inputs of production
- Prior to the 1990s, the consensus was that high levels of school expenditures had little impact on student outcomes
- A recent research suggests that expenditures in school system today might indeed improve the outcomes of students later in life
- Much of the other recent research exploit natural experiments
  - e.g. Maimonides' rule in Israeli school system
- and RCTs
  - e.g. STAR experiment

6-8 Do Workers Maximize Lifetime Earnings?

- Directly comparing the difference in wages of high school- / college- graduates is only valid when they have the same wage-schooling locus (i.e. same ability)
- Otherwise, comparing the observed difference is subject to selection bias -- workers self-select themselves into jobs for which they are best suited

6-9 Signaling

- Alternative hypothesis: education does not increase human capital, but signal a worker's innate ability to potential employers
- This is only valid when there's asymmetric information in the labour market -- one of the parties in the transaction knows more about the terms of the contract

Pooling Equilibrium

Type of Worker	Proportion of Population	Present Value of Lifetime Productivity
Low-productivity	q	\$200,000
High-productivity	$1 - q$	300,000

- Pooling Equilibrium: the employer simply pools all job applicants and treat them identically. The average salary of workers hired by the firm is:

$$200000 \times q + 300000 \times (1 - q)$$

  - Low-productivity workers like this equilibrium because it pushes up their wages
  - High-productivity workers dislike this equilibrium because their earnings are dragged down
  - Employers dislike this equilibrium because job mismatch harms efficiency and profits

- Because of these, high-productivity workers and employers have incentives to use a signal to determine the type of workers.
  - If the signalling is perfectly precise, there will be no mismatch

Separating Equilibrium

- The firm classifies a worker as high-productivity if he/she has more than $\bar{y}$ years of college
- Low-productivity workers have a higher costs of obtaining $\bar{y}$ years of college
  - *The assumption that low-productivity workers find it costlier to obtain the signal is the fundamental assumption of the signalling model*
- Separating Equilibrium occurs when low-productivity workers choose not to get $\bar{y}$ years of college education and voluntarily signal their low productivity, while high-productivity workers choose to get at least $\bar{y}$ years of eduction and separate themselves from the crowd.
  - A separating equilibrium *requires that low-productivity workers do not go to college at all*. This will occur whenever the *net return from getting zero years of college* $>$ *the net return from getting* $\bar{y}$ *years*
  - also requires that *high-productivity workers do get* $\bar{y}$ *years of college*. This will occur whenever the *net return from getting zero years of college* $<$ *the net return from getting* $\bar{y}$ *years*
  - Condition:

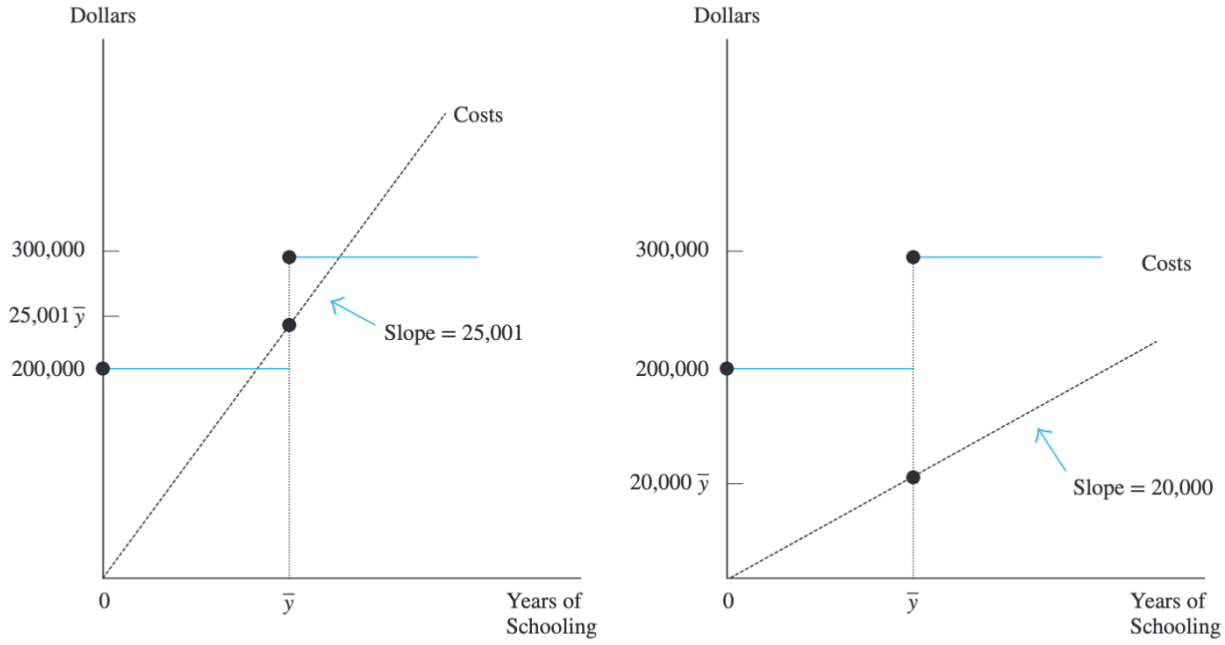
$$\begin{cases} w_{low} > w_{high} - \bar{y} \times \text{per year cost for low ability} \\ w_{low} < w_{high} - \bar{y} \times \text{per year cost for high ability} \end{cases}$$
$$\implies w_{high} - \bar{y} \times \text{per year cost for low ability} < w_{low} < w_{high} - \bar{y} \times \text{per year cost for high abili}$$

  - In our example:

$$\begin{cases} 200000 > 300000 - 25001 \times \bar{y} \\ 200000 < 300000 - 20000 \times \bar{y} \end{cases} \implies 3.999 < \bar{y} < 5$$

  choosing any $\bar{y}$ in this interval generates separating equilibrium, and the competitive solution is to use the lower bound

FIGURE 6-7 A Separating Equilibrium
Workers get paid \$200,000 if they get less than $\bar{y}$ years of college and \$300,000 if they get at least $\bar{y}$ years. Low-productivity workers find it expensive to invest in college and will not get $\bar{y}$ years. High-productivity workers do get $\bar{y}$ years. The worker's education signals if he is a low-productivity or a high-productivity worker.



(*a*) Low-Productivity Workers (*b*) High-Productivity Workers

- note that the costs are total costs in the above diagram
- In summary, the signalling model shows that education can play the role of signalling the worker's innate ability without increasing the worker's productivity

Private and Social Rates of Return

- Education may both increase productivity and have a signalling value
- $\Longrightarrow$ The private rate of return to school, as measured by the increase in a worker's earnings resulting from an additional year of schooling, may differ substantially from the social rate of return to school, as measured by the increase in national income resulting from that same year of education
  - But even if education only functions as a signal, it sill improves skill matching $\Longrightarrow$ higher national income

Reading: Angrist & Krueger 1991 QJE - DOES COMPULSORY SCHOOL ATTENDANCE AFFECT SCHOOLING AND EARNINGS?

- Children born earlier in a year have less years of education compared with children born later in a year $\rightarrow$ exogenous variations in education
- TSLS: Quarter of birth $\rightarrow$ education $\rightarrow$ outcome
- The estimated monetary return to an additional year of schooling for those who are compelled to attend school by compulsory schooling laws is about 7.5 percent, which is hardly different from (very similar to) the ordinary-least-squares (OLS) estimate of the return to education for all male workers.
  - Signalling model may not be valid -- no/small bias in OLS

- Run a placebo test of quarter of birth on outcomes of college graduates, confirming that quarter of birth has no direct effect on outcomes

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Week 6: Wage Distribution I

- We only consider wage inequality, which is not the same as wealth inequality

Textbook Chapter 7

7-1 Postschool Human Capital Investments

- Facts:
  - Highly educated workers earn more than less-educated workers
  - Earnings rise over time, but at a decreasing rate
  - The age–earnings profiles of different education groups diverge over time

7-2 On-the-Job Training

Introduction

- General Training: enhances productivity equally in all firms
- Specific Training: enhances productivity only if the worker stays in that firm
- Multiperiod Marginal Productivity Condition: 2 periods

$$C_1 + \frac{C_2}{1+r} = VMP_1 + \frac{VMP_2}{1+r}$$

  - With OJT in the first period (costs H):

$$H + w_1 + \frac{w_2}{1+r} = VMP_1 + \frac{VMP_2}{1+r}$$

Who Pays for General Training?

