Ch. 3: Productivity, Output and Employment

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Chapter Outline

- Production Function
- Demand for Labor
- Supply of Labor
- Labor Market Equilibrium
- Unemployment
- Okun's Law

Production Function

- How much the economy produces depends on factors of production
  - Capital (K)
  - Labor (N)
  - Others (raw materials, land, energy)
- Productivity of factors depends on technology and management

Production Function (Cont'd)

- Production function

$$Y = A \times F(K, N),$$

  where A = Total Factor Productivity (TFP)

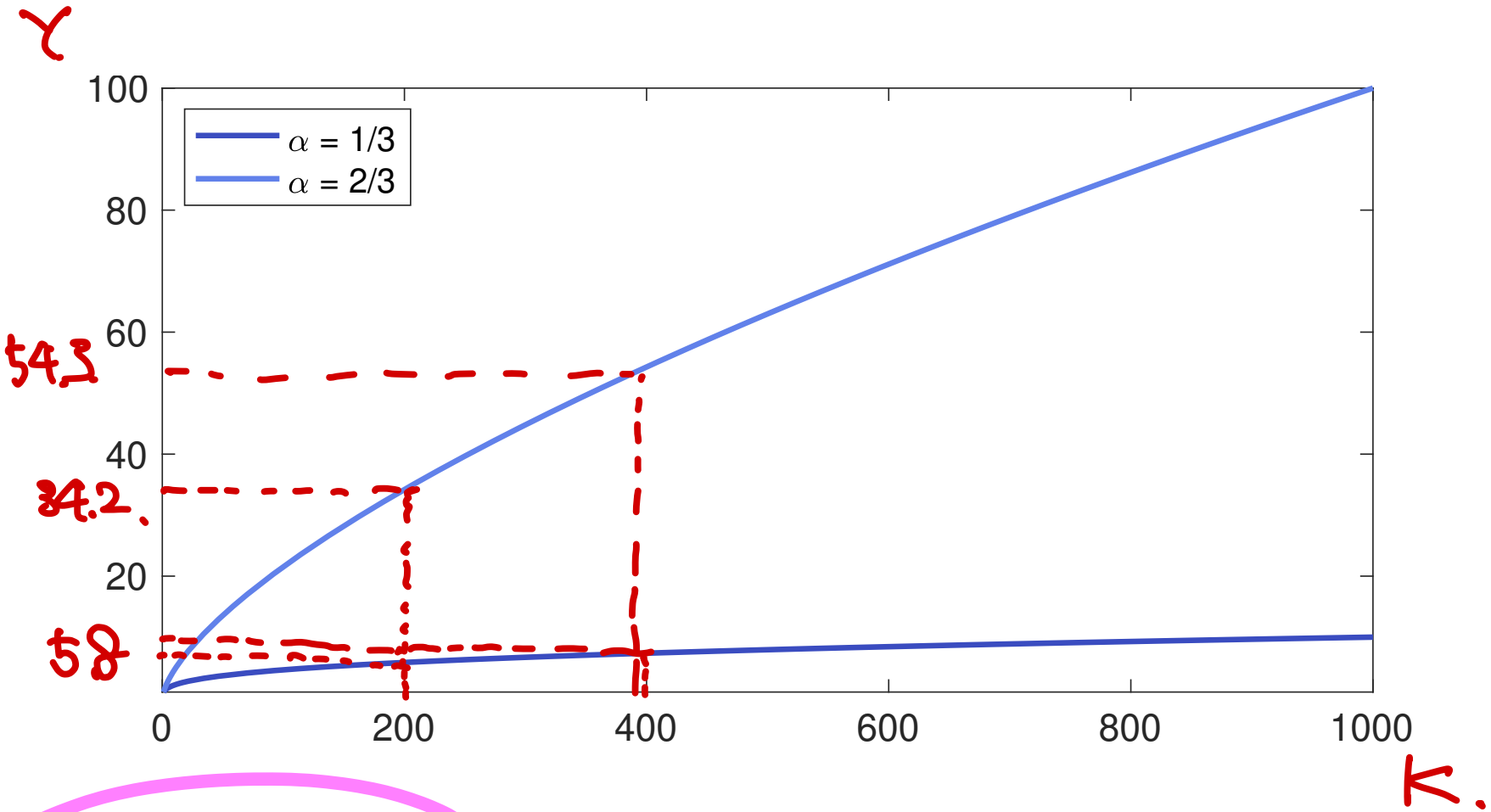
- Cobb-Douglas production function: $Y = AK^{\alpha}N^{1-\alpha}$
- What value of α should be?

= prof for technology.

← Contains many things that affect the amount of output, other than K and N.

Holding K and N fixed,
↑ in A ⇒ ↑ in Y.

Illustration: Plot of Y against K



- $Y = AK^{\alpha}N^{1-\alpha}$ with $A = 1$ and $N = 1$

Marginal Product of Capital (MPK)

≈ productivity of additional capital stock (= machines).

6/3

- $MPK = \frac{\Delta Y}{\Delta K}$
- Slope of production function
- Always positive, but diminishing MPK as $K \uparrow$
- The same thing applies to marginal product of labor (MPN)

