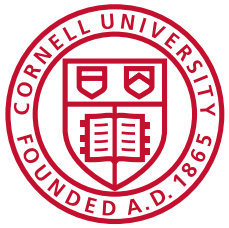

Cornell University

ECON 3040
Intermediate Macroeconomic Theory

Lecture 5: The Labor Market

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Outline

- Labor demand (by firms)
- Labor supply (by people)
- Labor market equilibrium
- Why do the French work less?

Factor Demand by Firms

Firms produce and sell goods

Why ?

To maximize profits

How ?

- By choosing how much inputs to use (labor, capital)
- Taking their current technology as given

Labor Demand

- Assume
  - Capital stock is fixed in the short run (we will relax that later)
    - Capital takes time to adjust
    - Focus on demand for labor
  - Workers are identical
  - Perfect competition on product and labor market
    - Firms have no control over prices and wages
  - Firms maximize profits

Notation

- Notations :
  - P = price level of the unique good
  - Y = real GDP
  - W = nominal wage (in $)
  - w = W/P = real wage
  - UC = nominal user cost of capital, or rental price of capital
  - uc = UC/P = real user cost of capital

Labor Demand by Firms

- Firms maximize profits
  - In nominal terms:

Profits = Revenue − Costs

$$\Pi = P \cdot Y - (W \cdot N + UC \cdot K)$$

  - P.Y = total sales revenue (in $)
  - W.N = total wage bill (in $)
  - UC.K = income accruing to capital holder (in $)

Labor Demand by Firms

- Maximization problem :
  - Given a stock of capital K, choose N to maximize profits.

- Represent firms' problem mathematically:

$$\max_N P.Y - W.N - UC.K$$

$$\text{subject to } Y = AF(K, N)$$

Solving the Firm's Problem

$$\max_N P.Y - W.N - UC.K \qquad \textbf{(Objective)}$$

$$\text{subject to } Y = AF(K, N) \qquad \textbf{(Constraint)}$$

- This is a constrained maximization problem :
  - How should we deal with the constraint ?
  - Simply by substituting in the objective function :

$$\max_N P.AF(K, N) - W.N - UC.K$$

Solving the Firm's Problem

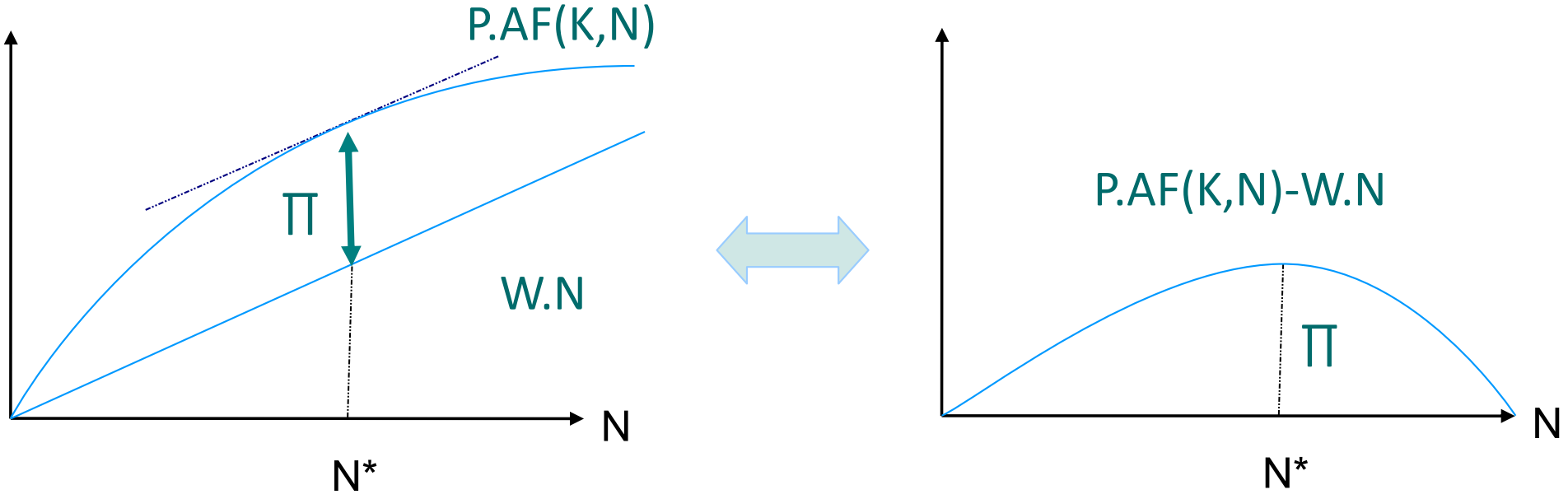
- Holding P, W, UC, A and K fixed, we solve for the optimal labor N :
  - Derive the First Order Condition (FOC) :

$$P.\underbrace{A\frac{\partial F(K,N)}{\partial N}}_{MPN}-W=0$$

$$MPN \equiv \underbrace{A\frac{\partial F(K,N)}{\partial N}}_{\text{marginal product of labor}} = \underbrace{\frac{W}{P}}_{\text{real marginal cost}} \equiv MC$$

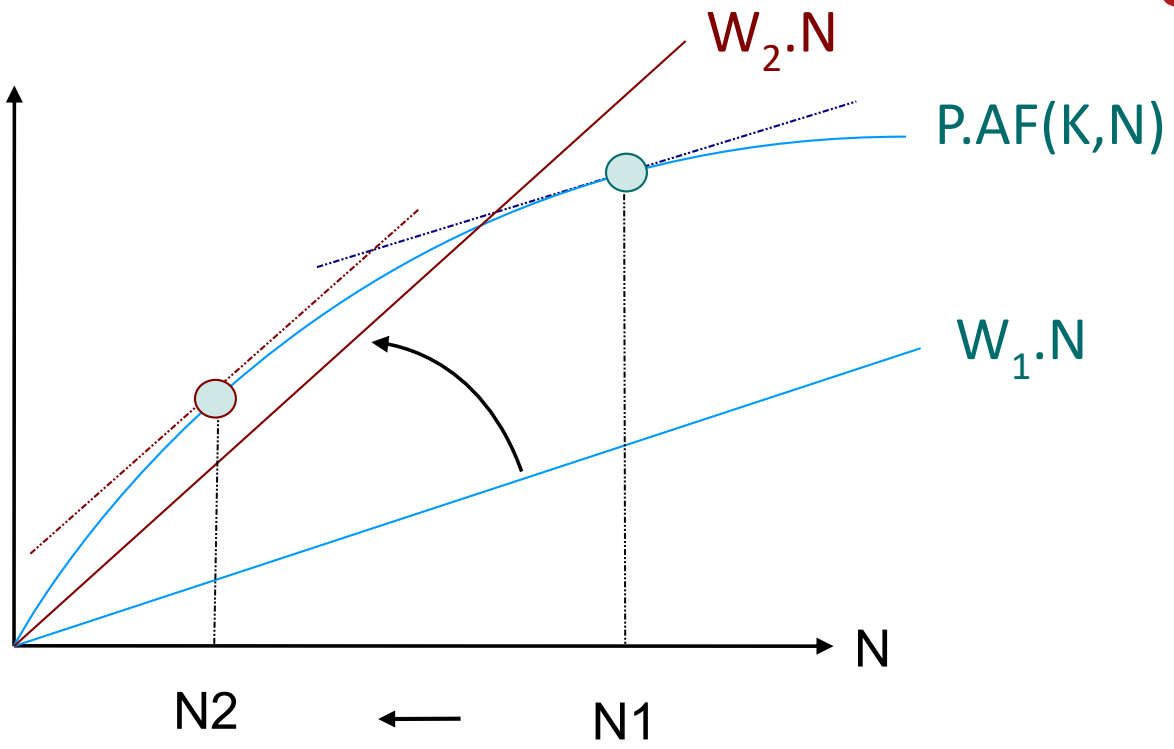
  - With Cobb-Douglas: $MPN = (1-a)AK^aN^{-a} = (1-a)Y/N = W/P = w$