- After training (period 2), $w_2 = VMP_2$, so we can simplify the above equation as:

$$w_1 = VMP_1 - H$$

  - i.e. workers get a lower "trainee wage" during the training period (*workers pay for the general training*)
  - competitive firms provide general training only if they do not pay any of the costs
- A firm that paid for general training and did not raise the post-training wage would get an oversupply of trainees and the trained workers would then quit

Who Pays for Specific Training?

- If the wage does not change after training, both the firm and the worker are reluctant to pay for specific trainings because there's no insurance that the worker will not quit / the firm will continue employ
- Solution: adjust w_2 to reduce the possibility of both quits and layoffs

$$w^* < w_2 < VMP_2$$

  - where w^* is the alternative wage
  - The returns to specific training is shared between the worker and the firm
- The cost of must be shared with the same proportion in equilibrium (so the worker still get less than VMP_1 wage during training):

$$VMP_1 - H < w_1 < VMP_1$$

  - *Cost/return are both shared*

Implications of Specific Training

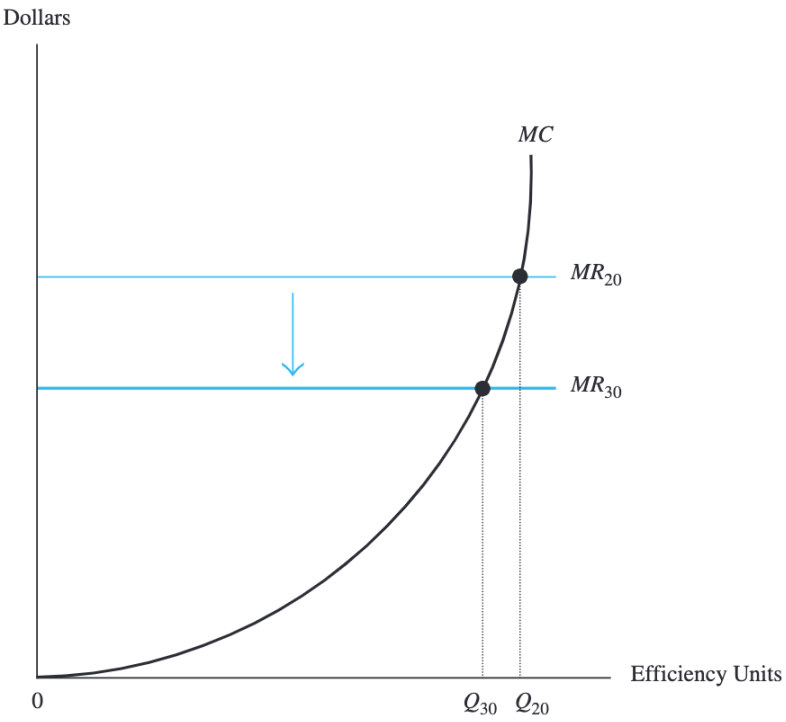
- Long term contract for workers with specific training
- Last hire, first fired
- Temporary layoffs: workers with specific trainings tend to be re-employed after begin laid off
- *Negative correlation between job turnover/separation and job seniority*

7-3 The Age-Earnings Profile

Intro

FIGURE 7-2 The Acquisition of Human Capital over the Life Cycle

The marginal revenue of an efficiency unit of human capital declines as the worker ages (so that MR_{20}, the marginal revenue of a unit acquired at age 20, lies above MR_{30}). At each age, the worker equates the marginal revenue with the marginal cost, so that more units are acquired when the worker is younger.

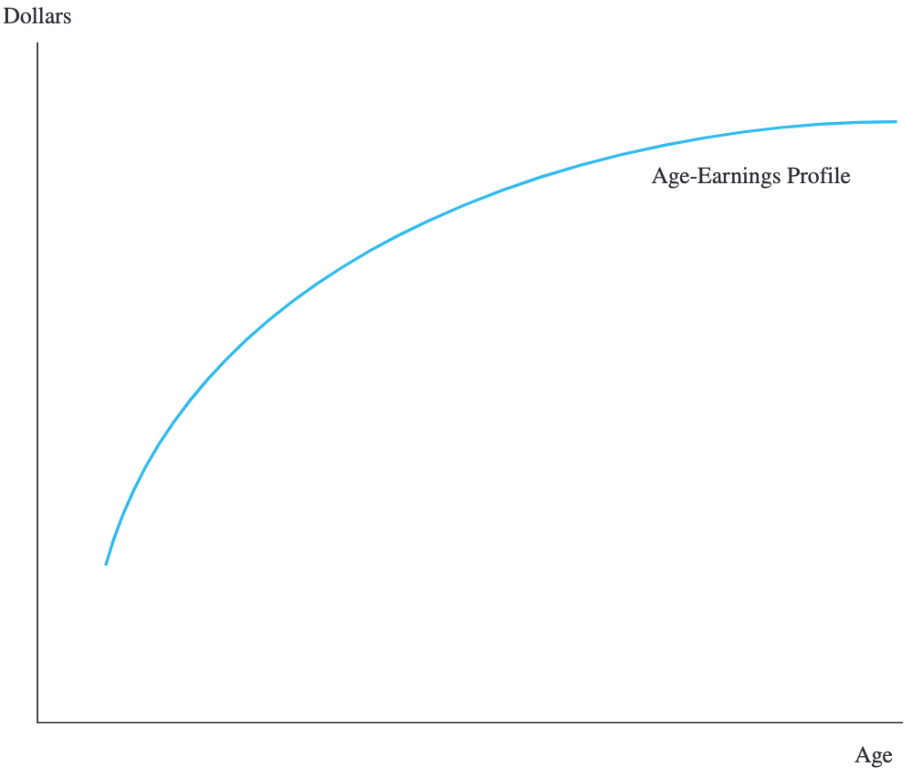


- Measure human capital by efficiency units
- MR of human capital (discounted return over the rest of working life) at year t until retire T:

$$MR_t = \sum_{k=0}^{T-t} \frac{R}{(1+r)^k}$$

- Therefore *$MR\downarrow$ as a worker ages*, so a *worker acquires fewer efficiency units as he gets older*

FIGURE 7-3 The Age–Earnings Profile Implied by Human Capital Theory
The age–earnings profile is upward-sloping and concave. Older workers earn more because they invest less in human capital and because they are collecting the returns from earlier investments. The rate of growth of earnings slows down over time because workers accumulate less human capital as they get older.