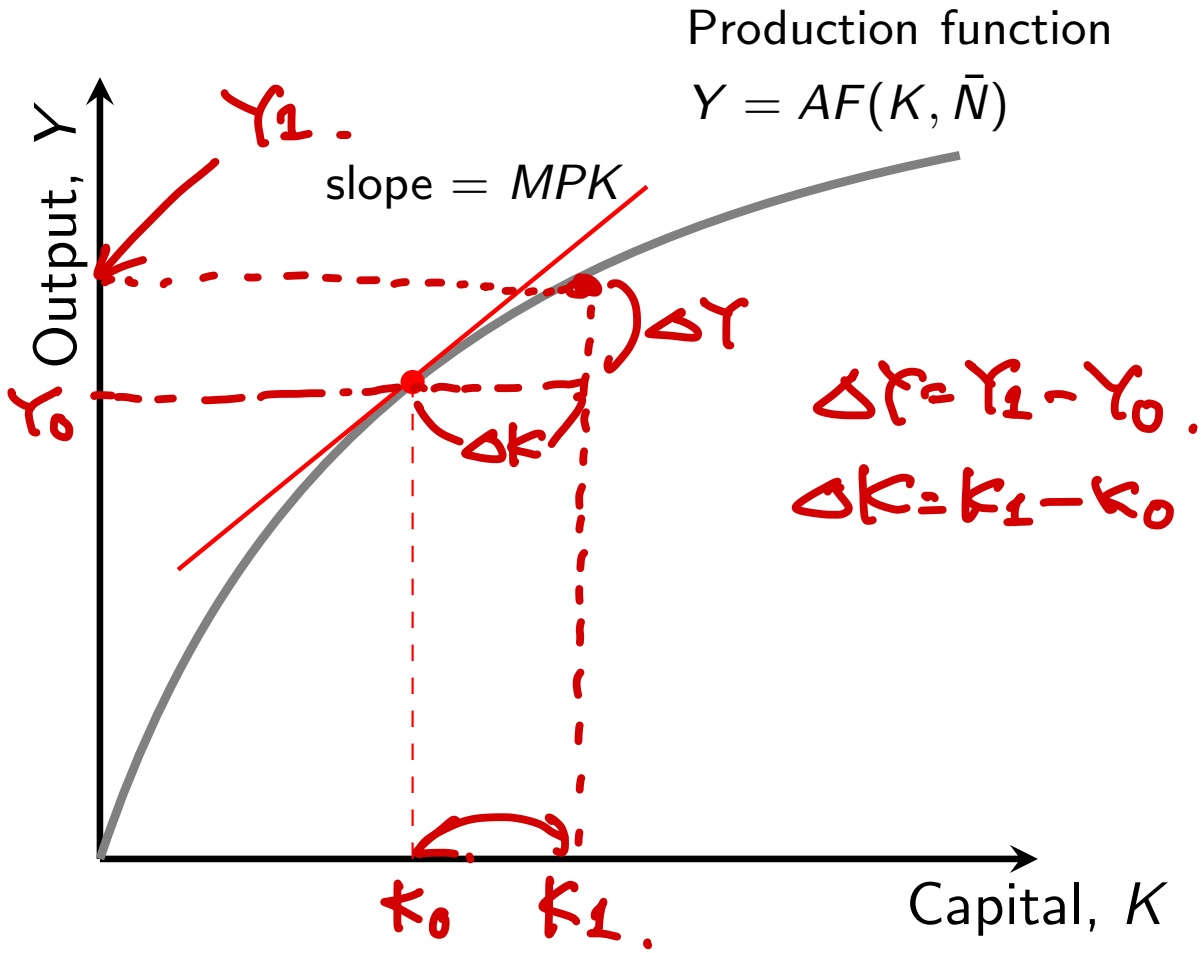


Figure: Production Function (holding N fixed)

Supply Shocks

- A change in an economy's production function (productivity shock)
- May be positive (increasing output) or negative (decreasing output)
- Examples: weather, inventions and innovations, government regulations, oil prices

Supply Shocks (Cont'd)

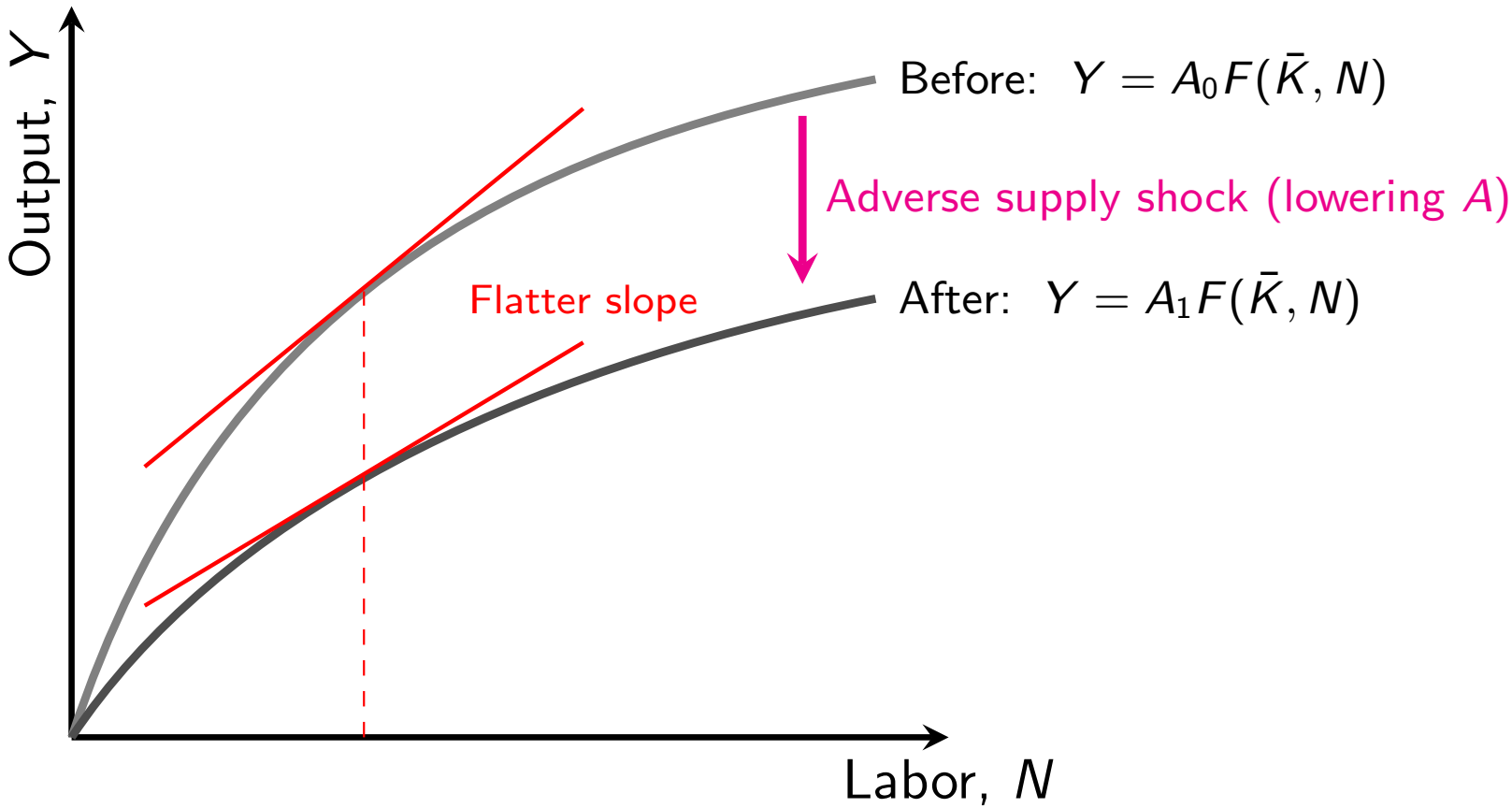


Figure: An Adverse Supply Shock Lowering the MPN (holding K fixed)