Intuition



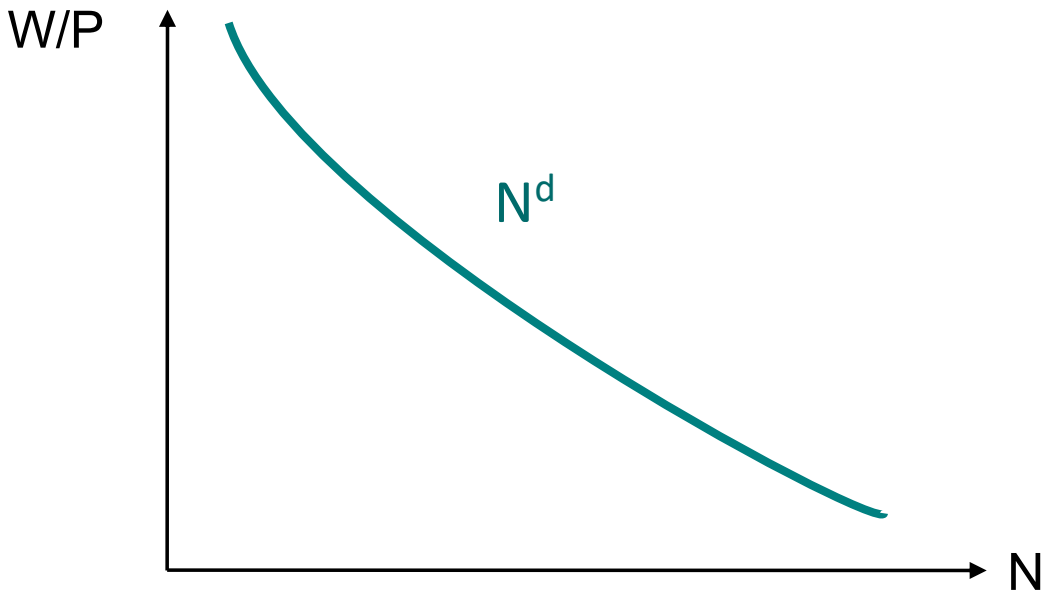
- Intuition for the result:
  - With fewer workers, MPN > W/P, so more gains to makes!
    - The revenue from an extra worker exceeds the cost, so hire more.
    - Hire more until at some point MPN = W/P
  - If hire too much, MPN < W/P, so start making losses!
    - The revenue from extra worker is less than the cost so reduce workforce.

Effect of an Increase in the Wage



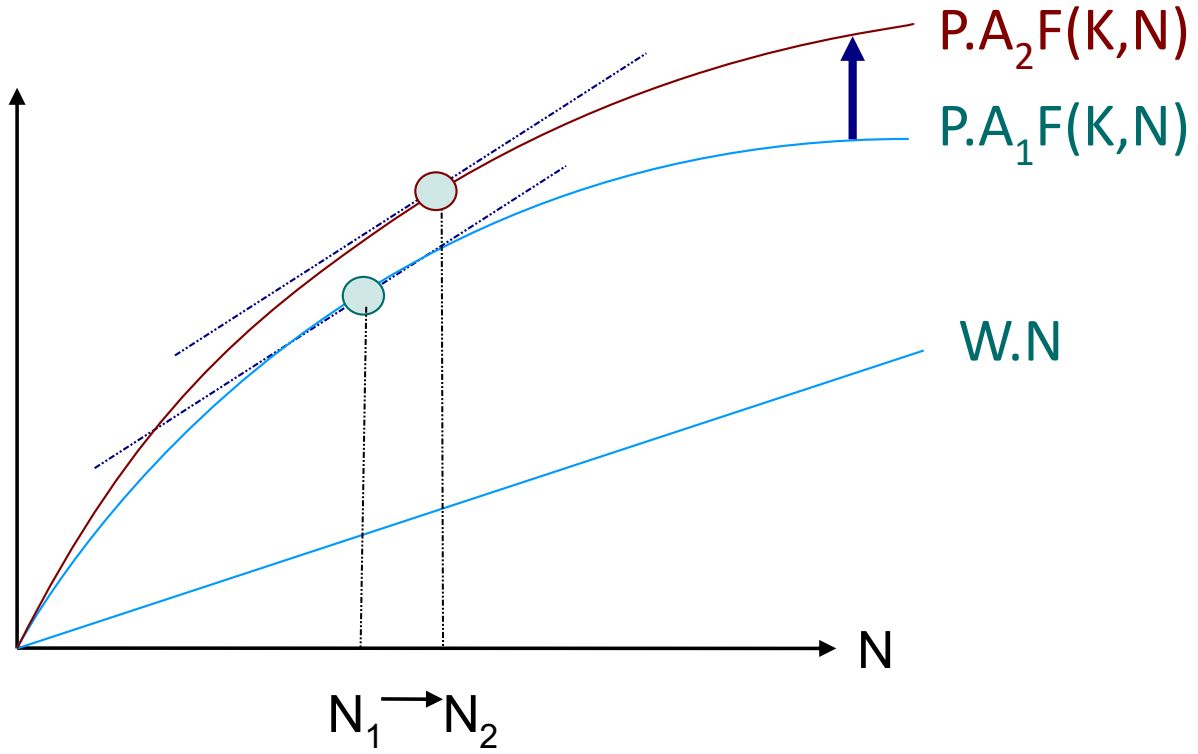
- If the real wage W/P increases:
  - The slope of the cost function becomes steeper
  - Diminishing returns: N must decrease so that MPN=W/P
- Conclusion : Labor demand N is a decreasing function of W/P

Demand for Labor



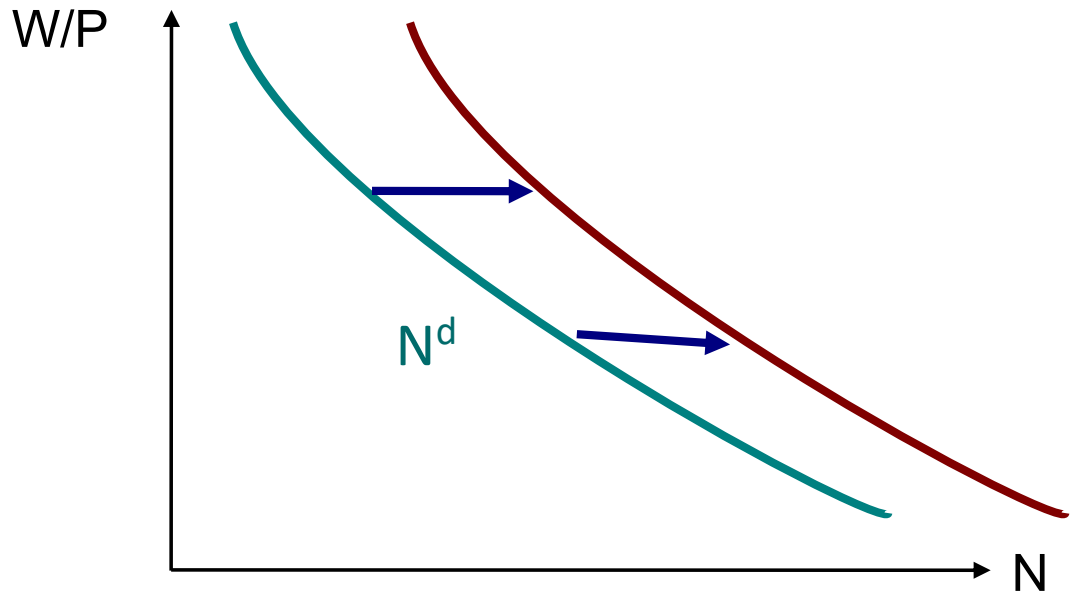
- Aggregate labor demand N^d is the sum of firms individual demand.
- As the real wage increases, labor demand by firms decreases

