

Intermediate Macroeconomic Theory

Costas Azariadis

Lecture 3: Productivity and Labor

Productivity and Labor

1. THE ISSUES

a) Productivity → most important determinant of living standards in the long run

2008 U.S. GDP per worker employed (current \$)

≈ \$100,000 per worker per year

≈ \$60 per hour worked

b) Measures of Productivity

output per unit labor = labor productivity

TFP = total factor productivity

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TFP = combination of $\left\{ \begin{array}{l} \text{labor prod.} \\ \text{capital prod.} \end{array} \right\}$ weighted by factor share

How does productivity change incomes? What makes productivity high or low?

c) The Aggregate production Function

GDP depends on

- the capital stock: K
- labor services: N

U.S. Data fit: $Y = AK^{0.36}N^{0.64}$

$A = \text{TFP}$

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Table 1: The Production Function of the United States, 1979-2007

(1)	(2)	(3)	(4)
Real GDP, Y	Capital Stock, K	Labor, N	Productivity A
Output increases by 120% in 28 years	Capital stock increases by 110%	Labor increases by 47%	TFP increases 35%

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Table 3.1

The Production Function of the United States, 1979–2007

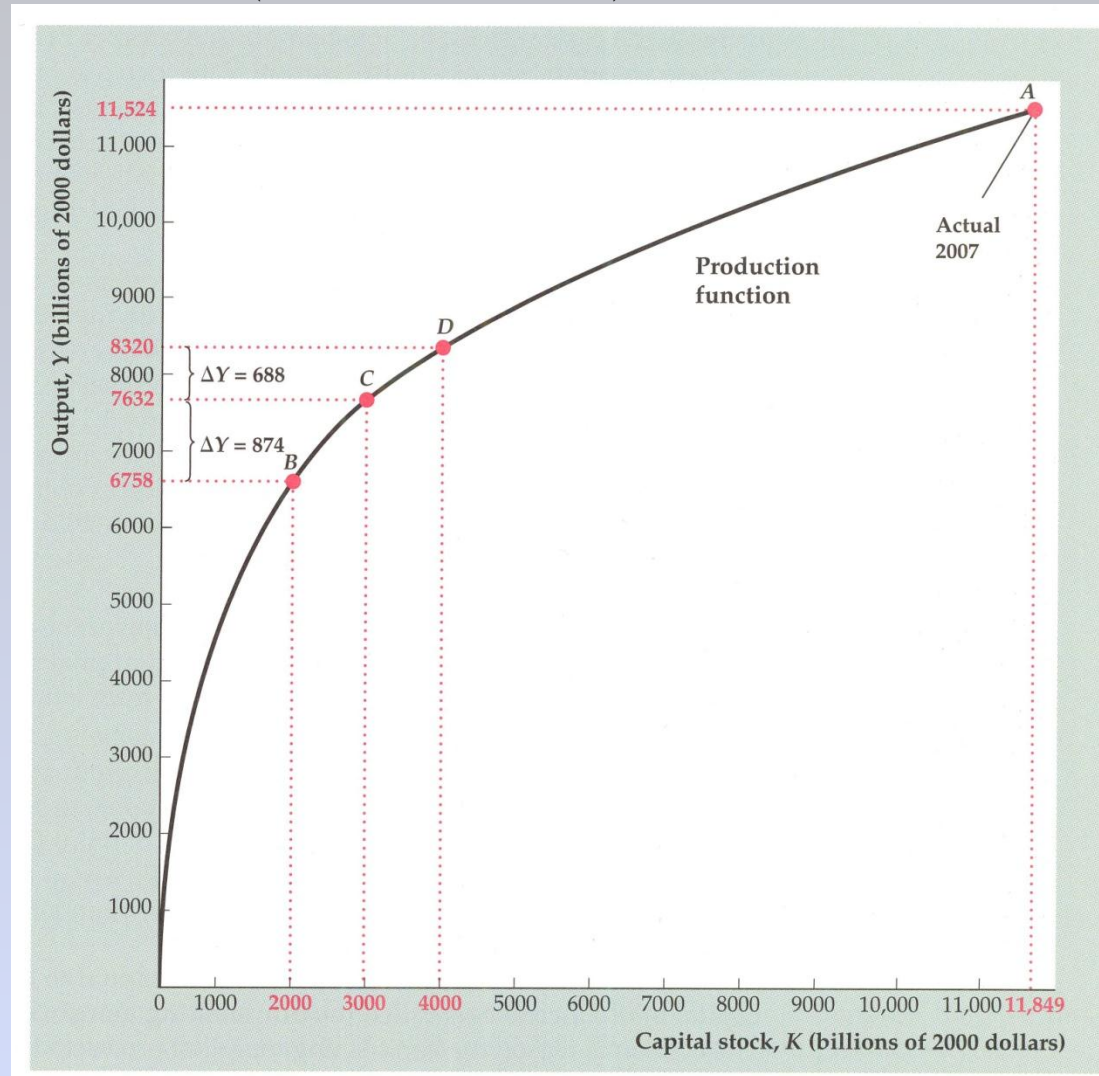
Year	(1) Real GDP, Y (billions of 2000 dollars)	(2) Capital stock, K (billions of 2000 dollars)	(3) Labor, N (millions of workers)	(4) A^a	(5) Growth in A (% change in A)
1979	5173	5615	98.8	15.58	
1980	5162	5831	99.3	15.32	-1.7
1981	5292	6060	100.4	15.40	0.6
1982	5189	6236	99.5	15.07	-2.2
1983	5424	6383	100.8	15.50	2.8
1984	5814	6614	105.0	15.98	3.1
1985	6054	6863	107.2	16.22	1.5
1986	6264	7060	109.6	16.38	1.0
1987	6475	7239	112.4	16.51	0.8
1988	6743	7429	115.0	16.79	1.7
1989	6981	7623	117.3	17.01	1.3
1990	7113	7809	118.8	17.06	0.3
1991	7101	7932	117.7	17.06	0.0
1992	7337	8045	118.5	17.47	2.4
1993	7533	8208	120.3	17.64	1.0
1994	7836	8396	123.1	17.94	1.7
1995	8032	8638	124.9	18.04	0.6
1996	8329	8917	126.7	18.35	1.7
1997	8704	9242	129.6	18.67	1.8
1998	9067	9605	131.5	19.03	1.9
1999	9470	9986	133.5	19.44	2.1
2000	9817	10,392	136.9	19.57	0.6
2001	9891	10,669	136.9	19.55	-0.1
2002	10,049	10,841	136.5	19.82	1.3
2003	10,301	10,986	137.7	20.10	1.5
2004	10,676	11,147	139.3	20.59	2.4
2005	10,990	11,333	141.7	20.83	1.2
2006	11,295	11,584	144.4	20.99	0.8
2007	11,524	11,849	146.0	21.10	0.6

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Output with fixed labor ($N=146$ mn workers)