US Growth Accounting

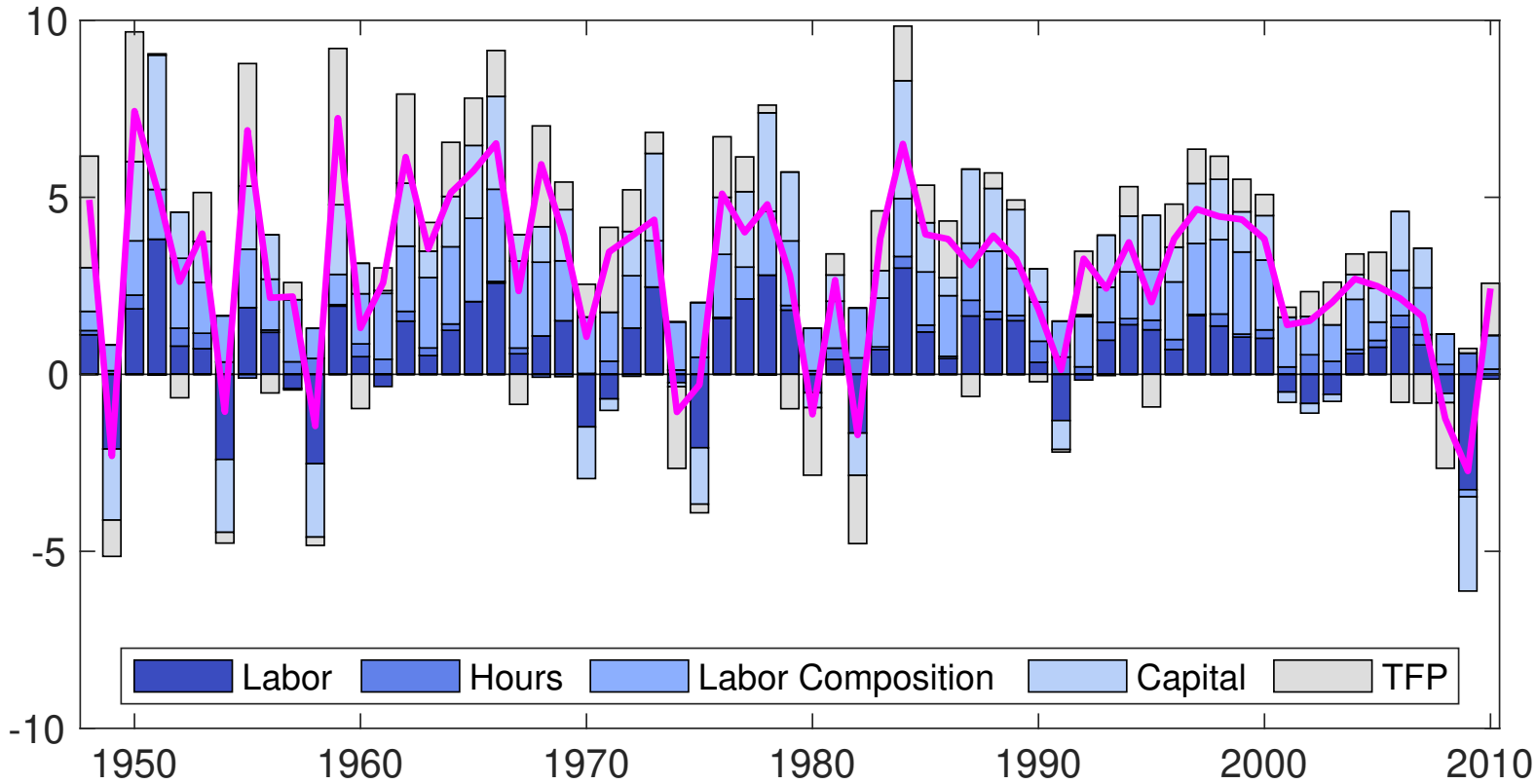


Figure: Contributions to US GDP Growth Rate (%)

Source: World KLEMS Data.