Effect of an Increase in A



- If A increases from A_1 to A_2 ($A_1 < A_2$) :
  - Each worker produces more for a given wage, so firms are more willing to hire them
  - The demand for labor increases

Effect of an Increase in A



- If A increases from A_1 to A_2 ($A_1 < A_2$) :
  - The labor demand shift to the right

Cobb-Douglas Example

- Assume : $Y = AK^a N^{1-a}$

$$MPN = (1-a)AK^a N^{-a} = W/P = w$$

$$N^d(w) = \left(\frac{w}{(1-a)AK^a}\right)^{-\frac{1}{a}} = \left(\frac{(1-a)AK^a}{w}\right)^{\frac{1}{a}}$$

- N decreases with the real wage w
- N increases with A and K :
  - More capital per worker implies that workers are more productive.
  - Firms are more willing to hire them (given a fixed wage)

Labor Supply

- The supply of labor is determined by individuals
  - Aggregate supply is the sum of individuals' labor supply.
  - Individuals' labor supply depends on labor-leisure choice

- Two simultaneous effects :
  - Substitution effect (SE) : Higher real wage encourages work, since reward for working is higher (opportunity cost of leisure is higher)
  - Income effect (IE) : Higher real wage increases income for same amount of work time, so person can afford more leisure, so will supply less labor.

Theoretical Analysis

- Effect of an increase in the real wage
  - Note : the price (opportunity cost) of leisure is the real wage
- 2 simultaneous effects :
  - Substitution effect : leisure is now more expensive

    ⇒ consume less leisure ⇒ work more

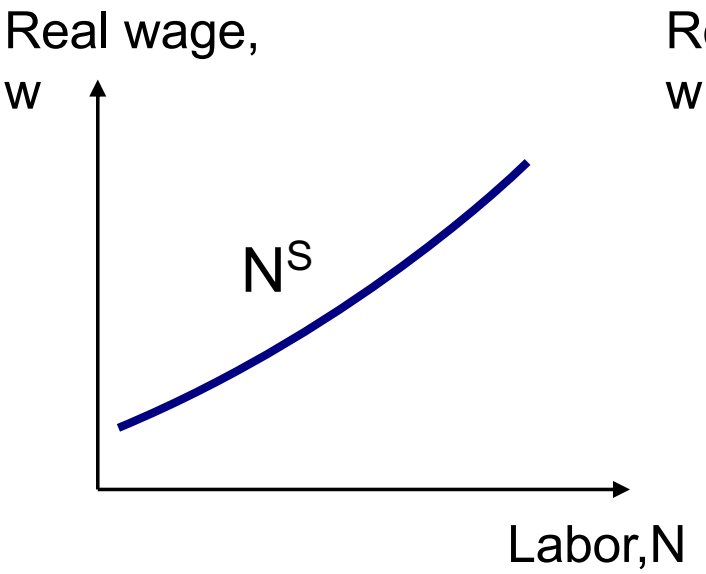
    Labor Supply Increase
  - Income effect : individuals feel wealthier

    ⇒ consume more leisure ⇒ work less

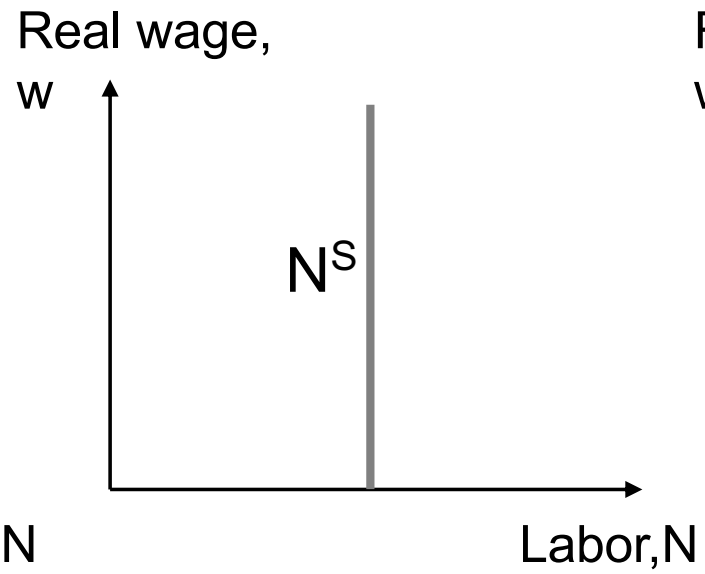
    Labor Supply Decreases
- The theory alone does not tell us which effect dominates. It all depends on people's preferences… look in the data!

Substitution vs Income Effects

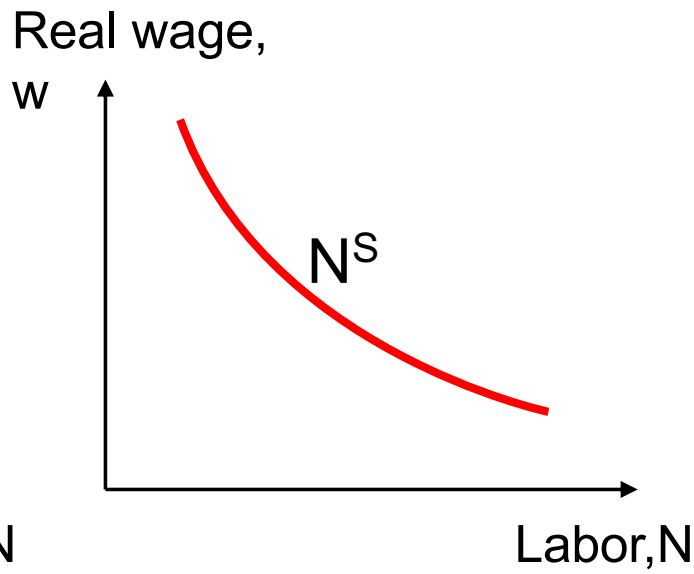
Substitution > Income



Substitution = Income



Substitution < Income

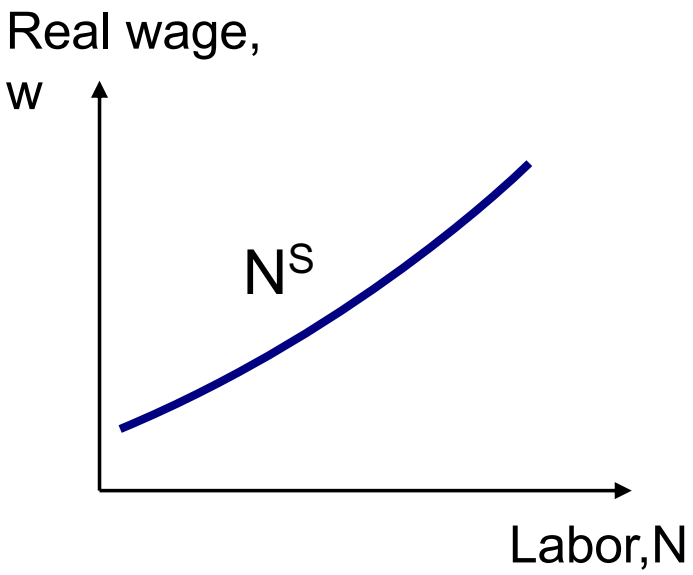


Factors that Affect Labor Supply

- Wealth
  - Greater wealth reduces labor supply (income effect)
- Expected increase in future real wage
  - Like an increase in wealth so reduces labor supply
  - The longer the high wage is expected to last the larger is the income effect
- Working age population and labor force participation rate also affect labor supply