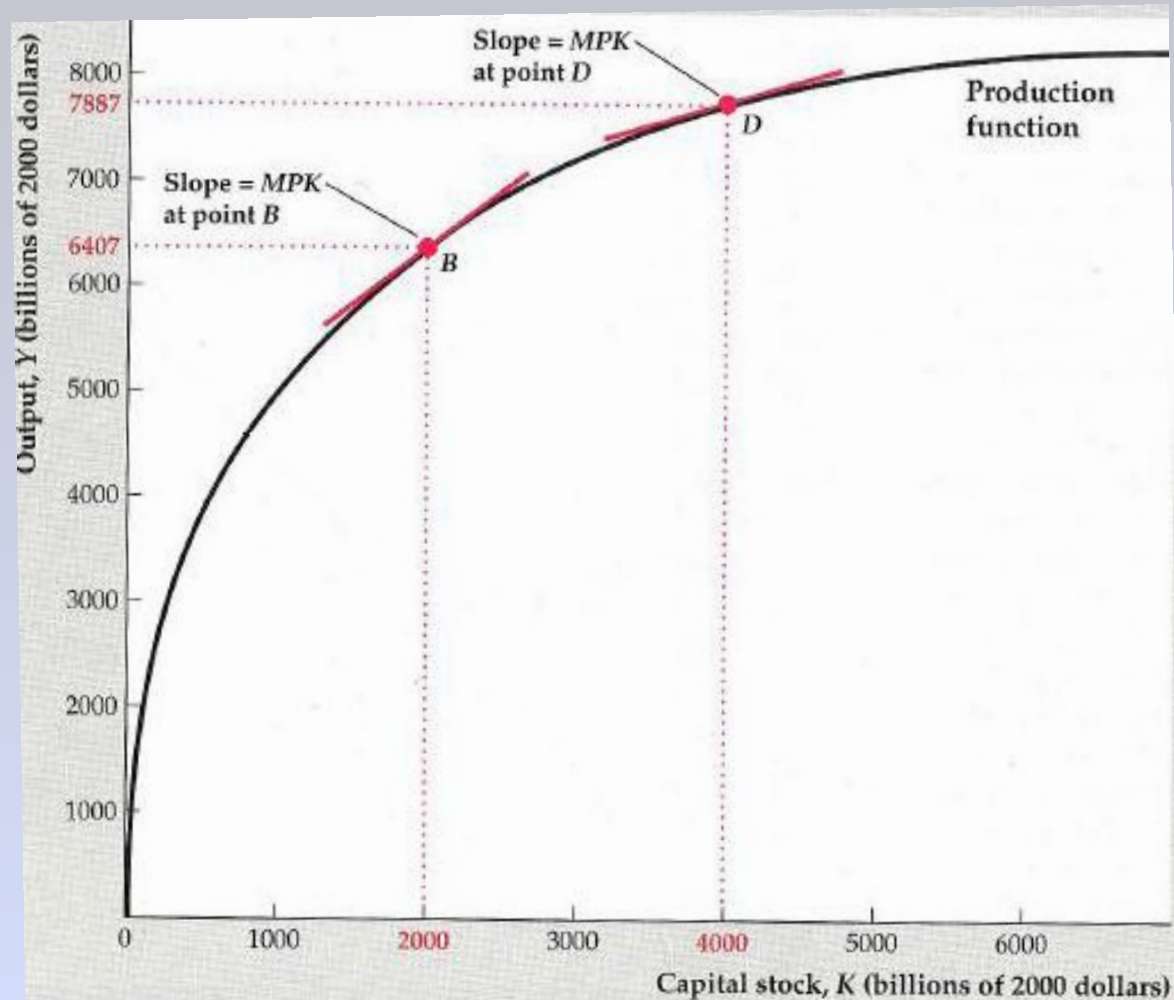


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MPK = Marginal productivity of capital (sensitive to capital input)

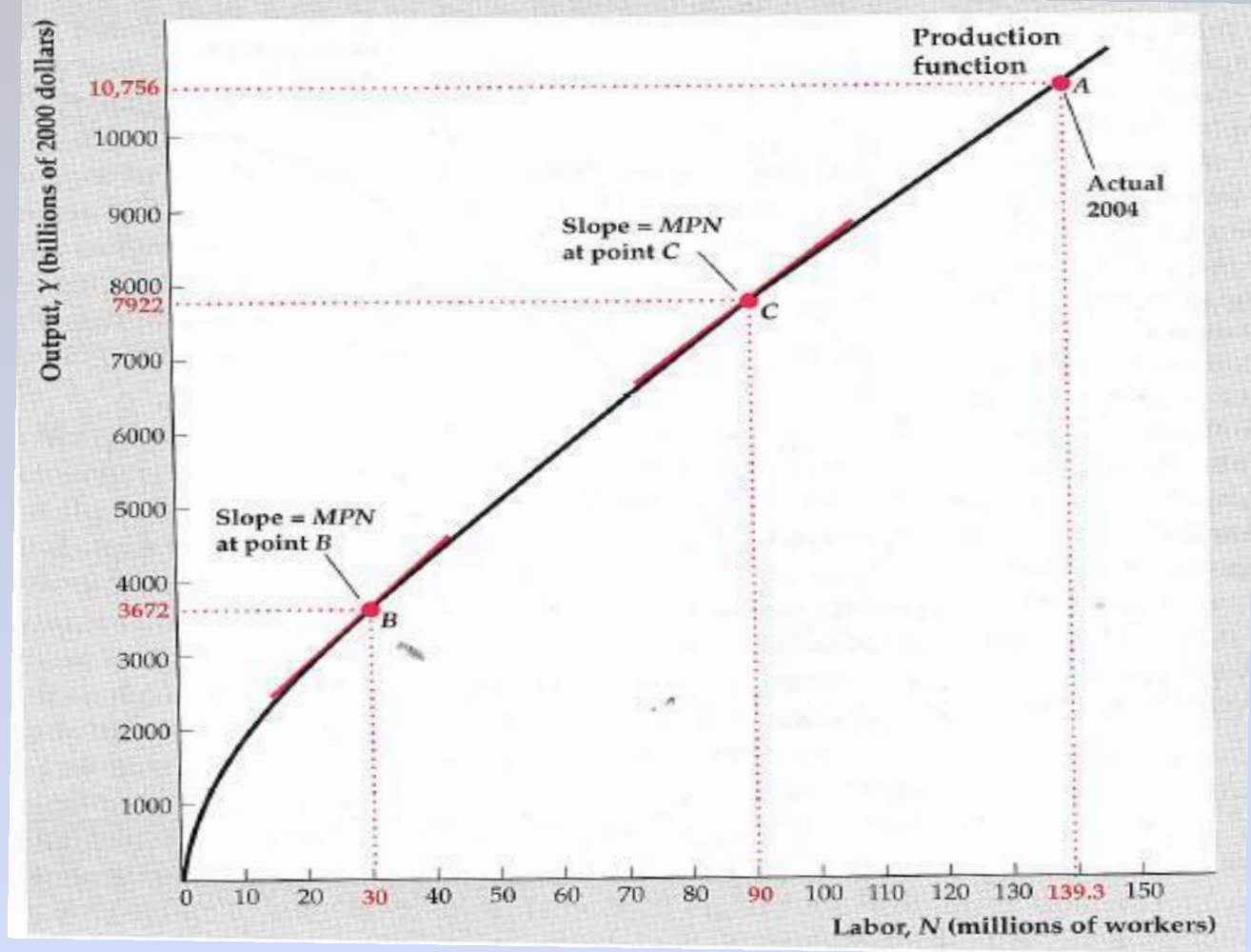


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Output with fixed capital = \$11.5 trillion (relatively insensitive to labor input)