Japan's Growth Accounting

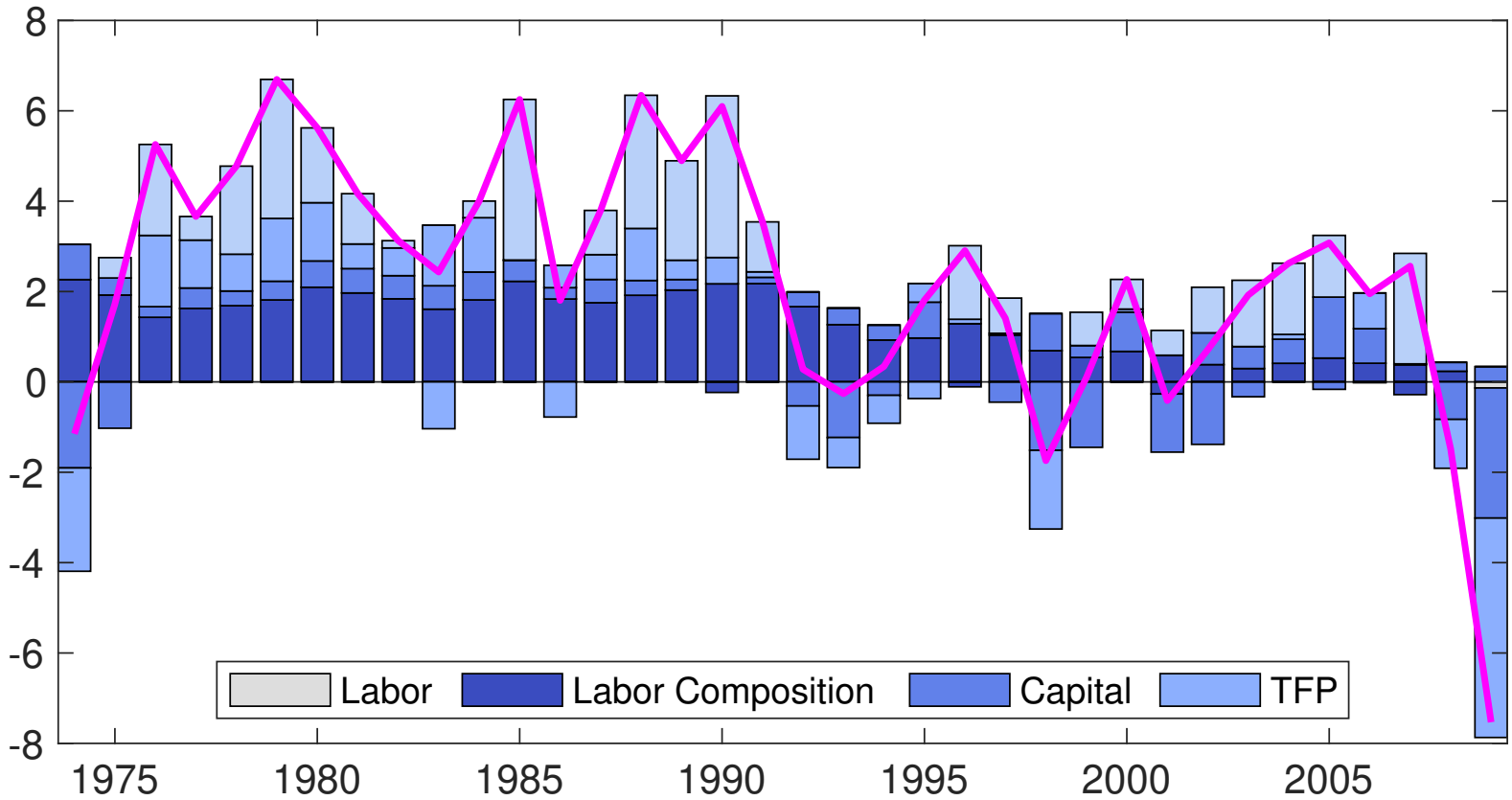


Figure: Contributions to Japan's GDP Growth Rate (%)

Source: World KLEMS Data.

Demand for Labor

- Assumptions
  - Hold capital stock fixed (short-run analysis)
  - Labor market is competitive
  - Firms maximize profits
  - Workers are all alike
- Labor demand is determined by

$$\frac{W}{P} = MPN$$

- Aggregate labor demand
  - Adding up firms' labor demand
  - Factors that shift firms' labor demand cause shifts in aggregate labor demand

Demand for Labor (Cont'd)

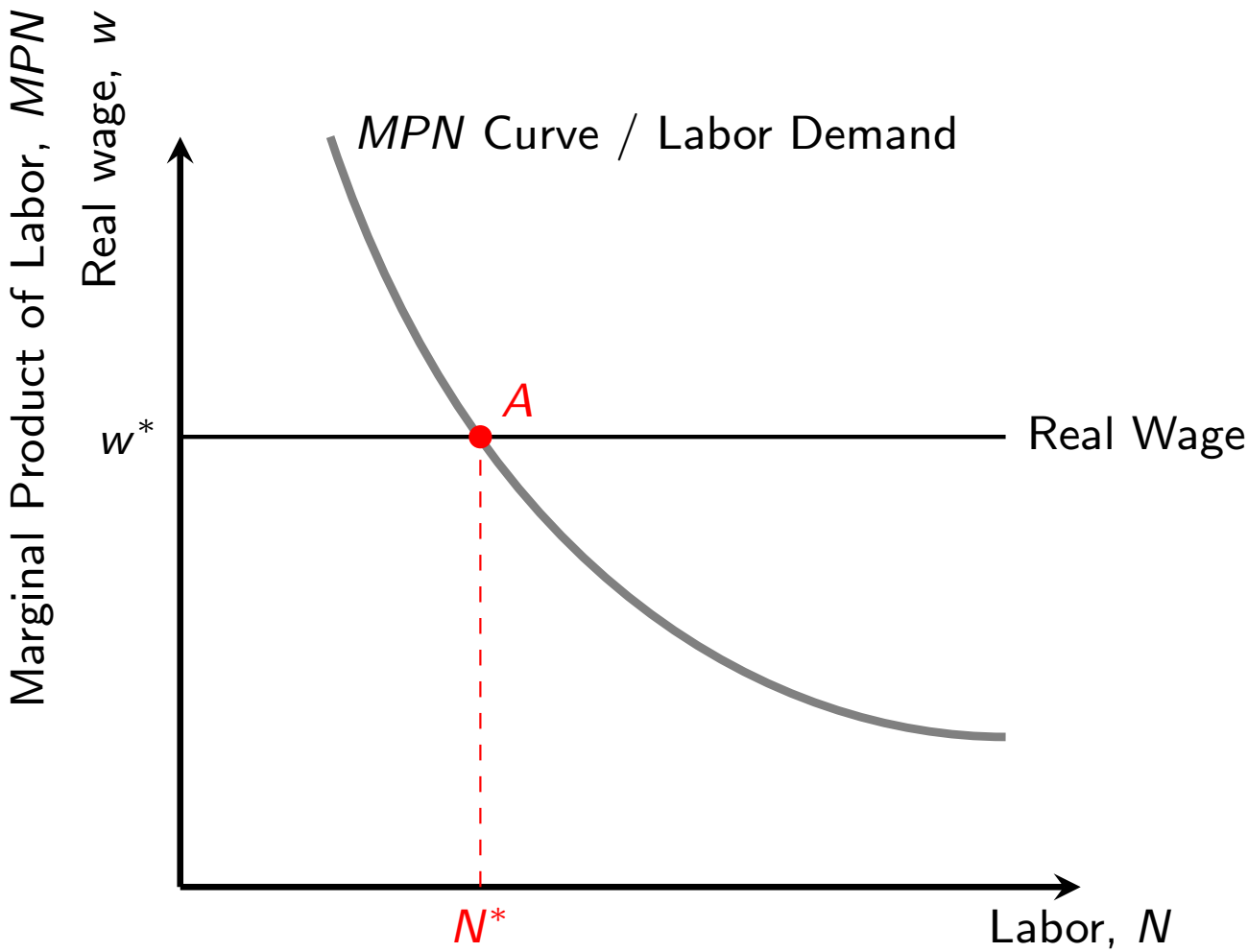


Figure: The Determination of Demand Curve

Shifts in Labor Demand

Labor Demand Shifters:

- Supply shocks
- Size of capital stock

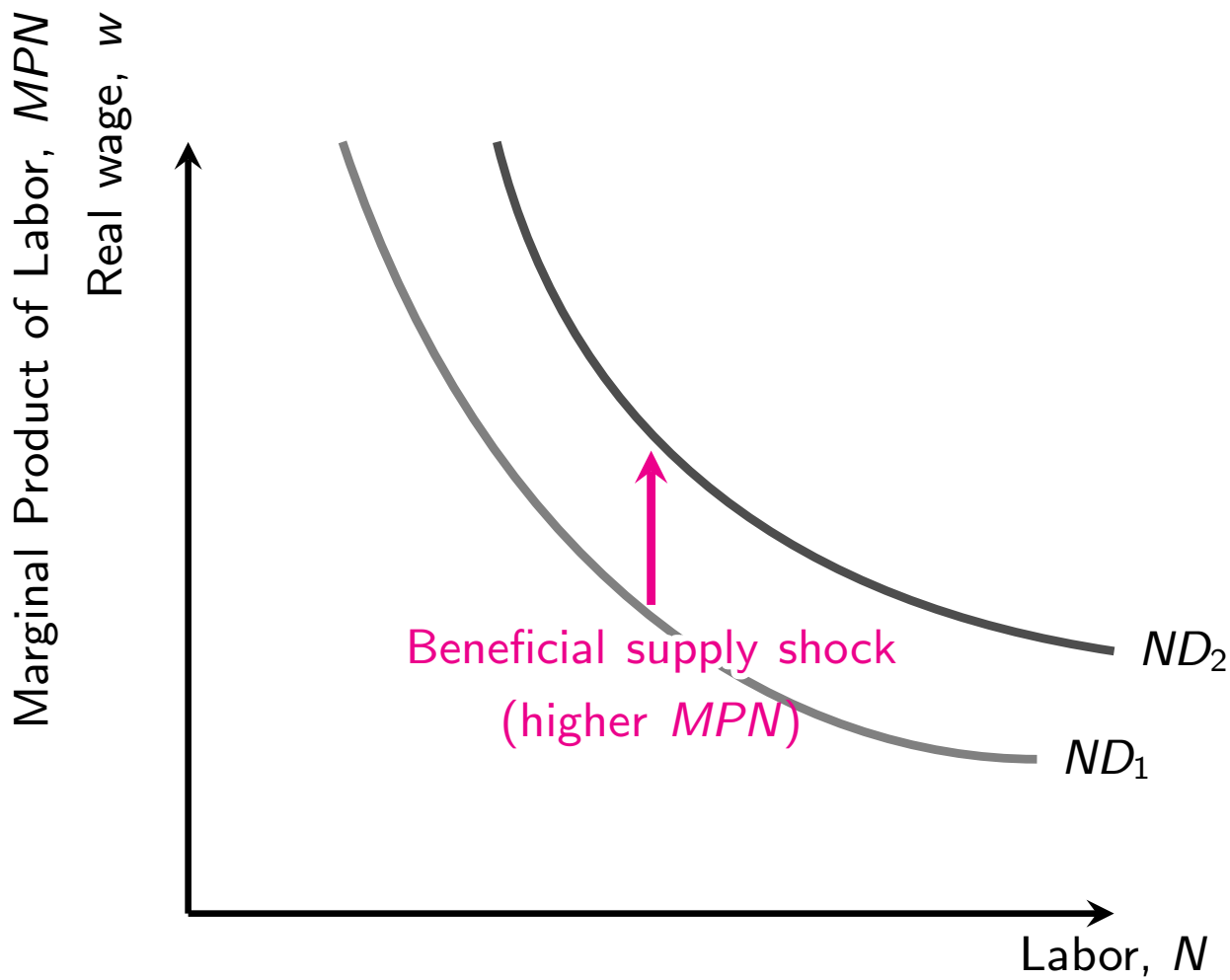


Figure: The Effect of a Beneficial Supply Shock

Supply of Labor

- Supply of labor is determined by individuals
- Aggregate supply of labor is the sum of individuals labor supply
- Labor supply of individuals depends on labor-leisure choice
  - Utility depends on consumption and leisure
  - Need to compare costs and benefits of working another day
  - Keep working additional days until benefits equal costs

Supply of Labor (Cont'd)

- How does an increase in the real wage affects the labor supply decision?
- **Substitution effect:** Higher real wage encourages work, since reward for working is higher
- **Income effect:** Higher real wage increases income for same amount of work time, so person can afford more leisure, so will supply less labor

Supply of Labor (Cont'd)

- A one-day rise in the real wage
  - A temporary real wage increase has just a pure substitution effect, since the effect on wealth is negligible
- Winning the lottery
  - A pure income effect
  - Doesn't have a substitution effect, because it does not affect the reward for working
  - Since a person becomes wealthier, s/he will both consume more goods and take more leisure

Supply of Labor (Cont'd)

- A long-term increase in the real wage
  - The substitution effect AND the income effect
  - The reward to working is greater (substitution effect toward more work)
  - With higher wage, a person does not need to work as much (income effect toward less work)
  - The longer the high wage is expected to last, the stronger the income effect
- Empirical evidence on real wages and labor supply
  - Labor supply increases with a temporary rise in the real wage
  - Labor supply falls with a permanent increase in the real wage

Labor Supply Curve

- Labor supply curve relates quantity of labor supplied to real wage
- Upward-sloping