Empirical Evidence

- Suppose the real wage increase :
  - For a temporary increase in real wages, labor supply increases
    - Substitution effect dominates.
  - For a permanent increase in real wages, labor supply decreases
    - Income effect dominates
- Business cycles, we usually assume that substitution dominates :

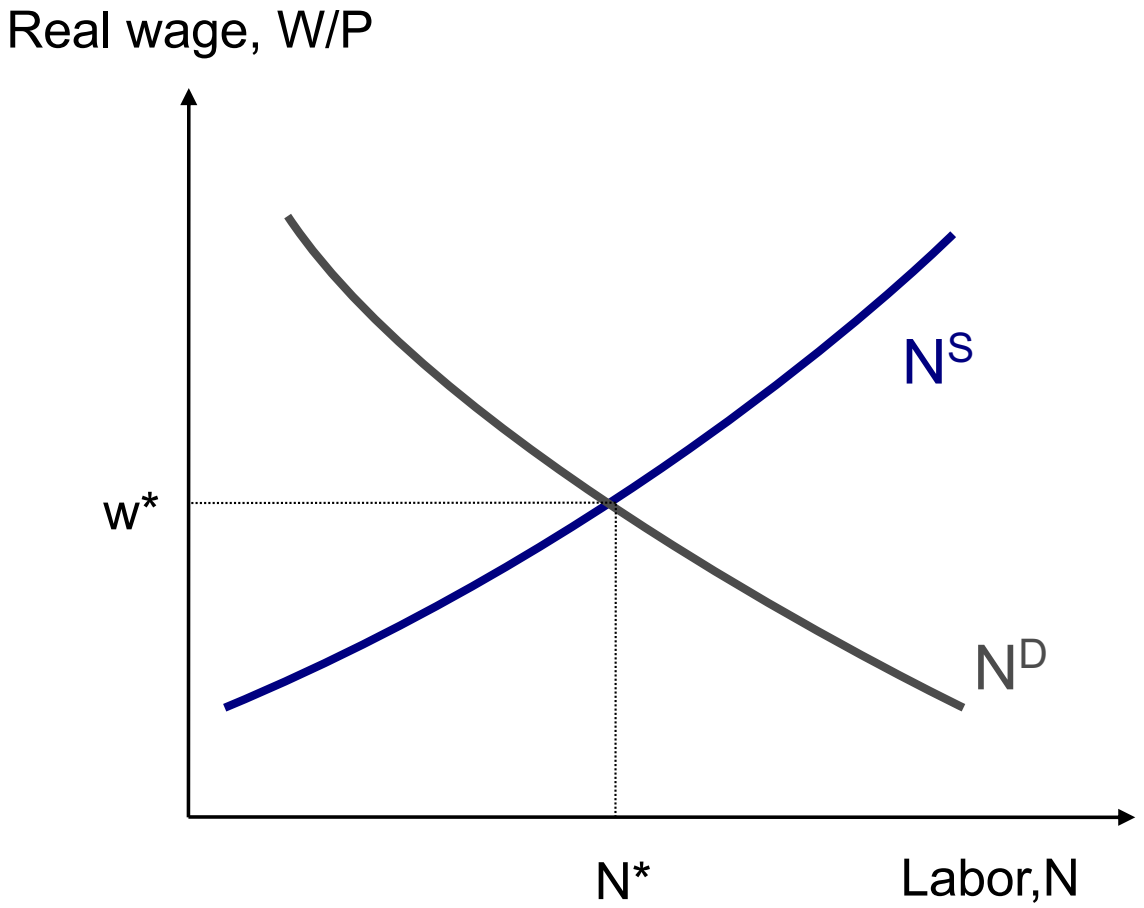


Labor Market Equilibrium

- We have modeled both sides of the labor market :
  - Demand (firms) : $N^d(W/P)$
  - Supply (workers) : $N^s(W/P)$

- How does the labor market reach an equilibrium?
  - In particular, how are wages determined?

Labor Market Equilibrium

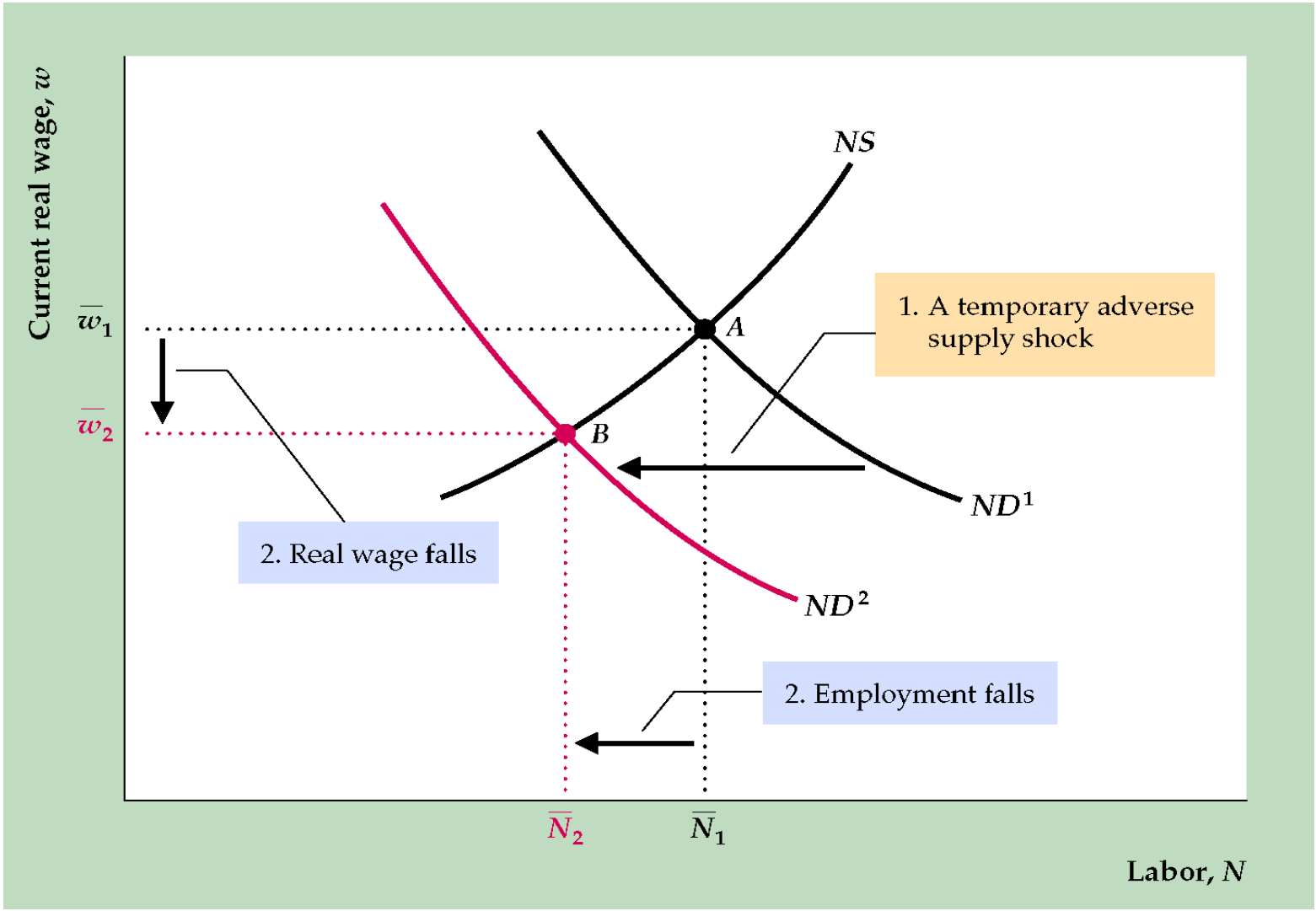


- Equilibrium : $N^d(W/P) = N^s(W/P)$
  - The real wage is such that supply equals demand
  - At N*, the economy is at full employment