- age-earnings profile is concave -- earnings increase over time but at a decreasing rate

The Mincer Earnings Function

- Mincer Earnings Function:

$$\log w = as + bt - ct^2 + \text{Other Variables}$$

  - where
    - w is wage
    - s is years of schooling
    - t is the years of labour market experience

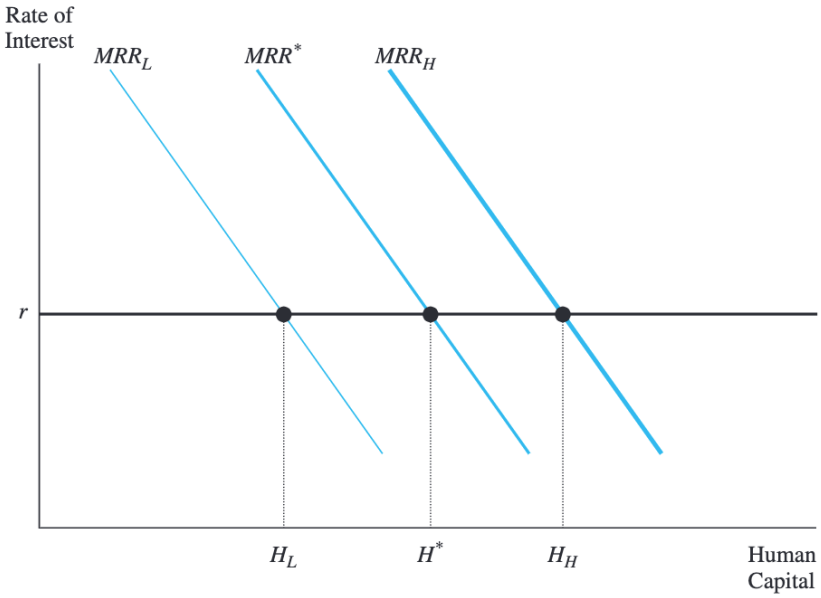
7-4 Policy Application: Training Programs

NN

7-5 Wage Inequality

- Positively skewed income distribution: long right tail and clustered on the left

FIGURE 7-5 **Ability Differences Create Positive Skewness**
Low-ability workers face the marginal rate of return curve MRR_L and acquire H_L units of human capital. High-ability workers face the MRR_H curve and acquire H_H units of human capital. High-ability workers earn more than low-ability workers both because they have more ability and because they acquire more human capital. The positive correlation between ability and acquired human capital "stretches out" the wage distribution at the top, creating positive skewness.

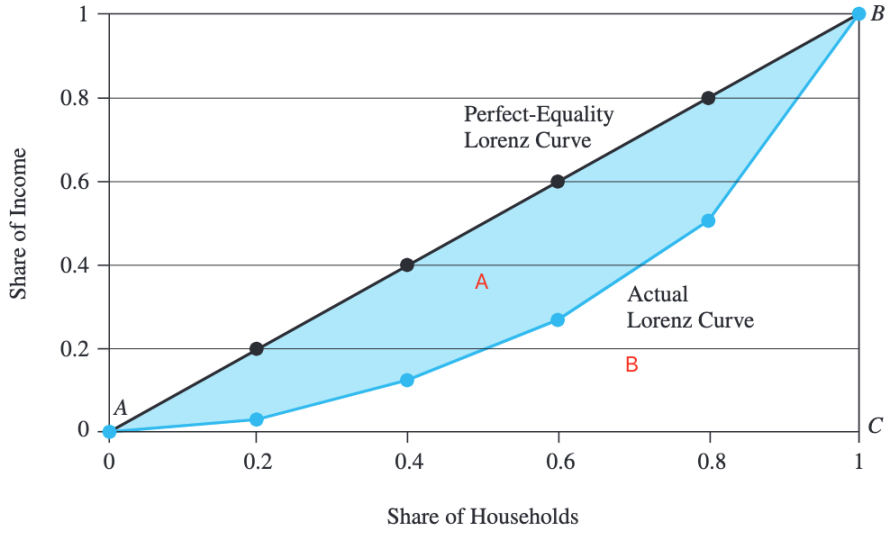


-
- *Positive correlation between ability and human capital investments "stretches out" wages in the upper tail, creating positive skewness*
- High-ability workers earn more for 2 reasons
  - higher ability
  - higher education

7-6 Measuring Inequality

- Laurenz Curve

FIGURE 7-6 **The Lorenz Curve and the Gini Coefficient**
The straight line AB gives the "perfect-equality" Lorenz curve, indicating that each quintile of households gets 20 percent of aggregate income. The Lorenz curve describing the actual income distribution lies below it. The ratio of the shaded area to the area in the triangle *ABC* gives the Gini coefficient.



- *Both axises are cumulative shares*

- Gini Coefficient:

$$\text{Gini Coefficient} = \frac{A}{A+B}$$

7-7 The Changing Wage Distribution

NN

7-8 Policy Application: Why Did Inequality Increase?

Intro

- Constant Elasticity of Substitution (CES) Production Function ignoring capital:

$$Q = \left[\alpha L_S^{\delta} + (1-\alpha) L_U^{\delta}\right]^{\frac{1}{\delta}}$$

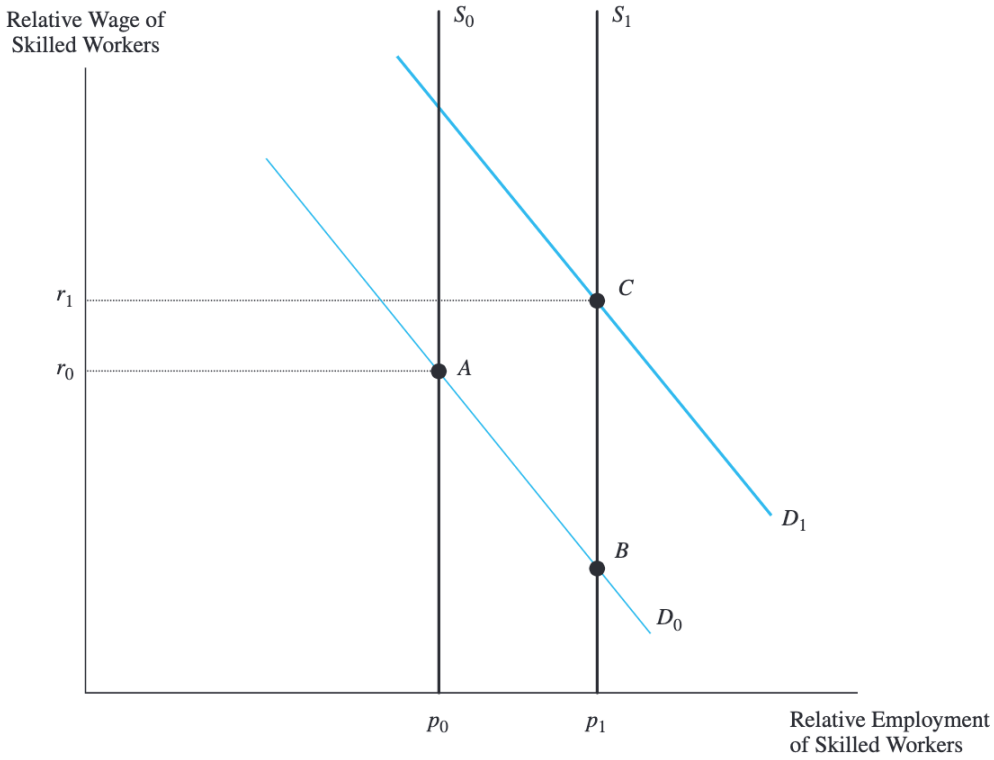
  - S means skilled, U means unskilled
- With CES PF, marginal productivity conditions imply the Relative Demand Curve:

$$\log\left(\frac{w_S}{w_U}\right) = b_0 - b_1 \log\left(\frac{L_S}{L_U}\right)$$

  - *downward sloping and linear* (relative number of skilled worker↑, relative wage of skilled worker↓)

- LM for skilled workers

FIGURE 7-8 Changes in the Wage Distribution Resulting from Shifts in Supply and Demand
The downward-sloping relative demand curve implies that employers hire relatively fewer skilled workers when their relative wage is high. The perfectly inelastic supply curve indicates that the relative number of skilled workers is fixed. The labor market is in equilibrium at point A. A rise in the relative supply of skilled workers to S_1 would lower their relative wage. The relative wage can rise only if there was also a sizable outward shift in the relative demand curve (to point C).