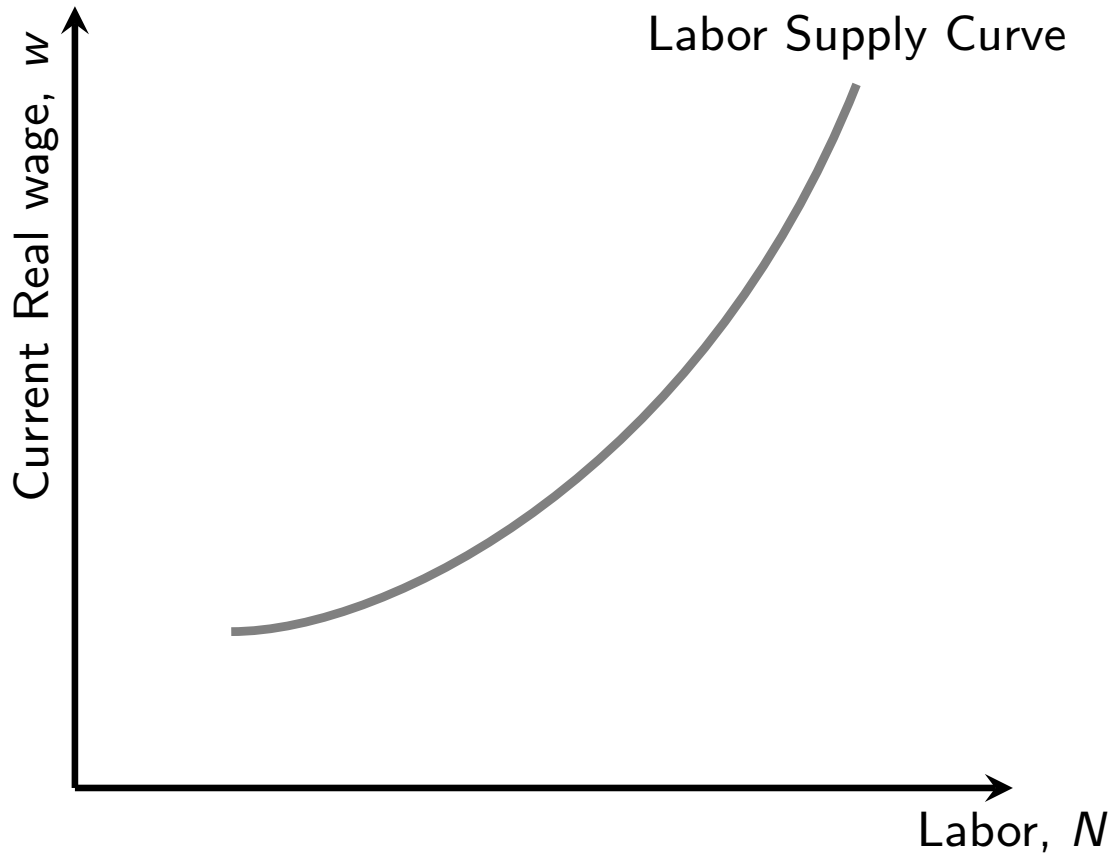


Figure: The Labor Supply Curve of an Individual Worker

Shifts in Labor Supply

Labor Supply Shifters:

- Wealth
- Expected future real wage

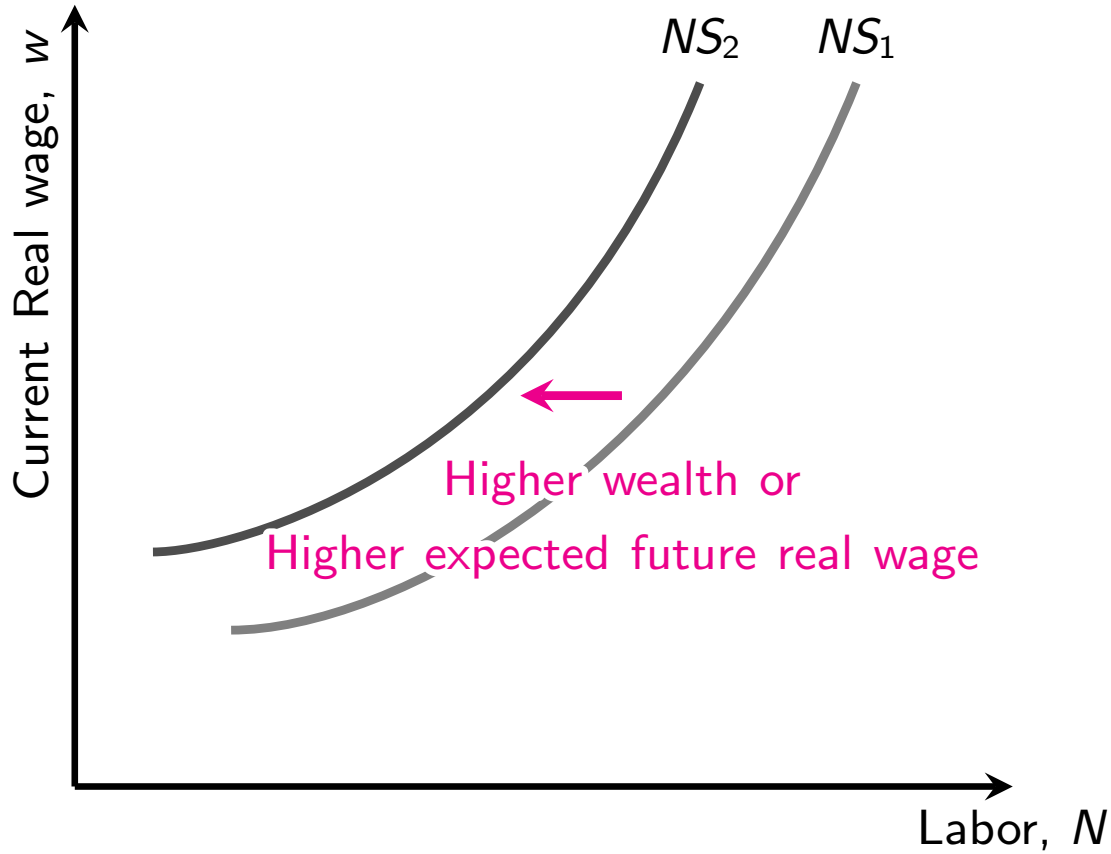


Figure: The Effect on Labor Supply of an Increase in Wealth

Labor Market Equilibrium

- Classical model of the labor market – real wage adjusts quickly
- Determines full-employment level of employment and market-clearing real wage
- Problem with classical model: can't study unemployment