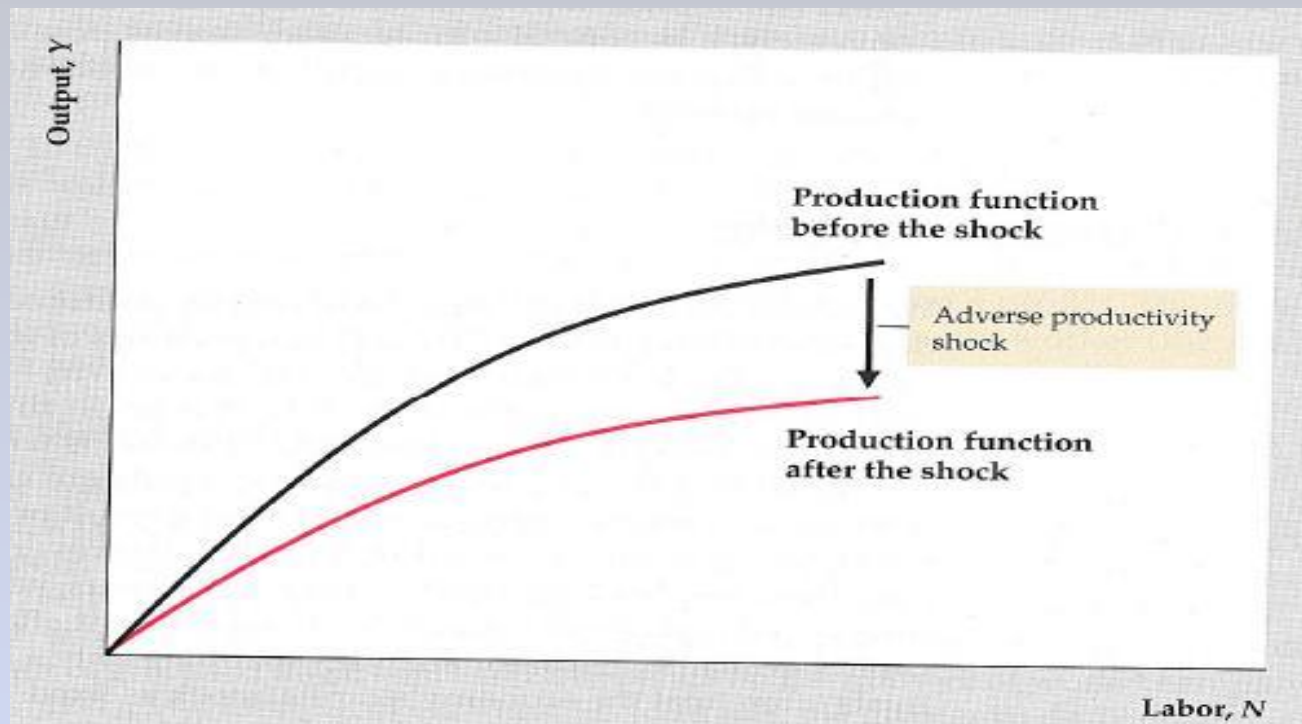


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Impact of bad productivity shock (weather, high energy prices, political corruption)



→ Lower output at given (K, N) , lower MPK, lower MPN

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2. DEMAND FOR LABOR BY FIRMS

a) Is there a labor market?

Facts: There are many labor markets separated by

- geographic location (area)
- types of skills (physician vs lawyers)
- level of skills (GP physician vs neurosurgeon)
- labor unions and single employer markets

Assumption: pretend that labor is a homogeneous input hired in a single competitive market

Question: Are homogeneity & competition good or bad assumptions to make in labor market?

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- Commodity traded = labor services, not people.
Employers rent services

- Homogeneity → all workers are substitutes for all other workers.

e.g. Janitor owns 1 unit of labor services per week

Accountant owns 5 units

Brain surgeon owns 25 units

- surgeon gets paid 25 times what the janitor receives
- Competition → labor unions represent 10% of labor force in U.S.
- Localized markets → not important because people move

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b) The Marginal Product of Labor

For any production function

$$Y = F(K, N) = AK^\alpha N^{1-\alpha}$$

We define

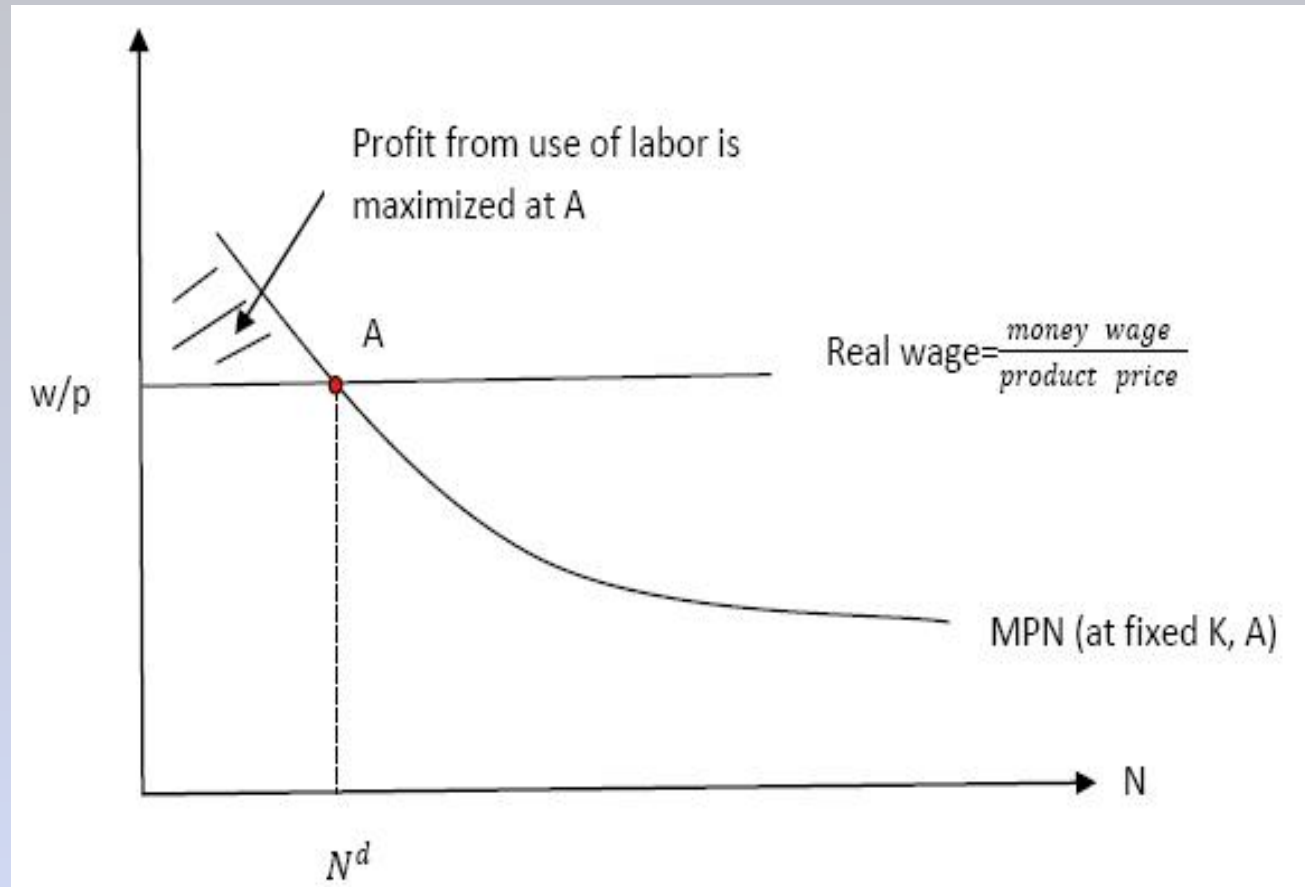
$$MPN = \frac{\partial F}{\partial N} \approx \left(\frac{\Delta Y}{\Delta N} \right) \Big|_{K=\text{fixed}}$$

In any competitive labor market, the firm's demand for labor is the same as the MPN schedule