  - Fact: In the US, the relative supply of skilled labour ↑
  - there must have been an increase in relative demand to generate higher inequality
    - the number of skilled workers ↑ ⇝ relative employment of skilled workers ↑
    - their relative wage ↑

Suspects for Larger Inequality

- Supply Shifts
  - shifts in the relative supply curve, including the labor market entry of the college graduates in the baby boom cohort or the increase in the number of unskilled immigrants, can explain some of the changes in the wage distribution
- International Trade
  - Skilled workers in export industry, unskilled workers in importing industry
  - Internationalisation can be modelled as a right shift of relative LD for skilled workers
- Skill-Biased Technological Change
  - Also right shift of relative LD for skilled workers
- Labor Market Institutions
  - Weakened power of unions (typically covering unskilled workers)
  - Decline in real minimum wage

- Also right shift of relative LD for skilled workers

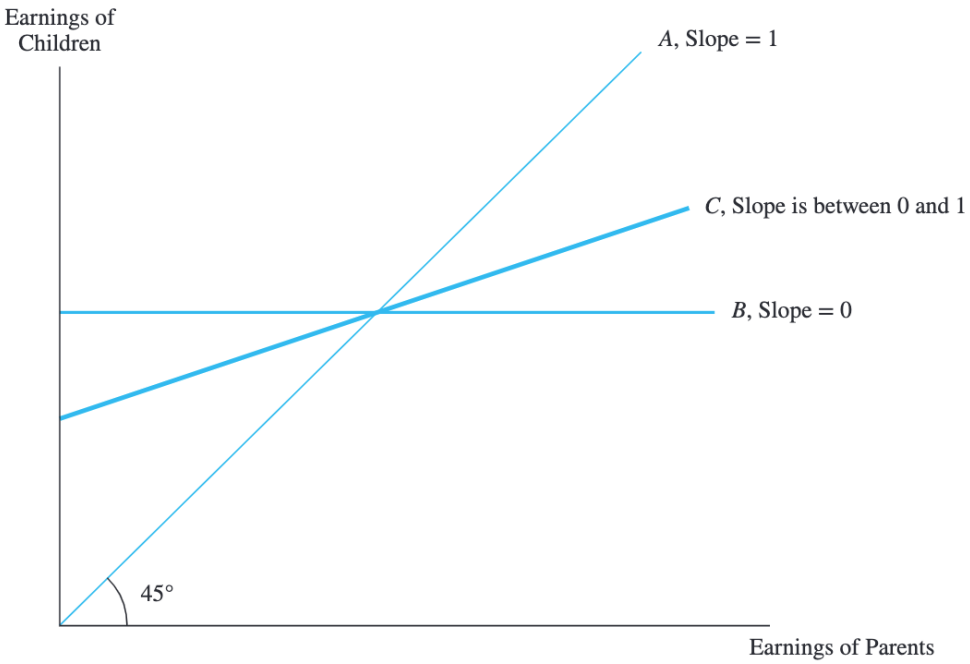
And in the End. .

- Summary of suspects: deunionization of the labor market, minimum wages, international trade, immigration, and skill-biased technological change
- In short, the labor market in some countries may have responded to the increase in the relative demand for skilled workers by changing quantities (that is, employment). In other countries, the market responded by changing prices (that is, wages)

7-9 Inequality Across Generations

- Intergenerational Correlation:

FIGURE 7-9 The Intergenerational Link in Earnings
The slope of the regression line linking the earnings of the children and the earnings of the parents is called an intergenerational correlation. If the slope is equal to 1, the wage gap between any two parents persists entirely into the next generation and there is no regression toward the mean. If the slope is equal to 0, the wage of the children is independent of the wage of the parents and there is complete regression toward the mean.



- Regression toward the mean: attenuation of income difference across generations
  - the closer the intergenerational correlation gets to 0, the more important regression toward the mean becomes

Lecture

- Reasons for difference in wages
  - *Productivity Difference*
    - Schooling choices
    - Post-schooling training
  - *Rate of return to skills differ across markets and over time*
    - e.g. LS/LD of college graduates (across markets)

    - Skill-biased technological change (across time)
- The wage gap between workers with different levels of education widens over lifecycle (attributed post-schooling training)
- Income distribution is not the same as the wage distribution (income includes non-labour income)
- *Residual wage gap*: after controlling all observed characteristics
    - e.g. even among college graduated workers, inequality ↑

Week 7: Wage Distribution II

Katz, Lawrence F., and Kevin M. Murphy. "Changes in relative wages, 1963–1987: supply and demand factors." QJE 1992

I. INTRODUCTION

Facts

- Change in wage structure along 3 dimensions contribute to the rising inequality
    - Education: wage of college graduates ↑
    - Age: for those with low education, wage of older workers ↑ relative to younger workers
    - *Earnings inequality ↑ within narrowly defined groups*
- *Gender inequality ↓*

Possible Explanations

- Shifts of relative LD
    - Variant: skill-biased tech change
- Trade deficit

Structure of This Paper

- Section II describes the data from the March Current Population Surveys that we use throughout the paper
- Section III uses these data to describe the basic patterns of change in real and relative wages in the United States over the 1963 to 1987 period
- Section IV outlines the simple factor demand model that we use to interpret these relative wage data and evaluates the ability of simple demand shift stories to explain the observed patterns of changes in relative factor prices and supplies
- Section V expands the basic model to incorporate both within- and between-industry components of relative factor demands. Section VI uses the basic framework to examine changes in education and experience differentials
- Section VI summarises our conclusions.

Main Findings

- *Rapid secular growth in the relative demand for "more-skilled" workers is a key component of any consistent explanation*
- The majority of such shifts in relative LD *happens within detailed sectors, which reflects skill-biased technological changes*
- *Differences in the time pattern of rising education differentials and rising within-group inequality suggest that they are distinct phenomena*
    - *education diff: fluctuations in the rate of growth of the relative supply of college graduates combined with smooth trend demand growth of more-educated workers* can largely explain fluctuations in the college/high school differential
    - *within diff: steady demand growth in favour of more highly-skilled workers* appears consistent with both movements in education differentials and within-group inequality

II. THE DATA

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III. REAL AND RELATIVE WAGE CHANGES, 1963-1987

- The college wage premium rose from 1963 to 1971, fell from 1971 to 1979, and then rose sharply from 1979 to 1987. The changes in the college/high school wage ratio were greatest for the youngest workers in the 1970s and 1980s and greatest for prime age workers in the 1960s.
- Experience differentials expanded substantially from 1963 to 1987. The most dramatic increases in experience differentials occurred for less-educated males from 1979-1987.
- Overall and residual weekly wage inequality for both men and women (as measured by the 90-10 log wage differential) were stable during the 1960s and then increased by almost 30 percent from the late 1960s to 1987. The increase in residual inequality has been quite steady since the early 1970s, while the growth in overall inequality accelerated in the 1980s.
- After remaining fairly stable in the 1960s and 1970s, male/female wage differentials narrowed substantially from 1979 to 1987

IV. A SIMPLE SUPPLY AND DEMAND FRAMEWORK

NN

V. MEASURING CHANGES IN THE RELATIVE DEMAND FOR LABOR

NN

VI. UNDERSTANDING CHANGES IN EDUCATION AND EXPERIENCE DIFFERENTIALS

NN

VII. CONCLUSION

- The relative wages and quantities of more-educated workers and women increased substantially from 1963 to 1987. Within-group and overall wage inequality also increased sharply over this period
- *Substantial secular growth in the demand for more-educated workers, females and "more-skilled" workers within groups is necessary to interpret the observed changes in relative wages as changes in competitive skill prices*
- Decompose the increase in relative LD
  - Allocation between sectors - minority
  - International trade - only after 1980
  - *Within sector change in LD in favour of high-educated and women - majority*
- The college wage premium increased moderately in the 1960s, declined in the 1970s, and expanded dramatically in the 1980s.
  - Rate of the growth of the supply of college graduates as a fraction of the labour force appear to play an important role in explaining these large differences in the behaviour of the relative earnings of college graduates
  - but not helpful for explaining male/female wage differential
- Within-group earnings inequality was stable in the 1960s and has increased steadily since the early 1970s.
- The *differences in the time pattern of rising education differentials and rising within-group inequality suggest that they are at least partially distinct economic phenomena*.