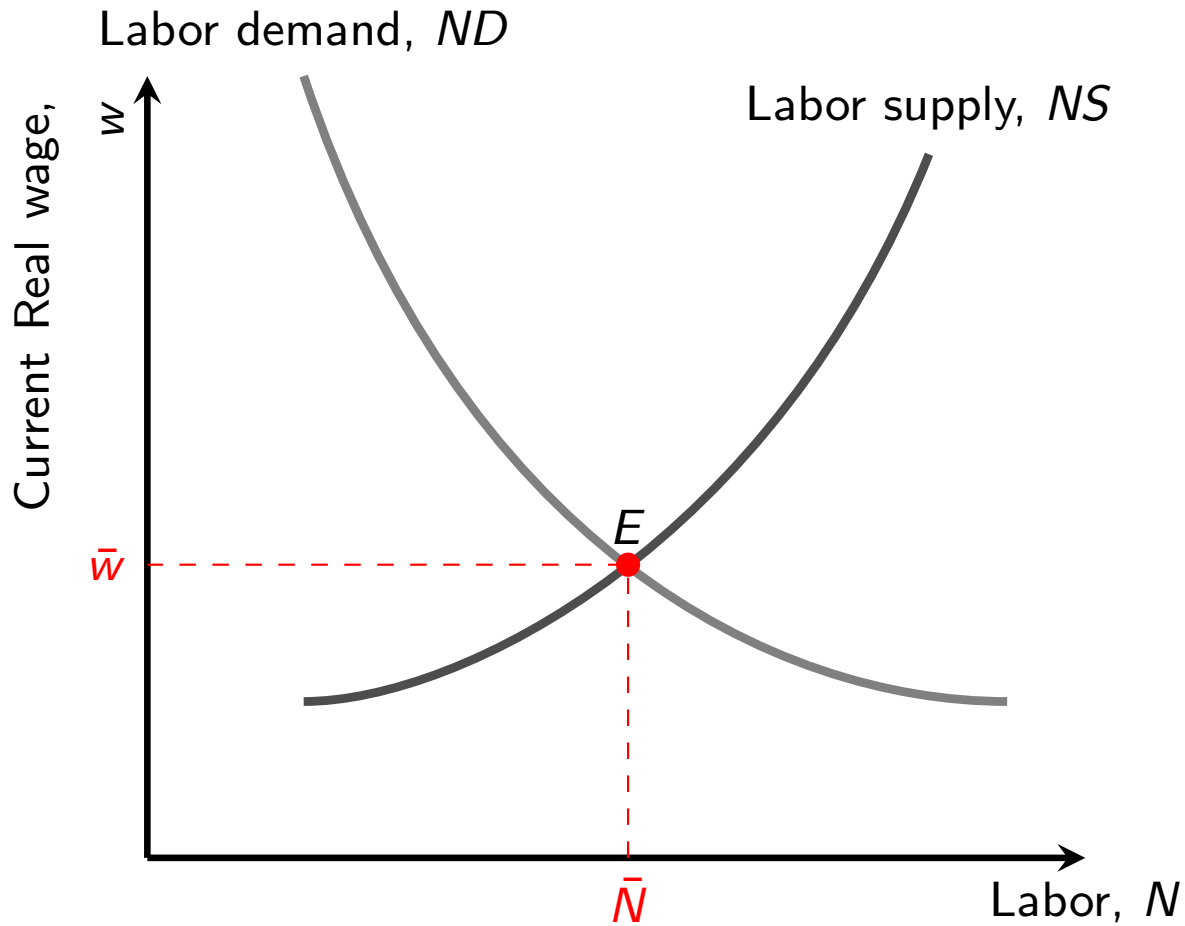


Figure: Labor Market Equilibrium

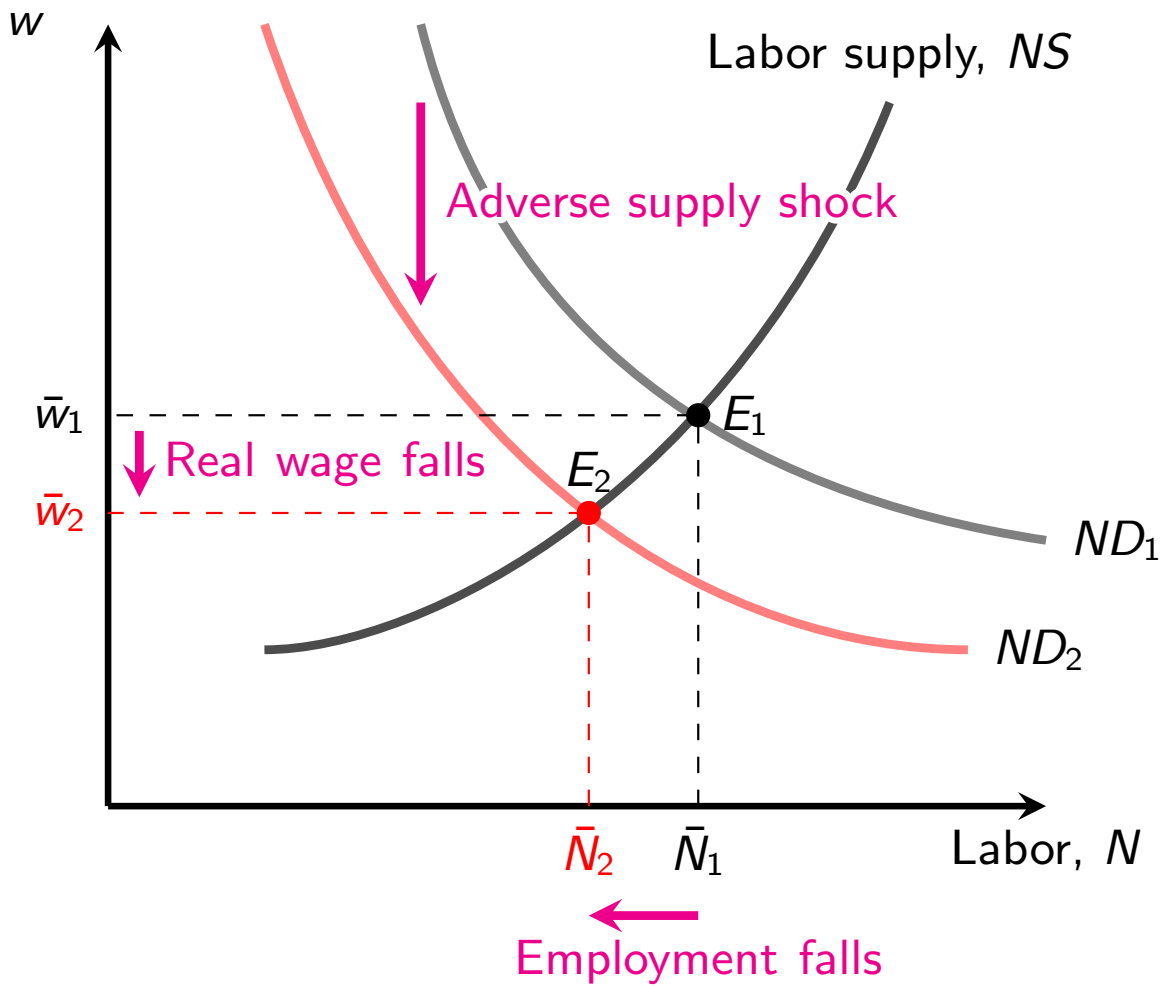
Labor Market Equilibrium

- Full-employment output
  = potential output
  = level of output when labor market is in equilibrium

$$\bar{Y} = AF(K, \bar{N})$$

- Affected by changes in full employment level or production function
- How does an adverse supply shock affect potential output?