Labor Market Equilibrium

- Notice that there is no unemployment
  - Not realistic (see later how to deal with it)
  - In particular, need to assume that wages are flexible :
    - Unemployed workers willing to accept wage cuts in order to find job. This prevent the existence of unemployment.
    - In reality : wages seem rigid and take time to adjust.
- This equilibrium concept describes labor markets in the long-run
  - When wages and prices have fully adjusted.

Negative Supply Shock



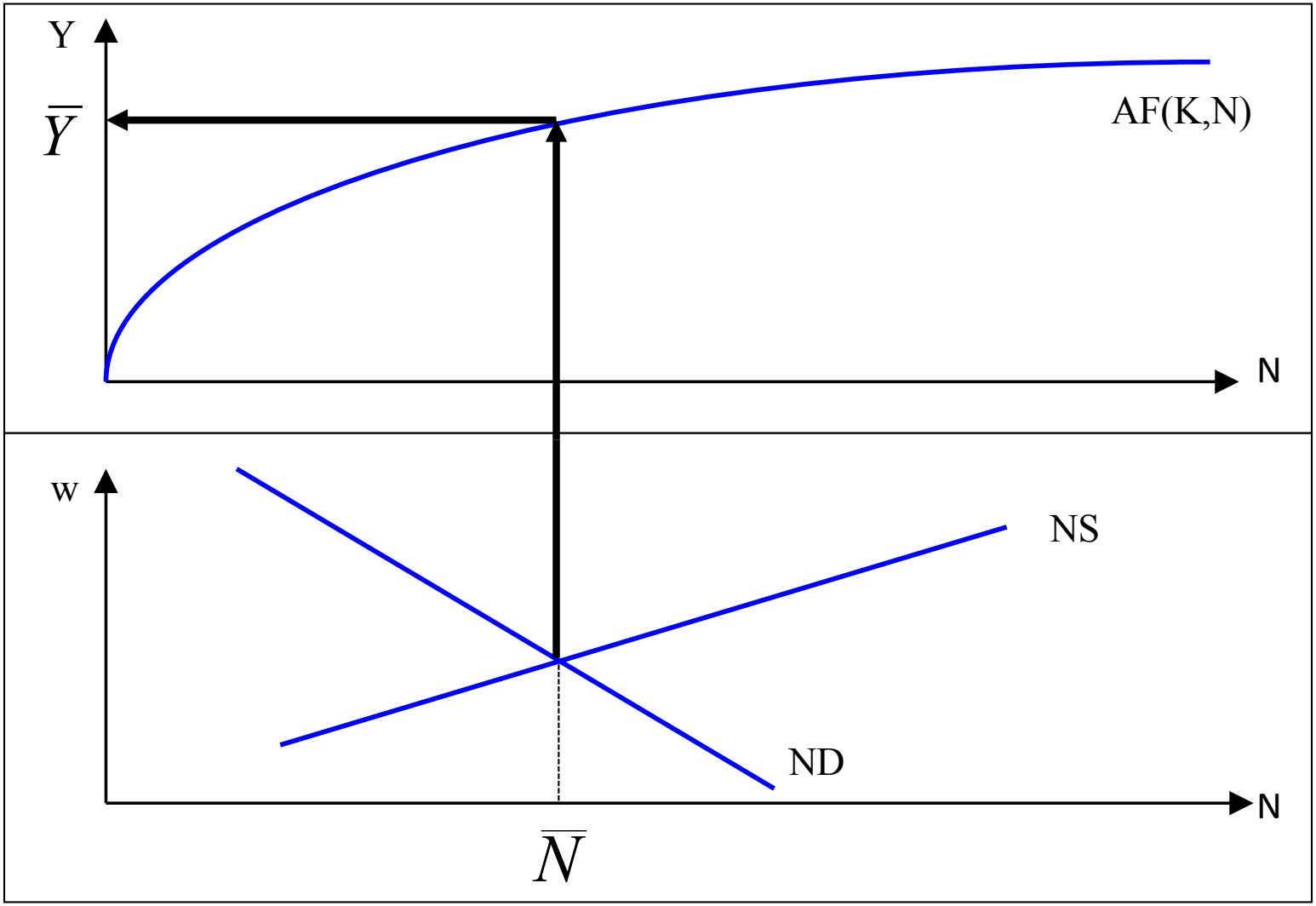
Full Employment

- Full-employment Output = Potential Output
  - We wait for the wage to adjust fully
  - Potential output = level of output when labor market is in equilibrium

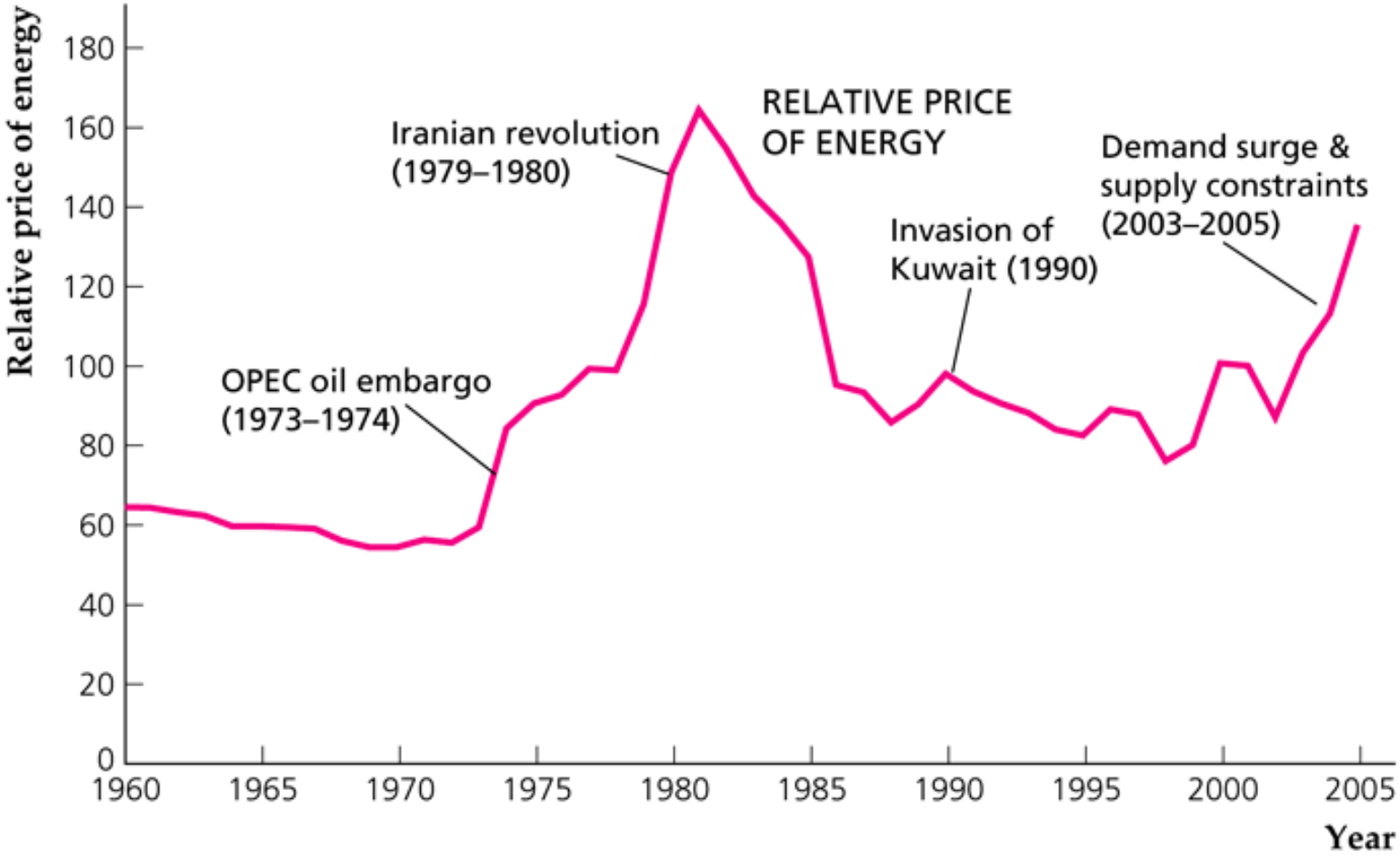
$$\text{Potential output} = Y^* = AF(K, N^*)$$