Autor, David H., Lawrence F. Katz, and Melissa S. Kearney. "Trends in US wage inequality: Revising the revisionists." Review of Economics and Statistics 2008

Abstract

- *"Revisionist" literature*:
  - widening wage inequality in U.S. since 1980 is an *episodic event* of the first half of the 1980s driven by *non-market factors* (particularly real minimum wage ↓)
  - Continued increase in wage inequality since the later 1980s reflect the mechanical confounding effects of changes in LF composition
- We analysed Current Population Survey 1963-2005
  - Growth of wage inequality slowed down in the 1990s
    - 90-50 inequality increased continuously

        - 50-10 inequality rose sharply in the first half of 1980s and became steady thereafter
    - *Real minimum wage cannot be an explanation because inequality ↑ above the median income*
- Past models:
    - Skill-biased tech. change ⇝ relative LD ↑ of college worker
    - Deceleration of relative LS of college workers
- Those models explain the evolution of college/high-school wage premium, but imply a puzzling deceleration in the relative LD for college workers in the early 1990s, and fail to explain the recent "polarisation" of skill demands
- *Reconciled by a modified version of skill-biased technical change hypothesis that emphasised the the role of info. tech. in complementing abstract/high-education tasks and substituting routine/middle-education tasks*

I. Introduction

- Wage differentials by education, by occupation, and by age and experience group all rose substantially. Residual wage inequality — that is, wage dispersion within demographic and skill groups — increased simultaneous
- This *literature* reaches two broad conclusions.
    - First, much of the rise in U.S. earnings inequality during the 1980s appears to be explained by shifts in the supply of and demand for skills combined with the erosion of labour market institutions—including labour unions and the minimum wage—that protected the earnings of low- and middle-wage workers.
    - Second, a number of influential studies argue that the surge of inequality evident in the 1980s reflected an ongoing, secular rise in the demand for skill that commenced decades earlier and perhaps accelerated during the 1980s with the onset of the computer revolution. When this secular demand shift met with an abrupt slowdown in the growth of the relative supply of college-equivalent workers during the 1980s—itself a consequence of slowing educational attainment for cohorts born after 1949 and of smaller entering labor force cohorts—wage differentials expanded rapidly
- *Revisionist*:
    - First, the rise of inequality during the 1980s is largely explained by non-market factors -- most importantly the declining real value of the minimum wage
    - Second, the growth of wage inequality is a one-time (episodic) event of the early 1980s
- Partial support revisionist literature: the increase in inequality and relative LD slow down after 1980s
- *Against main revisionist claims*:
    - Polarisation: Inequality in the upper half of the male wage distribution (the *90/50 wage gap*) *grew rapidly and nearly continuously* from 1980 to 2005, even after

adjusting for LF composition changes

- By contrast, *inequality in the lower half* of the distribution *expanded rapidly in first half of the 1980s and stabilised and decreased thereafter*
- $\Longrightarrow$ *minimum wage cannot be the reason*
- Change in "price" (earnings within narrowly defined groups) is a key factor explaining the rise of inequality in the upper tail

- The roughly parallel movement of earnings and employment growth in each decade suggests that *demand forces have played a key role in shaping wage structure* changes during the inequality surge of the 1980s and the polarisation that followed
  - Explanation: skill-biased technical change (SBTC) hypothesis in which information technology complements highly educated workers engaged in abstract tasks, substitutes for moderately educated workers performing routine tasks, and has less impact on low-skilled workers performing manual tasks

VI. Conclusion

- Revisionist explanations focusing on non-market factors, particularly minimum wages and the spurious effects of labor market composition on residual inequality, appear unable to provide a compelling explanation for the strong, secular rise in upper-tail inequality over at least the last 25 years and the polarisation of employment growth since 1990.
- *Explanations based on relatively steady-trend relative demand growth for more-skilled workers and fluctuations in relative skill supplies based on canonical supply-demand models imply a puzzling slowdown in relative demand growth starting in the early 1990s*
- The simple analysis above demonstrating that *employment and wage growth by skill percentile are positively correlated in each of the last two decades leaves us confident that skill demand shifts have played a central role in reshaping the wage structure, both during the monotone rise of inequality during the 1980s and the polarisation of wage growth that followed. These trends toward wage structure "polarisation"can, we believe, be partially reconciled by a reinterpretation of the skill-biased technical change hypothesis*: skill-biased technical change (SBTC) hypothesis in which information technology complements highly educated workers engaged in abstract tasks, substitutes for moderately educated workers performing routine tasks, and has less impact on low-skilled workers performing manual tasks

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Week 8: Labour Market Discrimination

Textbook Ch.9

9-1 Race and Gender in the Labor Market

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9-2 The Discrimination Coefficient

- Becker's Definitions
  - Taste Discrimination: the employer is prejudiced against blacks $\rightsquigarrow$ the employer gets disutility from hiring blacks $\rightsquigarrow$ even though it costs only w_B to hire a black worker, the employer *acts as if* it costs $w_B(1+d)$ where d is a positive number known as the discrimination coefficient
    - prejudice $\uparrow \rightsquigarrow d \uparrow$
  - Nepotism: black employers may prefer hire blacks $\rightsquigarrow$ utility-adjusted cost of hiring $= w_B(1-n)$ where n is a positive number known as the nepotism coefficient
- We can apply Becker's definition to other economic interactions
- The discrimination coefficient, therefore, "monetizes" prejudice, regardless of whether the source of the prejudice is the employer (leading to employer discrimination), the employee (leading to employee discrimination), or the customer (leading to customer discrimination)

9-3 Employer Discrimination (Becker's Model of Taste Based Discrimination of Firms)

Employment is a Non-Discriminatory Firm

- Suppose black and white workers are perfect substitutes and ignore capital.
- Then firm's PF:

$$q = f(E_W + E_B)$$

- Output depends on the total number of workers, regardless of race
  $\iff MP_W = MP_B \rightsquigarrow$ wage differentials entirely attributed to discriminations
- If there's *no discrimination, firms' optimal hiring decision* of the blacks is:

$$w_B = VMP_E$$

$$\begin{cases} w_B > w_W & \Longrightarrow \text{Only Hire White} \\ w_B < w_W & \Longrightarrow \text{Only Hire Black} \end{cases}$$

- *So a non-discriminatory firms hire only black workers if $w_B < w_W$*

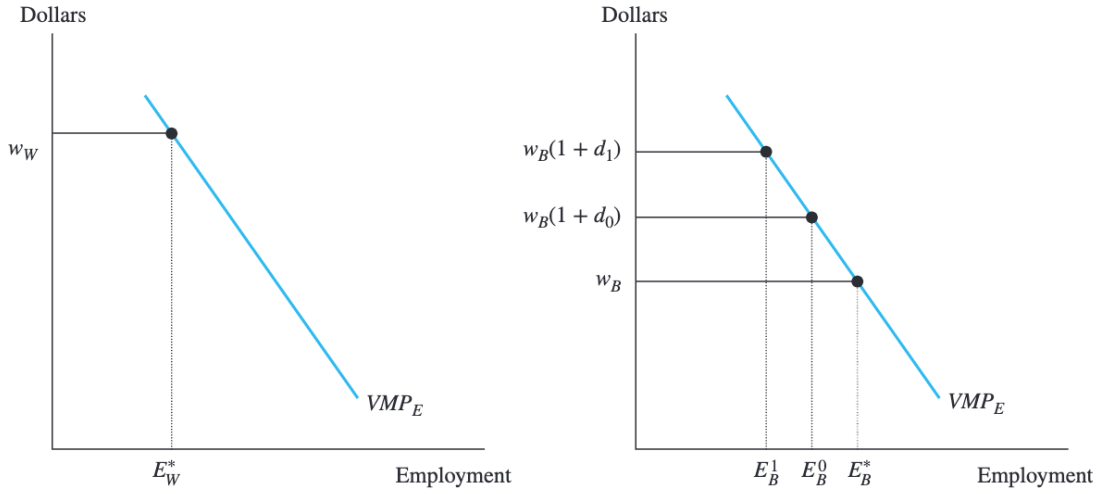
Employment in a Discriminatory Firm

- *Decision rule of a prejudiced employer*:

$$\begin{cases} w_B(1+d) > w_W & \Longrightarrow \text{Only Hire White} \\ w_B(1+d) < w_W & \Longrightarrow \text{Only Hire Black} \end{cases}$$