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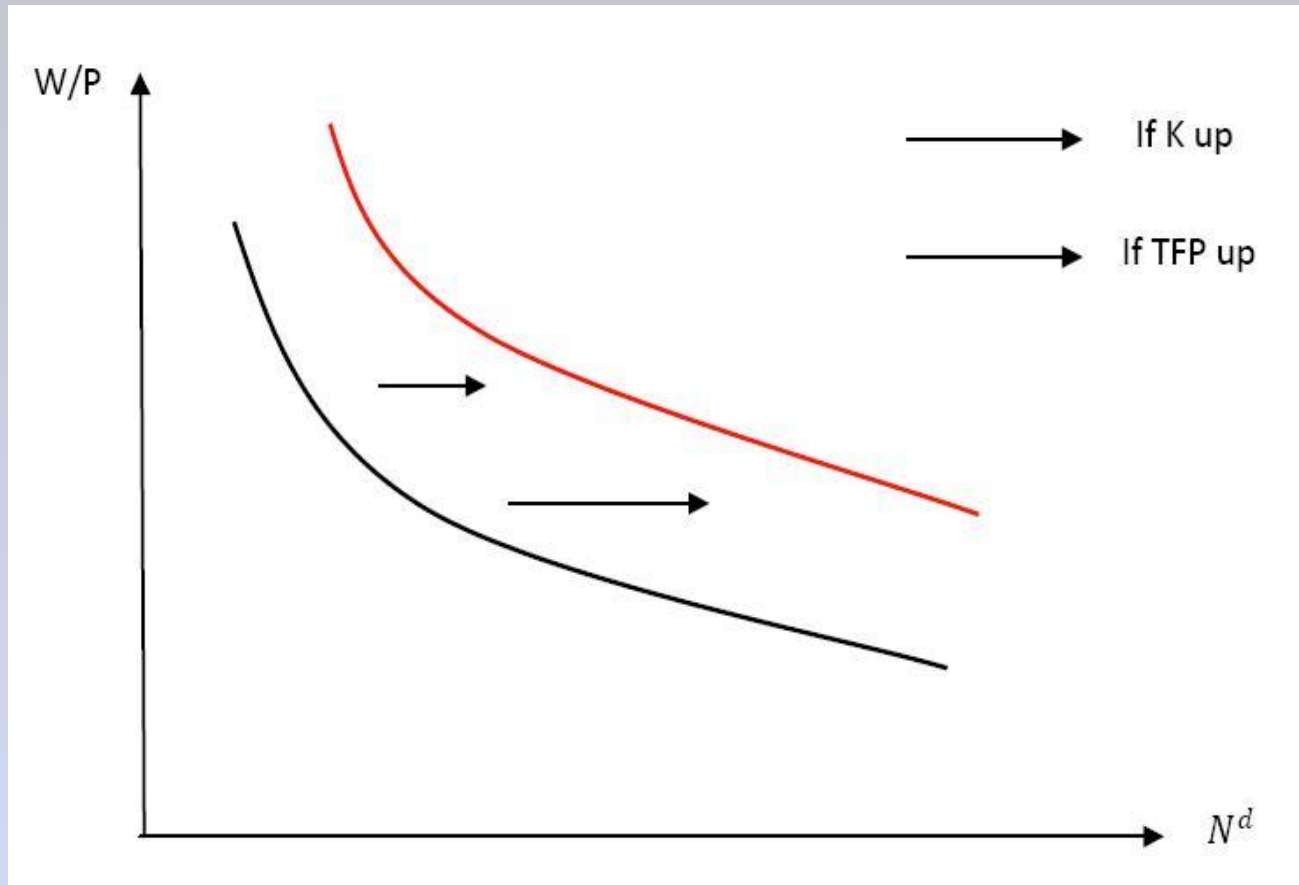


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Labor Demand

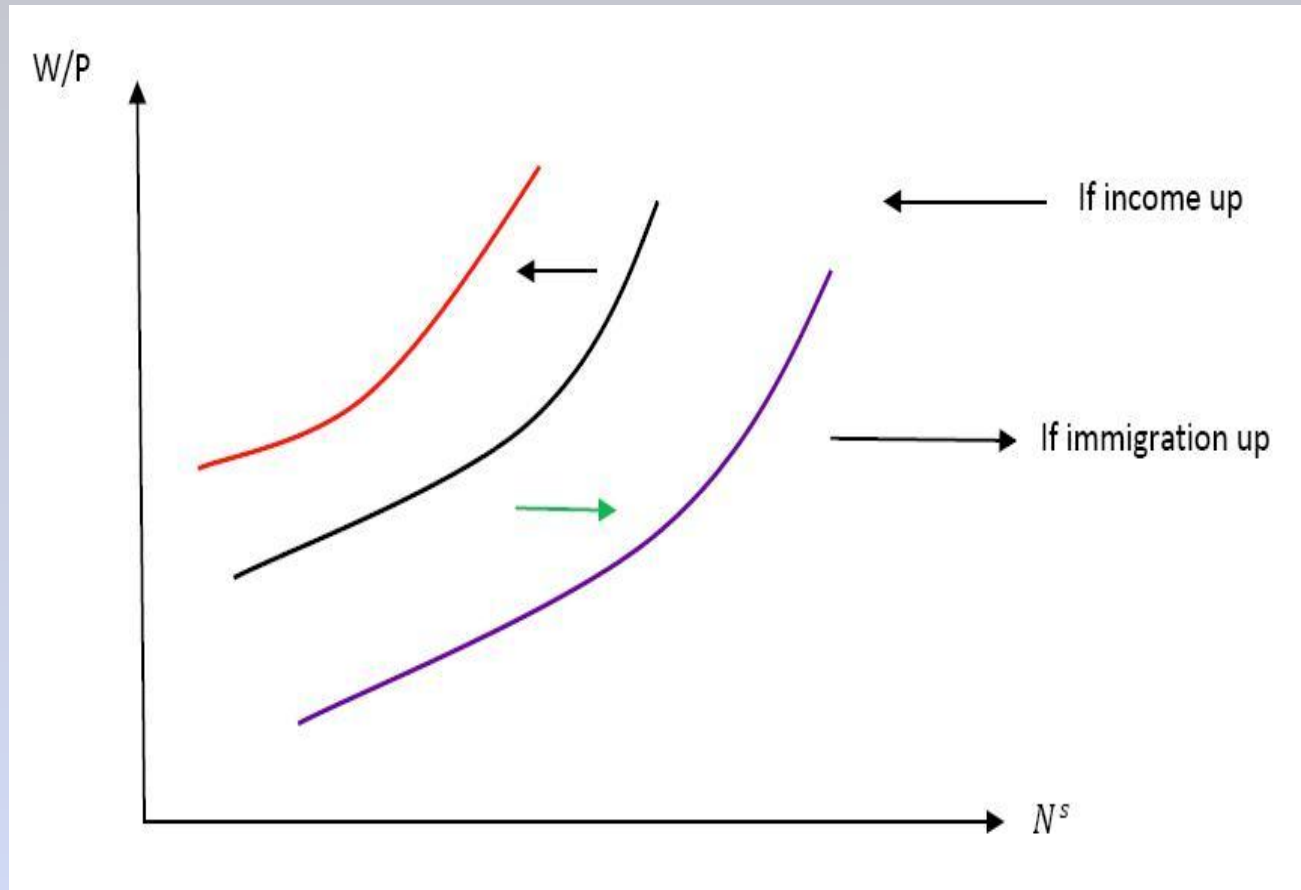


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Labor Supply



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3. THE SUPPLY OF LABOR SERVICES BY HOUSEHOLDS

(1) the substitution effect from short-lived wage movements
& long-run incentive pay plans \rightarrow N^s up when (w/p) up

(2) the income effect from long-run wage increases, inheritances,
lotteries: N^s down when income (wealth) up

(3) other factors:

-marriage, family, young children

-labor supply of spouses

-unemployment benefits

-income taxes

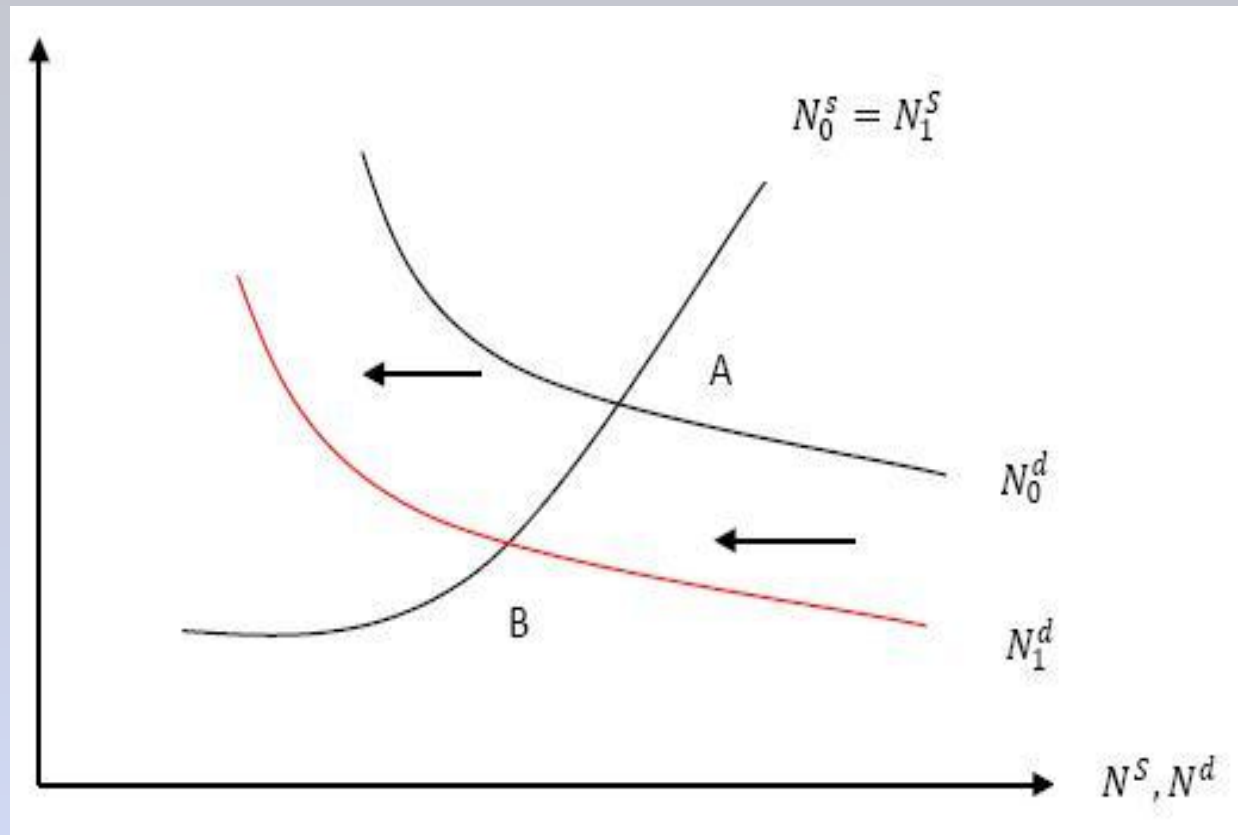
(last two factors are significant contributors to E.U. unemployment rates)

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a) The impact from negative productivity shocks: from A to B



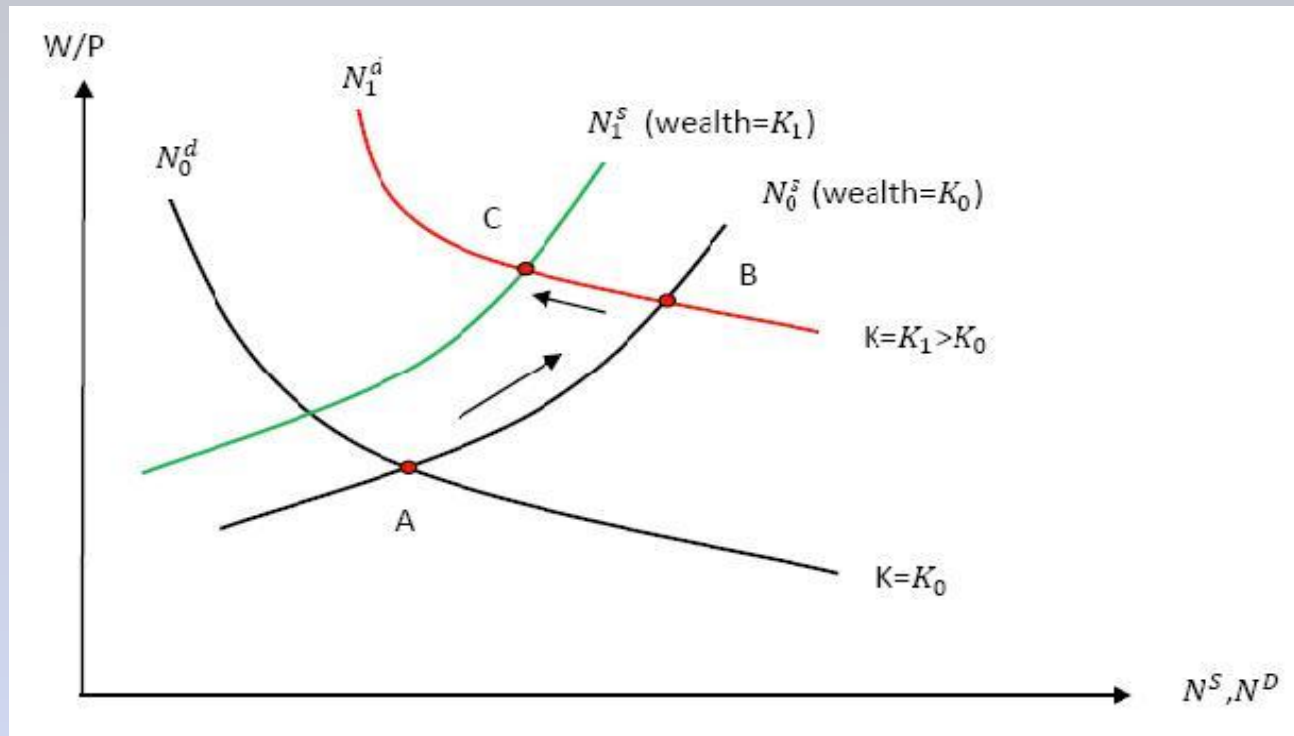
Employment goes down, real wage goes down
Ditto for higher energy prices

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b) The impact of economic growth, i.e., bigger K : from A to B to C



short run: $(N, w/p)$ goes up (a lot)

long run: N goes up a bit or not at all, w/p goes up a great deal.

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Ex: Hrs worked now are shorter than 100 years ago. Wages are much bigger. Cowboys worked dawn to dusk, 6 days a week. Made \$1 per day then(about \$15 in today's dollars) for ten hours of work.