  - Potential output can be affected by changes in full employment level, productivity and other kinds of supply shocks

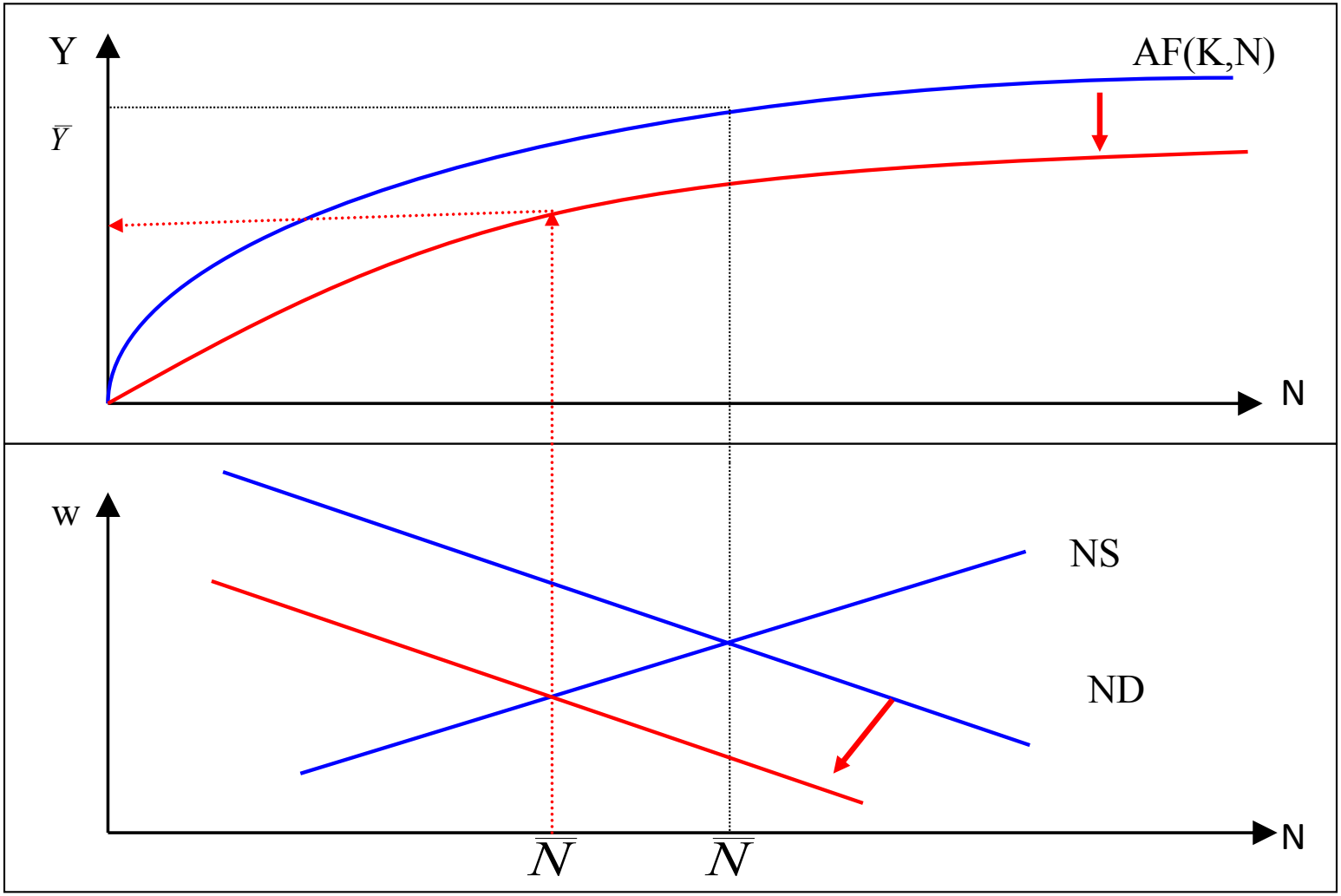
Full Employment Output



Application 1: Oil Shocks



Effect of a (temporary) Oil Shock



Effect of Oil Shock

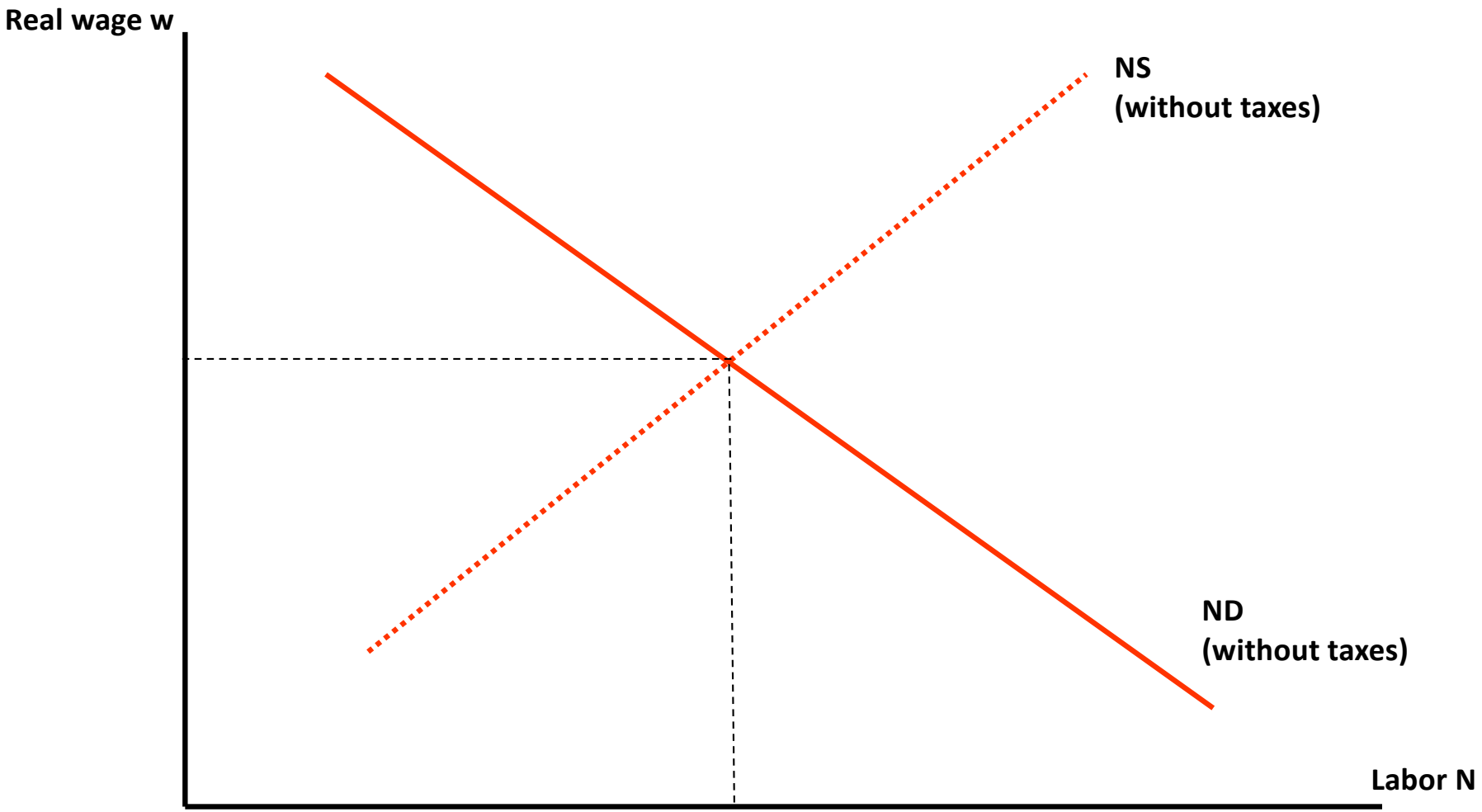
- Oil shocks
  - Sharp oil price increases in 1973–1974, 1979–1980, 2003–2005

- Effects
  - Adverse supply (or TFP) shock—lowers labor demand, employment, the real wage, and the full-employment level of output