- where $d > 0$ is the discrimination coefficient
- Implication: firms have a *segregated workforce* if black and white are perfect substitutes:
  - there will be 2 types of firms -- only hire black / only hire white

FIGURE 9-2 The Hiring Decision of a Prejudiced Firm
Firms that discriminate can be either white firms (if the discrimination coefficient is very high) or black firms (if the discrimination coefficient is relatively low). A white firm hires white workers up to the point where the white wage equals the value of marginal product. A black firm hires black workers up to the point where the utility-adjusted black wage equals the value of marginal product. Firms that discriminate hire fewer workers than firms that do not.



(*a*) White Firm (*b*) Black Firm

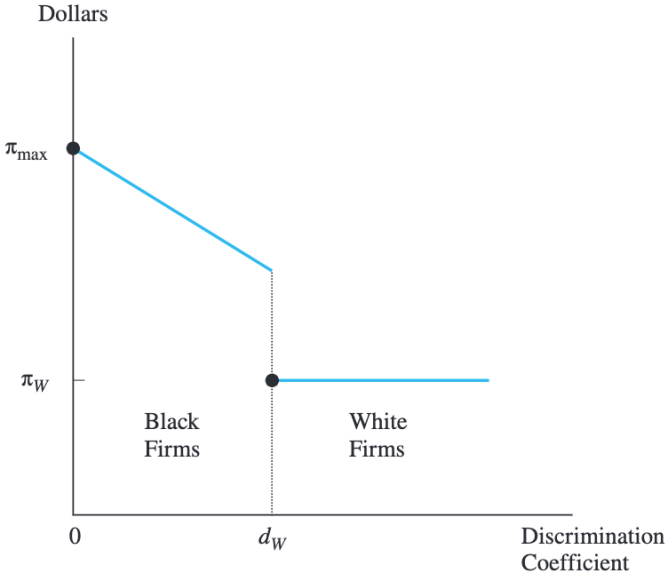
- Suppose $w_B < w_W$
- *White firms / very discriminatory firms* have high $d \rightsquigarrow w_B(1+d) > w_W$ hire only white up to the point where $w_W = VMP_E$
  - they pay an excessively high price for their workers (w_W) and consequently hires few of them $E_W^* < E_B$ and earn a much lower profit
- *Black firms / less discriminatory firms* have low $d \rightsquigarrow w_B(1+d) < w_W$ hire only black up to the point where $w_B(1+d) = VMP_E$ and pay wage w_B
  - $d \uparrow \rightsquigarrow E_B \downarrow, \pi \downarrow$
- *Non-discriminatory / colour-blind firms* have maximum profit by hiring E_B^* and paying wage w_B

Discrimination and Profits

- *Discrimination is not profitable*
- White firms' hiring decision is unprofitable in 2 ways:
  - *Wrong Wage / Wrong Colour*: they could hire the same number of black workers at a lower wage ($w_W > w_B$)
  - *Wrong Number of Workers*: they could expand profit by hiring more black
- Similarly, discriminatory black firms also give up some profits by hiring less than optimum (but at least they are paying the lower wage w_B)

- *Relation between the firm's profits and the discrimination coefficient*:

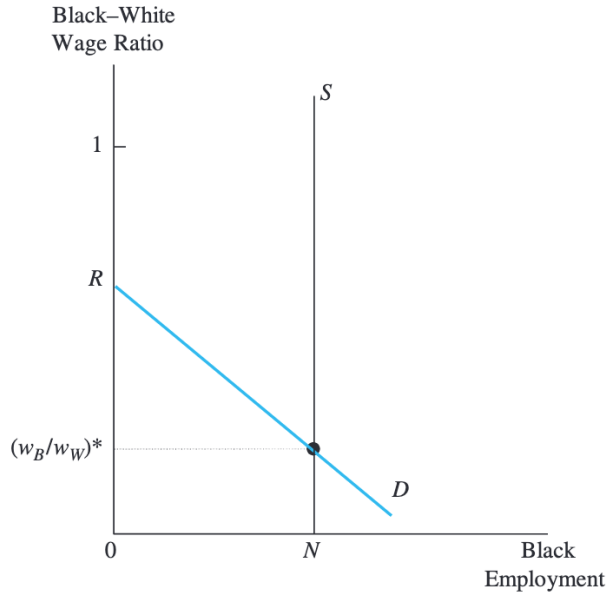
FIGURE 9-3 **Profits and the Discrimination Coefficient**
Discrimination reduces profits in two ways. Even if the discriminatory firm hires only black workers, it hires too few workers. If the discriminatory firm hires only white workers, it hires too few workers at a very high wage.



  - d_W is such that $w_B(1+d_W) = w_W$
  - $d \in [0, d_W)$: firms hire only blacks and pay the lower black wage w_B, but $d \uparrow \rightsquigarrow E_B \downarrow \rightsquigarrow \pi \downarrow$
  - $d \in [d_w, \infty)$: firms hire only white and suffer from both high white wage w_W and low employment
    - note that E_W will not change as $d \uparrow$, so profits are the same for all white firms
- $\implies$ if employers are indeed the source of discrimination, non-discriminatory firms will win the perfect competition and purchase all discriminatory firms $\implies$ *goods market competition is beneficial to minority groups*

Labor Market Equilibrium

FIGURE 9-4 **Determination of Black–White Wage Ratio in the Labor Market**
If the black–white wage ratio is very high, no firm in the labor market will want to hire blacks. As the black–white wage ratio falls, more and more firms are compensated for their disutility and the demand for black workers rises. The equilibrium black–white wage ratio is given by the intersection of supply and demand, and equals $(w_B/w_W)^*$. The assumption that all firms are prejudiced implies that the equilibrium black–white wage ratio is below 1.

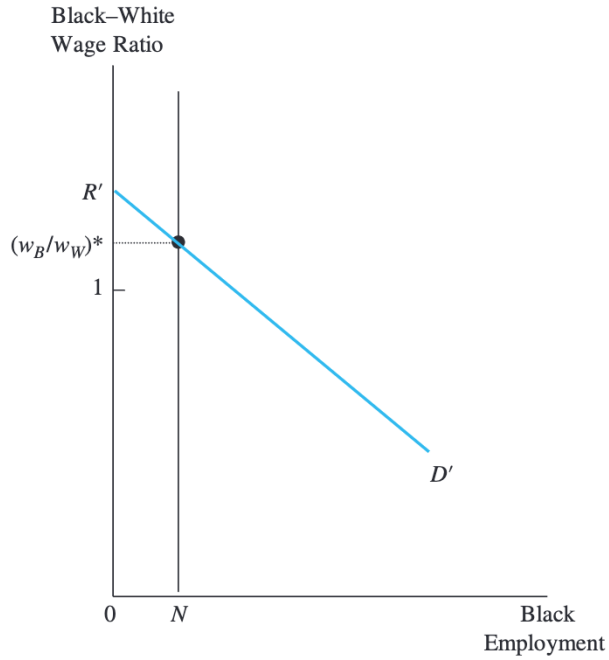


- *LD*: Assume all employers discriminate against blacks $(d > 0) \implies$ relative wage of the black $\frac{w_B}{w_W} \downarrow \rightsquigarrow D_B \uparrow$, so the LD for black is downward sloping, and the maximum possible relative wage for black < 1
- *LS*: Assumed to be perfectly inelastic
- Equilibrium: $LD = LS \implies \frac{w_B}{w_W} < 1$

The Equilibrium Black–White Wage Differential

- If *there are also some nepotistic firms*:

FIGURE 9-5 **Nepotism and the Black–White Wage Ratio**
If some firms prefer to hire blacks, they would be willing to hire blacks even if the black–white wage ratio exceeds 1, shifting the demand curve up to D'. If the supply of blacks is sufficiently small, it is then possible for the black–white wage ratio to exceed 1.