5. EMPLOYMENT STATUS OF U.S. POPULATION

Table 3.4

Employment Status of the U.S. Adult Population, June 2009

Category	Number (millions)	Share of labor force (percent)	Share of adult population (percent)
Employed workers	140.2	90.5	59.5 (employment ratio)
Unemployed workers	14.7	9.5 (unemployment rate)	6.2
Labor force (employed + unemployed workers)	154.9	100.0	65.7 (participation rate)
Not in labor force	80.8		34.3
Adult population (labor force + not in labor force)	235.7		100.0

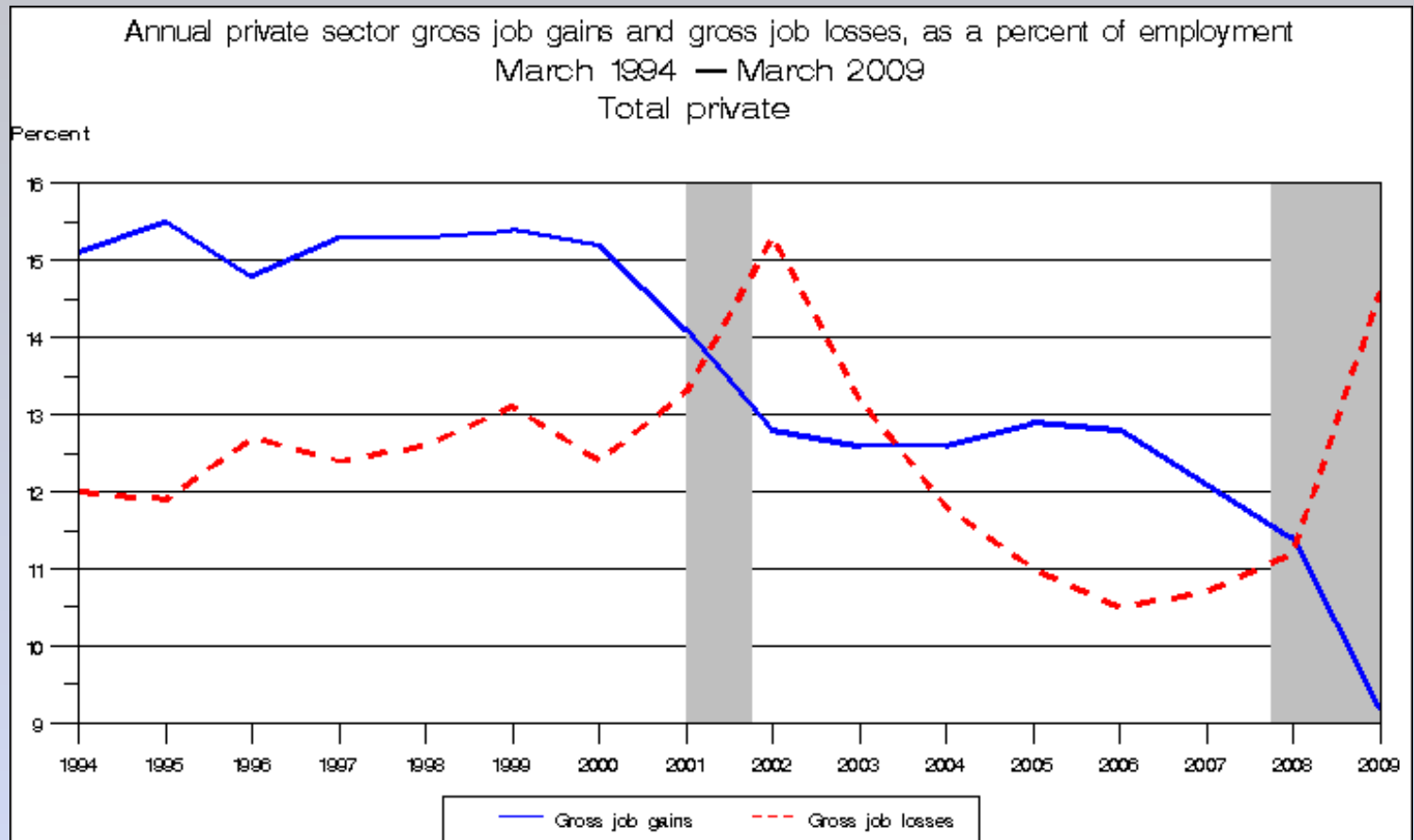
Note: Figures may not add up because of rounding.
Source: *The Employment Situation*, June 2009, Table A-1.

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Job Destruction and Job Creation



Source: U.S. Bureau of Labor Statistics

Note: Shaded area represents NBER defined recession period.

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4. INCOME INEQUALITY AND THE COLLEGE PREMIUM

a) Facts about U.S. dist'n of after-tax income

Between 1979 & 2005 real household incomes went up as follows:

Table	
Place in income dist'n	Raise %
Top 1%	176
Middle quintile	21
Bottom quintile	6

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Share of pre-tax income going to the top 1%

1928: 23.9%

1980: 10.0%

2007: 23.5%

Share of total after-tax income going to the top 1%

1979: 7.5%

2005: 14.0%

(about 2.7% went to top $\frac{1}{100}$ of 1%)

$$\frac{\text{Income of 95\% percentile}}{\text{Income of 20\% percentile}} = \begin{matrix} 6.3 \text{ times in 1967} \\ 8.6 \text{ times in 2003} \end{matrix}$$

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U.S. Income

Inequality increases in the 1970's, 1980's & 1990's after decreasing in the 1940's, 1950's & 1960's.

U.S. Wealth (2007)

34.6% goes to top 1% of households.

27.1% goes to bottom 90%.

b) Measuring Inequality: The Gini Coefficient

Gini lies in $[0, 1]$

$g = 0$ means complete equality

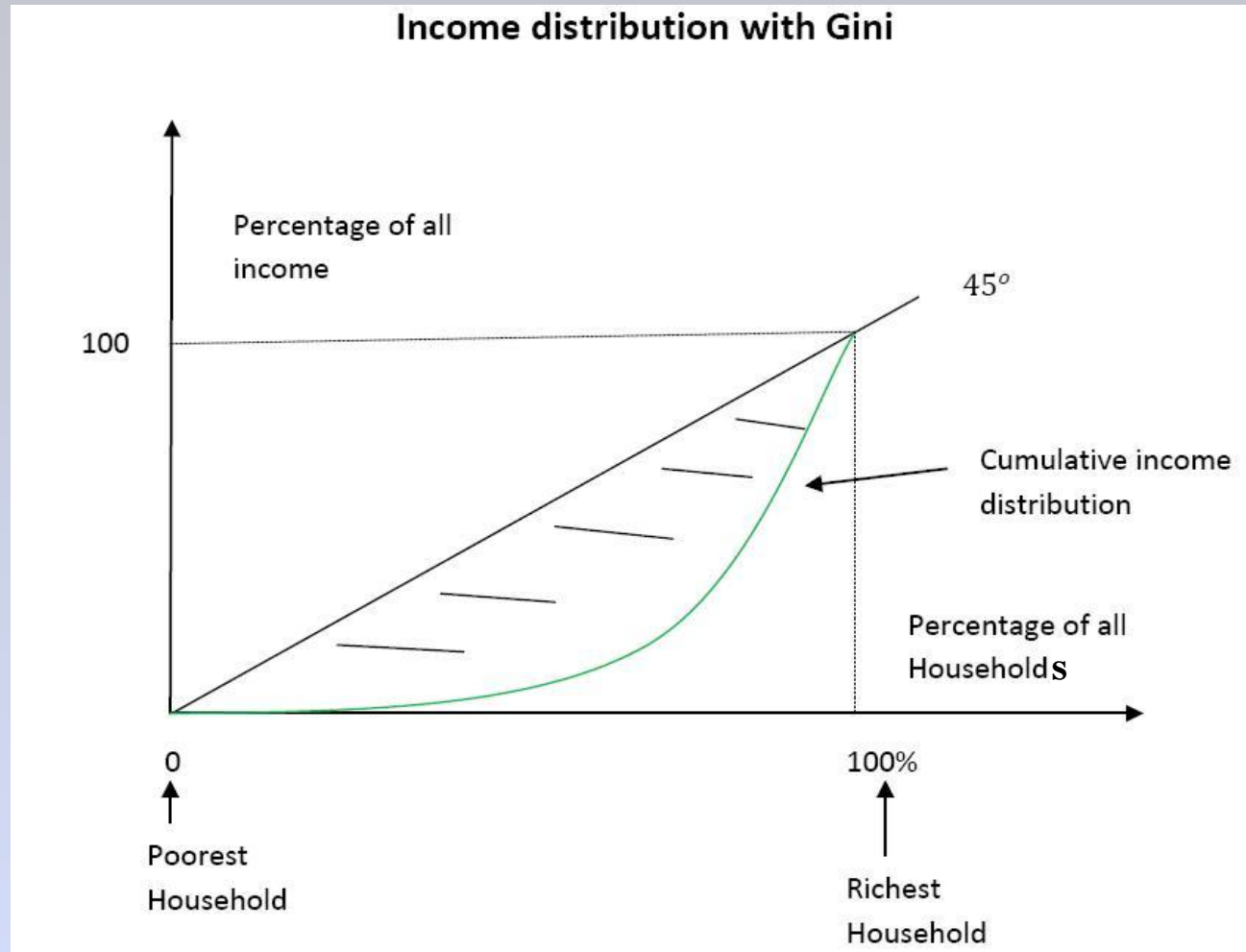
$g = 1$ means all income owned by one person