Effects of a Temporary Adverse Supply Shock



Relative Price of Energy and Recessions

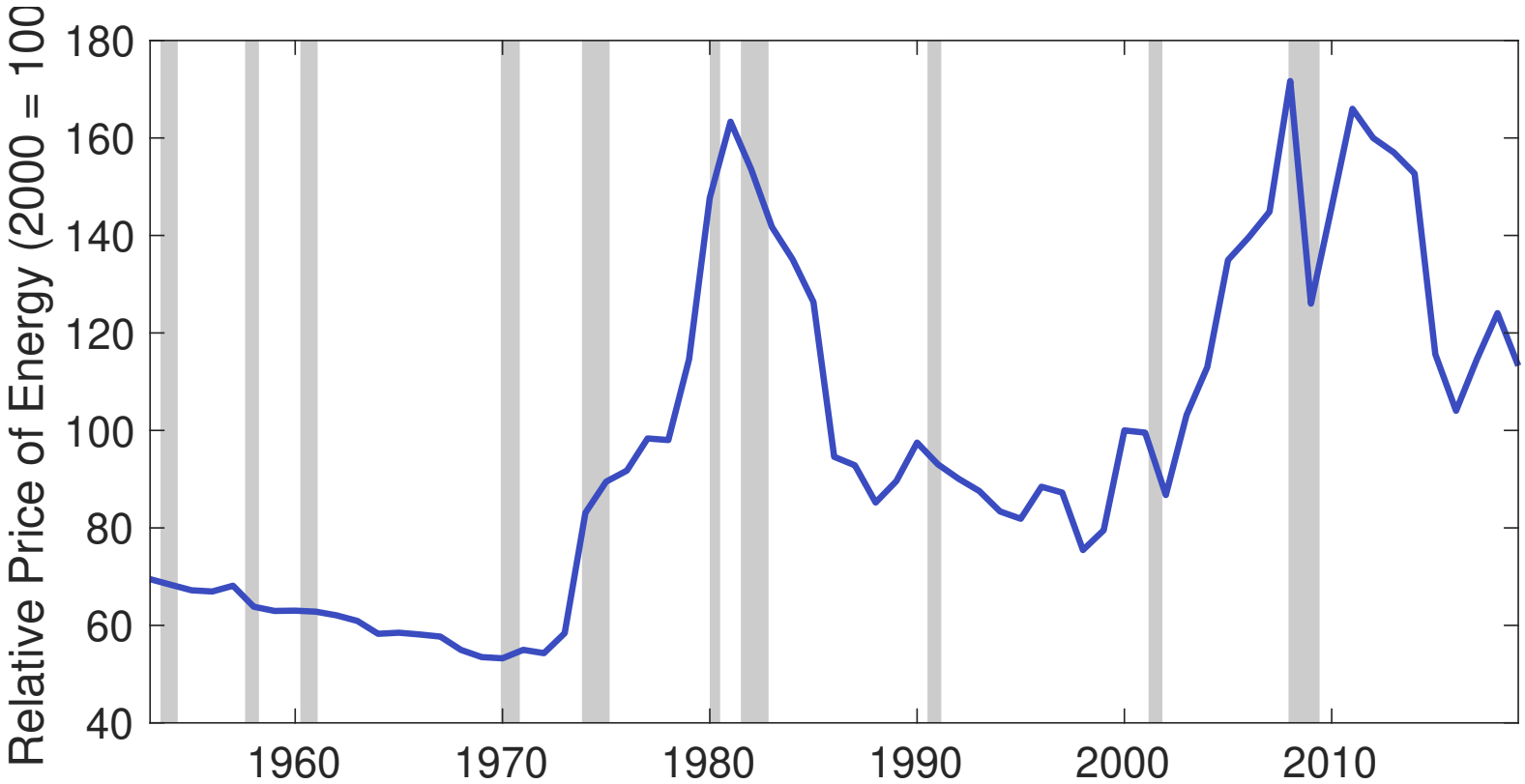


Figure: Relative Price of Energy

Source: FRED database, Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/PPIENG; https://fred.stlouisfed.org/series/GDPDEF.

Unemployment

- What is the strong assumption on the labor market model discussed so far?
- In reality, not everyone who would like to work has a job

Why There are Always Unemployed People?

- Frictional unemployment
  - Search activity of firms and workers due to heterogeneity
  - Matching process takes time
- Structural unemployment
  - The long-term and chronic unemployment that exists even when the economy is not in a recession
  - Lack of skills prevents some workers from finding long-term employment
  - Reallocation of workers out of shrinking industries or depressed regions

How is the Unemployment Rate Measured?

- Categories:
  - Employed
  - Unemployed
  - Not in the labor force

$$\text{Unemployment Rate} = \frac{\text{Unemployed}}{\underbrace{\text{Employed} + \text{Unemployed}}_{\text{Labor Force}}}$$

- Labor force = Employed + Unemployed

Employment Status

	Number (thousands)	Labor Force Share (%)	Adult Pop. Share (%)
Employed Workers	133,403	85.25	51.32
Unemployed Workers	23,078	14.74	8.88
Labor Force	156,481	100.00	60.21
Not in Labor Force	103,415		39.79
Adult Population	259,896		100.00

Table: Employment Status of the US Adult Population, April 2020

- Unemployment rate?
- Employment ratio?
- Labor participation rate?

Source: Bureau of Labor Statistics, Employment Situation Summary, Table A.

Natural Rate of Unemployment

- Natural rate of unemployment ($\bar{u}$): When output and employment are at full-employment levels

$$\bar{u} = \text{frictional} + \text{structural unemployment}$$

- Cyclical unemployment: Difference between actual unemployment rate and natural rate of unemployment ($u - \bar{u}$)

Okun's Law

- Relationship between output (relative to full-employment output) and cyclical unemployment

$$\frac{\bar{Y} - Y}{\bar{Y}} = 2(u - \bar{u})$$

- Alternative formulation if average growth rate of full-employment output is 3%:

$$\frac{\Delta Y}{Y} = 3 - 2\Delta u$$

Okun's Law (Cont'd)

Figure: Relating Output and Unemployment

Estimated relationship: $\widehat{\Delta Y/Y} = 3.2 - 1.7\Delta u$

Source: FRED database, Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/GDPC1; https://fred.stlouisfed.org/series/UNRATE.