- If the LS of black is relative low, the *equilibrium relative wage of the black could be >1 even if most firms dislike hiring blacks* because the labour market matches black workers with employers who prefer hire blacks
- $\Longrightarrow$ the *observed black-white wage gap should not be interpreted as a summary measure of how prejudice there is in the LM*, such as mean/median, it measures the *discrimination coefficient of the marginal firm*.

9-4 Employee Discrimination

- Suppose white workers dislike working with black workers $\Longrightarrow$ they treat $w = w_W(1-d)$ if working with black
- $\rightsquigarrow$ *workforce will be again completely segregated*:
  - because the employer have no incentive to mix black and white workers as doing so requires a compensation for white workers
- $\rightsquigarrow$ there will be *no wage gap* between black and white workers
  - because white/black are perfect substitutes $\rightsquigarrow$ firms hire whoever is cheaper
- $\rightsquigarrow$ does not affect *profitability of firms*
  - because all firms pay the same price for an hour of labour and black/white are perfect substitutes $\rightsquigarrow$ no advantage for being a black/white firms
  - $\rightsquigarrow$ *no market force to diminish employee discrimination over time*

9-5 Customer Discrimination

- If customers have a taste for discrimination, their buying decisions are not based on the actual price of the good, p, but on the utility-adjusted price, or $p(1+d)$, where d is the discrimination coefficient.
- If the firm can *hide black workers* from contacting with customers $\rightsquigarrow$ internal segregation $\rightsquigarrow$ customer discrimination does not matter too much
- impact also depends on the *relative supply* of black workers

9-6 Statistical Discrimination

Statistical Discrimination

- Statistical Discrimination: Information gathered from the résumé and the interview is an imperfect predictor of the applicant's true productivity $\rightsquigarrow$ The uncertainty encourages the employer to *use statistics about the average performance of the group to predict a particular applicant's productivity*.
  - As a result, *applicants from high-productivity groups benefit from their membership in those groups*, while applicants from low-productivity groups do not.
- Competitive firms frequently use statistical discrimination to *fill in information gaps* when the firm cannot perfectly predict the risks or rewards of particular economic transactions

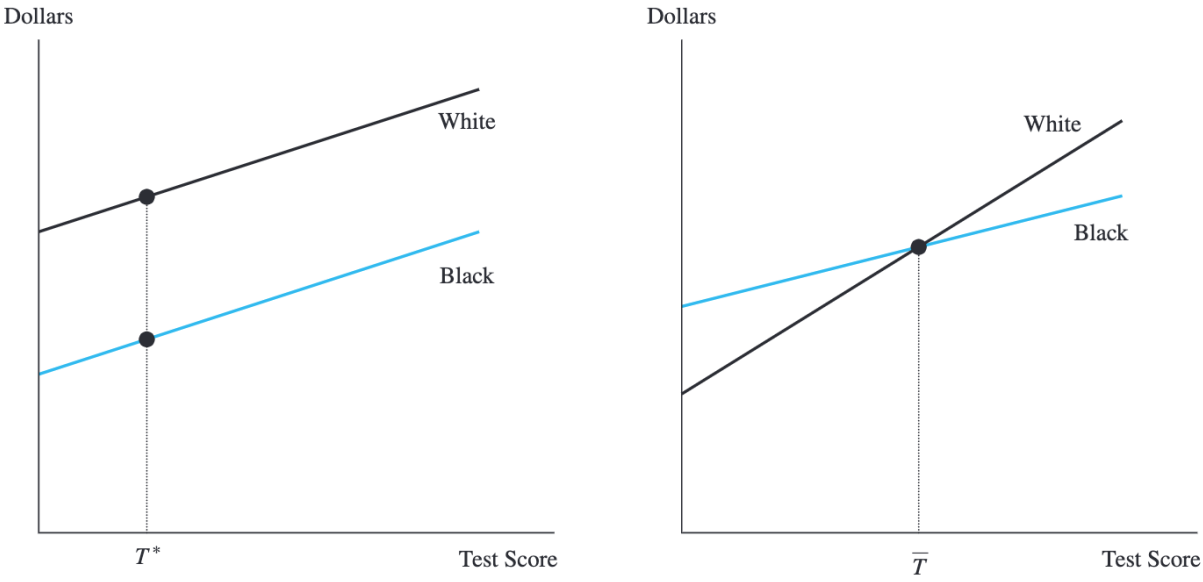
Statistical Discrimination and Wages

- *Wage offer* to a particular applicant:

$$w = \underbrace{(1-\alpha)\overline{T}}_{\text{Intercept}} + \alpha T$$

- where
  - T is the score of a screening test of a particular worker and $\overline{T}$ is the average test score of that group
  - α measures the relation between the test score and true productivity
    - $\alpha = 1 \implies$ test score perfectly predicts productivity

FIGURE 9-6 Statistical Discrimination and Wages
The worker's wage depends on both his own test score and the mean score of workers in his racial group. (*a*) If black workers have a lower average score, a white worker who gets T^* points earns more than a black worker with the same score. (*b*) If the test is a better predictor of productivity for whites, high-scoring whites earn more than high-scoring blacks, but low-scoring whites earn less than low-scoring blacks.



(*a*) Whites Have a Higher Average Score

(*b*) Test Is Better Predictor for White Workers

- Statistical discrimination affects wages in 2 ways:
  - *Different intercepts* (LHS): white has higher average $\overline{T}_W > \overline{T}_B$ but α is the same $\rightsquigarrow$ with same test score T^*, *a white worker will earn more than a black worker*
  - *Different slopes* (RHS): test score is a better predictor of productivity for white workers $\alpha_W > \alpha_B$ but two groups have the same average $\overline{T}_W = \overline{T}_B \rightsquigarrow$ the wage distribution of the black is more *centred at the average* $\implies$ *benefit low-productivity black but harm high-productivity black*
- In summary, statistical discrimination does not necessarily predict that the average black will be paid less than the average white. But it does raise the possibility that discrimination benefits some black workers, while harming others

9-7 Experimental Evidence

- Critics

- Applicants may not be indeed identical
- Applicants know the purpose of experiment and may respond
- Audit studies measure the preferences of the average firm, but it is the marginal d determines the wages gap