  - First two episodes: U.S. economy entered recessions and real wage fell
  - Last episode: U.S. economy didn't enter recession and real wages didn't fall. Why?

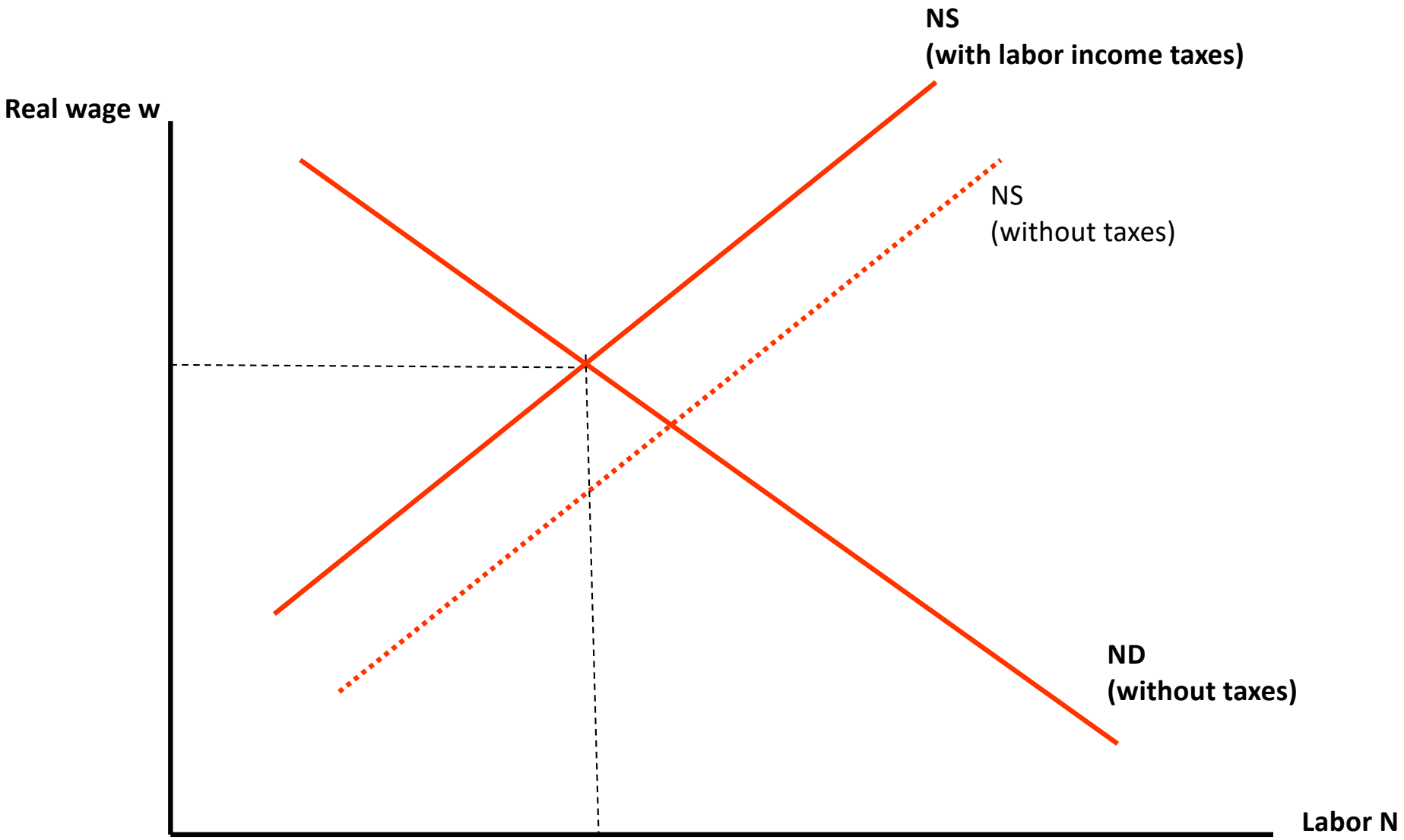
Why Do the French Work Less?

- In 2004, French GDP/capita was about 30% below U.S. GDP/capita, mostly because the French worked much less (both less employment and less hours worked per employee).
- Do the French have a bigger preference for leisure than Americans?
- Or are there are other possible explanations?