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Income dist'n example with Gini



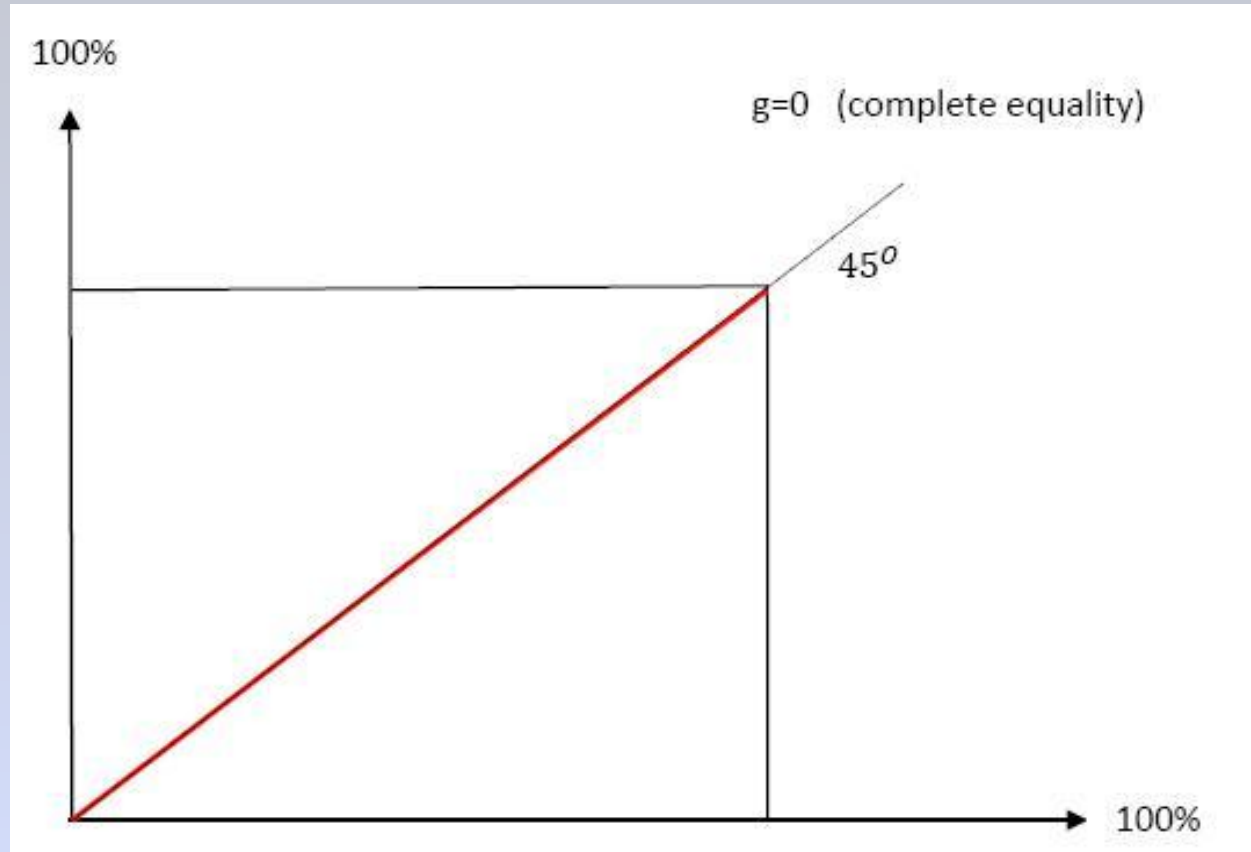
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Gini coefficient = area between cumulated income dist'n & 45 degree line

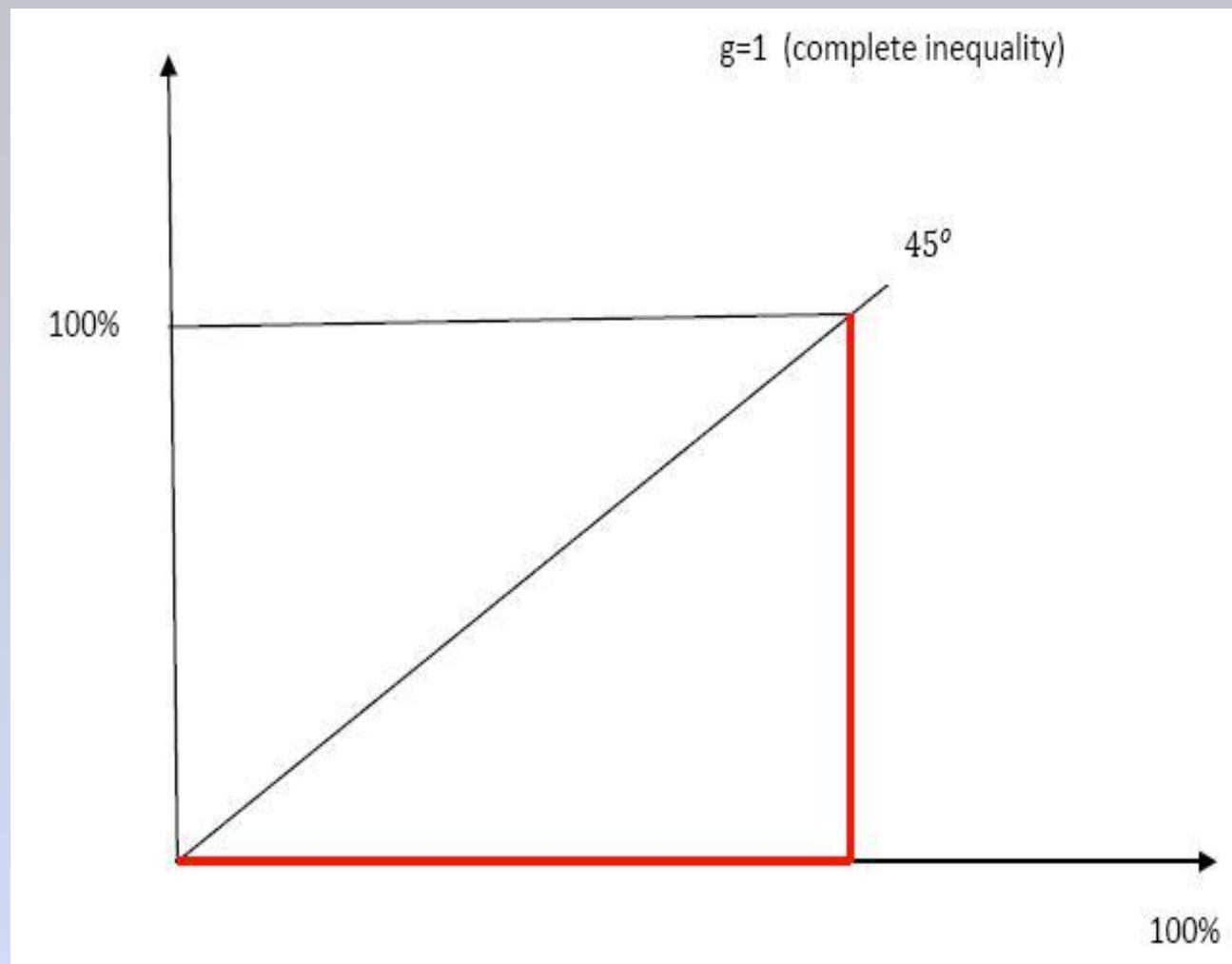
Extended Examples:



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c) Gini Coefficients for after-tax household income

Namibia = .73

USA = .38 - .40

Denmark = .25

before tax household earnings

U.S. = .45 - .49

Korea = .34

wealth dist'n Gini

U.S. = .78

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d) Causes of income inequality

(1) one earner vs. two-earner households

(2) single vs. two-parent households

(3) educational attainment:

median personal income in 2006

\$ 27,291 if high school graduate

\$ 71,184 if Ph.D.

(4) gender & race

(5) experience

e) gender inequality

$$\frac{\text{male median personal income}}{\text{female median personal income}} = \begin{matrix} 2.85 \text{ in } 1953 \\ 1.68 \text{ in } 2005 \end{matrix}$$

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Note: median educational attainment for men was higher in both 1953 & 2005

Ditto for experience.

Educational attainment & income

% of households with at least one college degree:

- 62% in upper income quantile
- 27% for all households

% of households with two or more earners:

- 76% in upper income quantile
- 42% for all households

College Premium <E.Moretti, AEJ, 01/2013> (%)

	“Nominal” Wages	“Real” Wages (adjusted for city living standard)
1980	40	38
1990	53	48
2000	60	53

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Ratio of Male-to-Female Earnings (full time workers)		
1980	1.64	
1990	1.39	
2004	1.31	
2008	1.25	All workers
2008	1.06	Never married workers (mostly young)

f) Causes of gender inequality

- hours worked: men work more overtime
- occupational choice: women choose careers that are easy on family life
- maternity and maternity leave
- aggressive negotiating by men (?)
- discrimination
 - U.S. customers prefer white male employees to women/minorities
 - statistical discrimination by employers

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g) Gender gap abroad

Ratio of Male-to-Female Earnings Abroad (full time workers 2005)		
Japan	1.66	
Colombia	1.34	
France	1.28	Similar to the U.S.
Sweden	1.10	

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5) SKILL-BIASED TECHNICAL CHANGE

Ideas:

(1) implementing new & more productive technologies requires an educated labor force

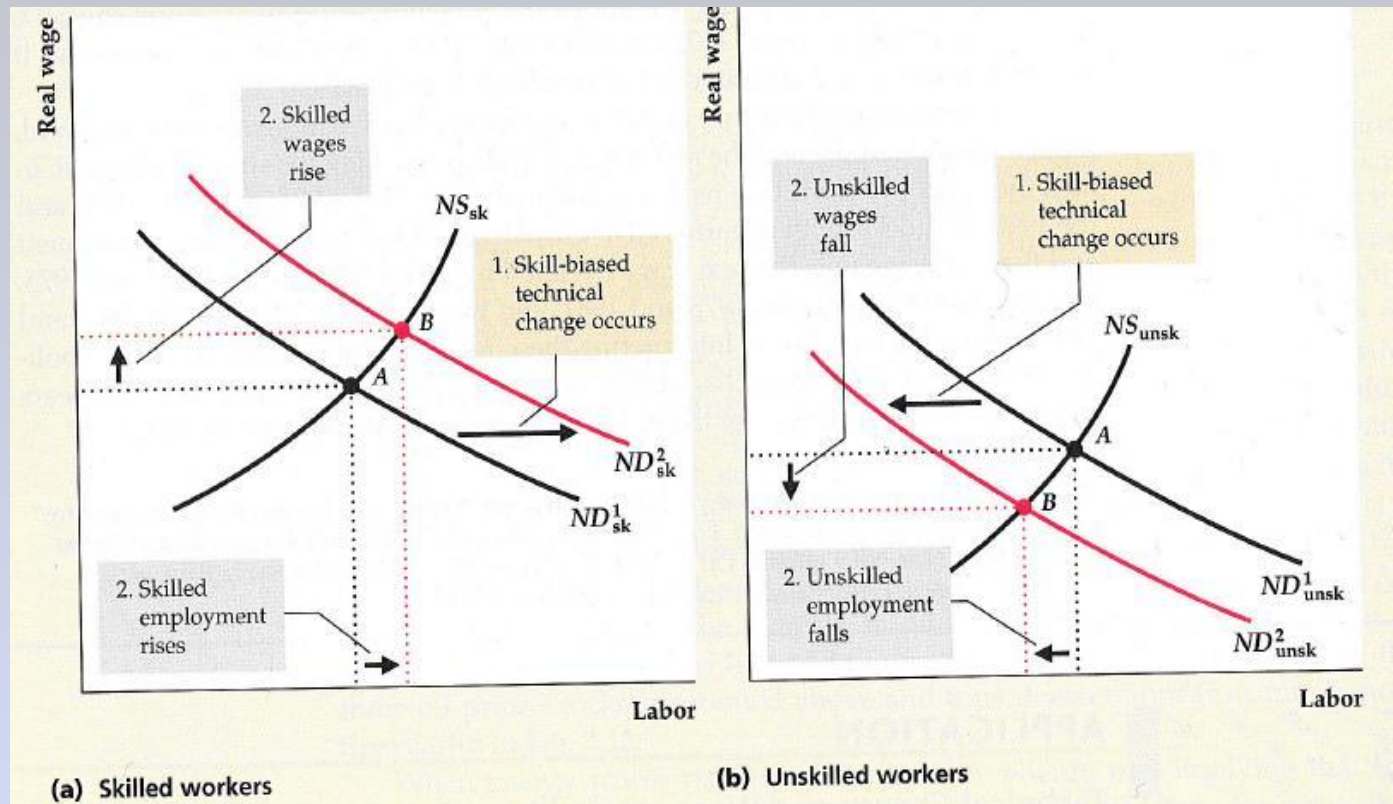
(2) technical change favors skilled workers (MPN increases), but not unskilled workers
(MPN steady)

(3) supply of unskilled labor has increased rapidly due to immigration

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6) ECONOMIC JUSTICE

Q1: What is the just distribution of income or wealth?

(a) Example: Economy with two persons $i=1,2$ (rich, poor)

Policy Options

1. No taxes $(y_1, y_2) = (9, 1)$
2. Low taxes $(y_1, y_2) = (7, 2)$
3. Medium taxes $(y_1, y_2) = (5, 3)$
4. High taxes $(y_1, y_2) = (3, 3)$

Q2: How do we measure inequality?

“Current” v. “Average” income

Ex. Suppose $(y_1, y_2) = (9, 1)$
 $= (1, 9)$ } \neq no wealth inequality

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b) Axioms of Choice

1. Highest total income → case 1
 2. Minimize inequality → case 4
 3. Maximize income of poorest person (Rawls) → case 3
- Role of Income mobility
 - transitory v. permanent poverty
 - U.S. attitude toward taxing the rich

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Q3: How do we eradicate permanent poverty?

1. Role of education and training
 - public education or a subsidy to the poor
 - neighborhood efforts: how do we give everyone access to good schools?
2. Evaluating schools
 - government looks at test scores
 - teacher pay v. school performance
 - parental choice & educational vouchers