9-8 Measuring Discrimination

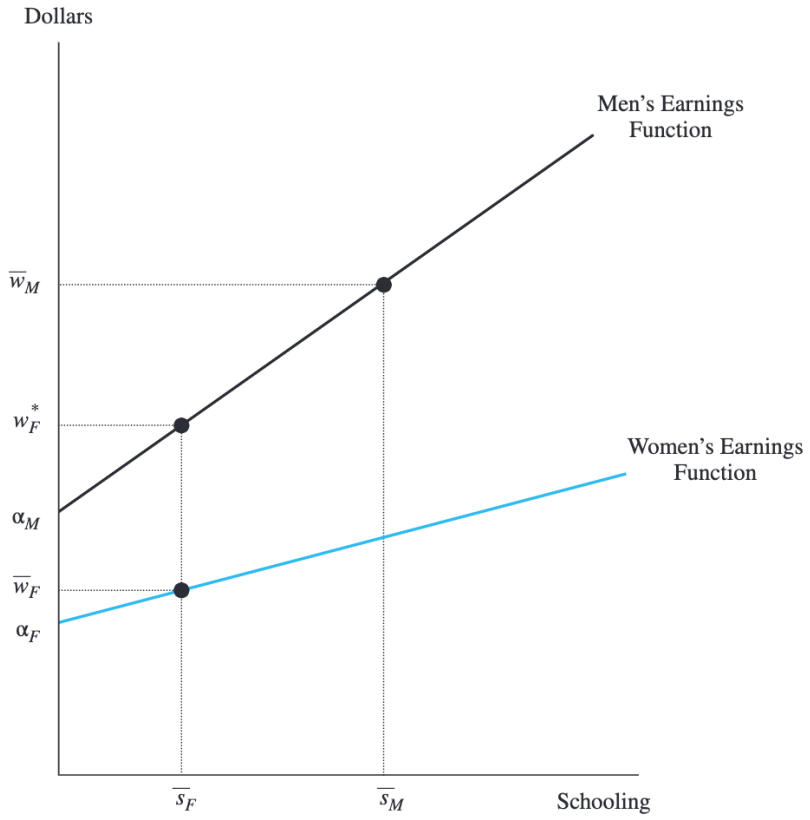
The Oaxaca–Blinder Decomposition

- Oaxaca-Blinder Decomposition: raw wage differential ($\Delta\overline{w} = \overline{w}_M - \overline{w}_F = \alpha_M + \beta_M \bar{s}_M - \alpha_F - \beta_F \bar{s}_F$) can be decomposed into *a portion due to differences in characteristics (skills)* between the two groups and *a portion that remains unexplained and that we call discrimination*

$$\Delta\overline{w} = \underbrace{[(\alpha_M - \alpha_F) + (\beta_M - \beta_F)\bar{s}_F]}_{\text{due to discrimination}} + \underbrace{\beta_M(\bar{s}_M - \bar{s}_F)}_{\text{due to skills}}$$

- Discrimination: employers either
  - value a man's schooling by more than a woman's schooling ($\beta_M > \beta_F$)
  - or just pay men more than women for any level of schooling so that the male intercept is larger ($\alpha_M > \alpha_F$)

FIGURE 9-7 Measuring the Impact of Discrimination on the Wage
The average woman has $\overline{s}_F$ years of schooling and earns $\overline{w}_F$. The average man has $\overline{s}_M$ years of schooling and earns $\overline{w}_M$. Part of the wage differential arises because men have more schooling than women. If the average woman was paid as if she were a man, she would earn w_F^* dollars. A measure of discrimination is $w_F^* - \overline{w}_F$.



- Observed difference: $\overline{w}_M - \overline{w}_F$
- Decomposition:

- $\overline{w}_M - w_F^*$ is attributed to average skill differential
- $w_F^* - \overline{w}_F$ is attributed to discrimination

What Does the Oaxaca–Blinder Decomposition Really Measure?

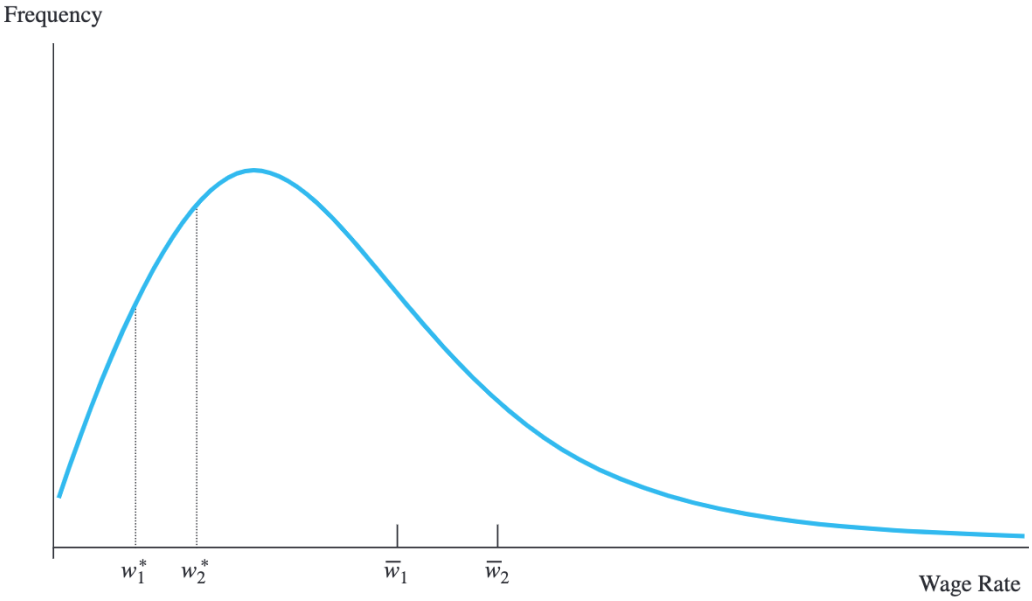
- There could always be *omitted variable bias* (unless we directly observed productivity difference)
- On the other hand, discrimination in more than LM (*structural discrimination*)
  - e.g. the black systematically attend low-quality schools

9-9 Policy Application: The Black and White Wage Gap

- For black men: $w\uparrow, LFPR\downarrow$ which could be caused by minimum wage$\uparrow$

FIGURE 9-10 **Decline in Black Labor Force Participation of Blacks and the Average Black Wage**

If the reservation wage of blacks is w_1^*, the mean wage observed among black workers is $\overline{w}_1$. Suppose the reservation wage rises to w_2^*. The black labor force participation rate falls, and the mean wage observed among blacks still working rises to $\overline{w}_2$.



9-10 The Relative Wage of Hispanic and Asians

- Hispanic people earn less mainly because they are less skilled
- Asians earn more typically because they are more educated
- Additional caveat: groups are self reported

9-11 Policy Application: The Male and Female Wage Gap

The Gender Wage Gap and Labor Market Experience

- The discontinuity in female labor supply over the life cycle then generates a gender wage gap for two distinct reasons:
  - First, it creates a wage gap because men tend to acquire more human capital. (women are more likely to have career interruptions) *human capital hypothesis*

    - Second, the household production years further increase the wage gap because a woman's *skills may depreciate* during that period
- Conceptual obstacle of human capital hypothesis: Reverse causality: did a woman's weaker work attachment lead to lower wage rates through reduced human capital investments? Or did the lower wage rate lead to a weaker work attachment?

Occupational Crowding

- Fact: a lot of occupational segregation by gender
- Occupational crowding hypothesis: women are intentionally segregated into particular occupations
    - factors such as employer discrimination, social climate $\rightsquigarrow$ women crowd into a small range occupations $\rightsquigarrow$ lower wages $\rightsquigarrow$ gender wage gap
- Alternative explanation: *Human capital model*: supply side:
    - women who maximise the PV of lifetime earnings will not enter occupations where their skills might depreciate during career interruptions

The Trend in the Female–Male Wage Ratio

- Women's economic status improved rapidly in the past few decades
    - one explanation: women are more attached to careers $\rightsquigarrow$ LM experience of women$\uparrow$
- Women LFPR$\uparrow$

Uber and the Gender Wage Gap

- Gender plays no role in Uber allocation and ride compensation, but males have 7% higher earnings than females
- 3 explanation
    - men exploit better hours and locations
    - men have more experience
    - men drive faster

Goldin, Claudia. "A grand gender convergence: Its last chapter." _American Economic Review_ 104, no. 4 (2014): 1091-1119.

- *Difference in human capital / productivity between genders has been nearly entirely eliminated*
- *Much of the wage gender gap today is attributed to the non-linearity / convexity of income with respect to working time*
    - examples of convex wage: business (MBA) and law (JD)
    - example of linear wage: pharmacist
- In the last chapter, we *must eliminate convexity* of wages