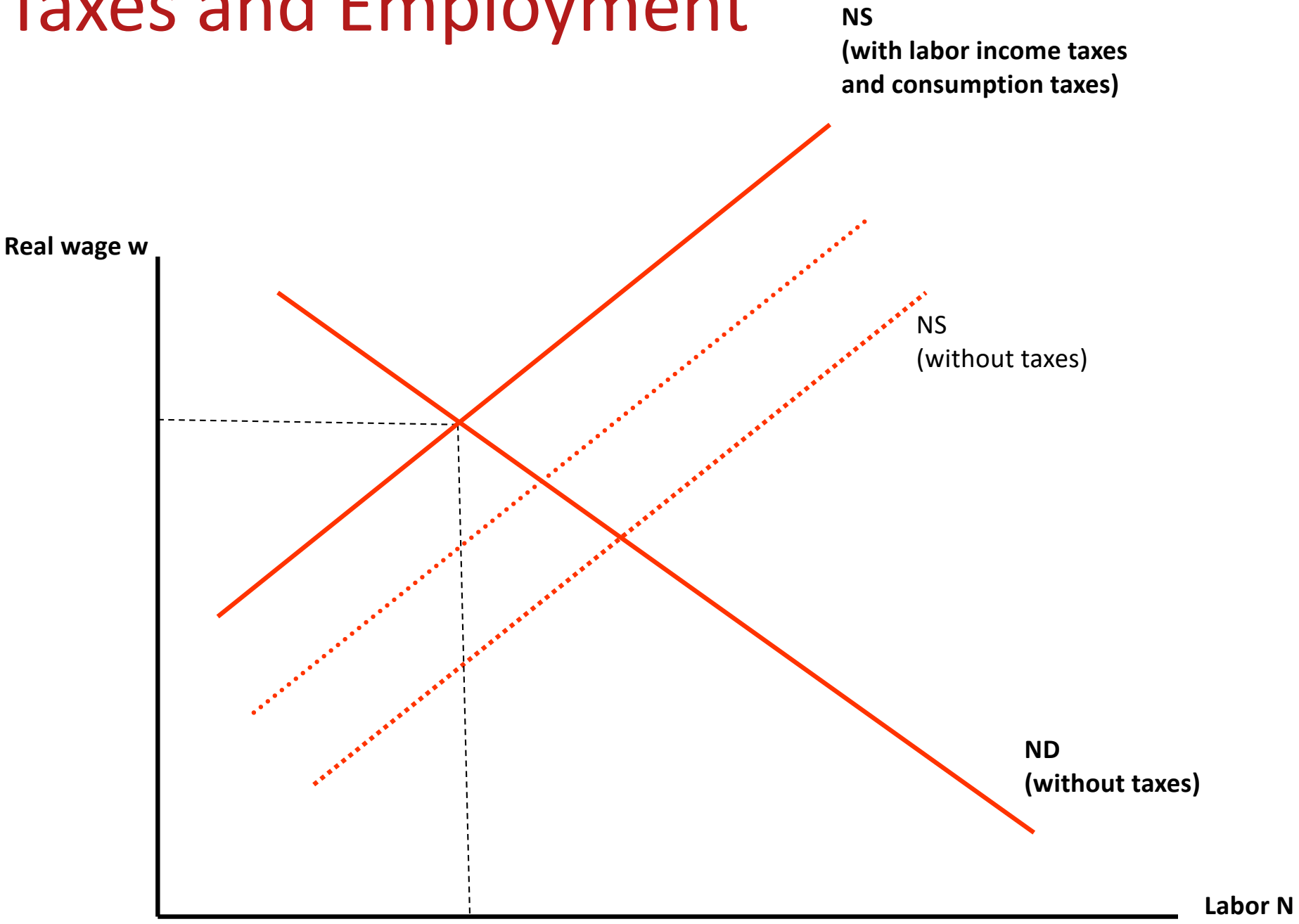
Taxes and Employment



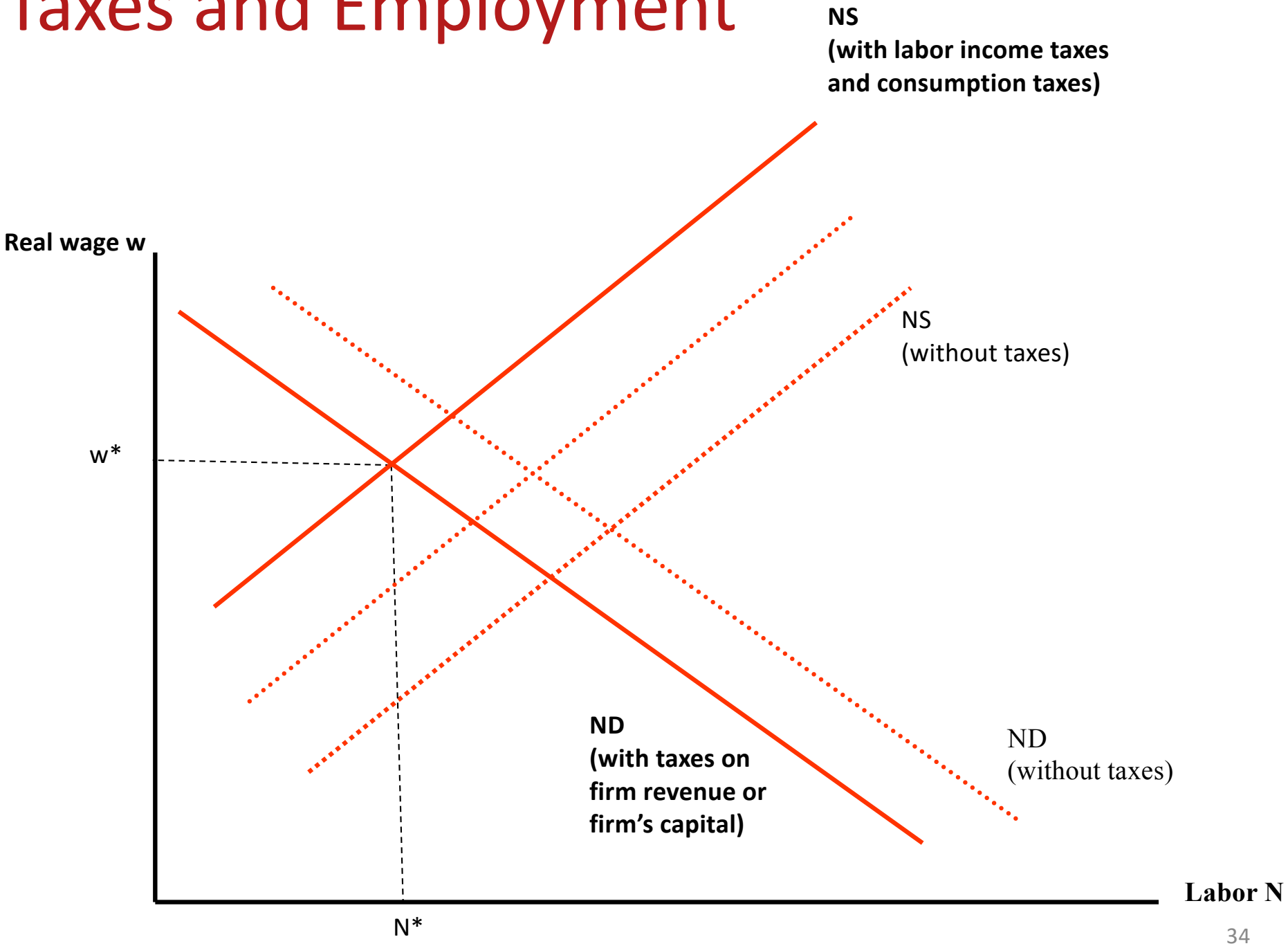
Taxes and Employment



Taxes and Employment



Taxes and Employment



Taxes and Employment

TABLE 4—CURRENT INTRATEMPORAL TAX WEDGE FOR FRANCE, THE UNITED KINGDOM, AND THE UNITED STATES

	France	United Kingdom	United States
τ_c	0.33	0.26	0.13
τ_h	0.49	0.31	0.32
Social-security tax	0.33	0.10	0.12
Marginal income tax	0.15	0.21	0.20
Intratemporal tax wedge	2.60	1.82	1.66
Hours, h	0.183	0.235	0.268
Predicted h	0.189	0.250	0.268

Source: United Nations (2000). Prescott (2002)

Summary

- Labor demand (ND): amount of labor that firms are willing to hire for a given wage (derived from profit maximization)
- Labor supply (NS): amount of labor that individuals are willing to supply for a given wage (derived from utility maximization)
- Classical labor market equilibrium: wage for which ND = NS
  - Presumes that wages adjust quickly
  - Describes full employment situation
- Problems with classical model
  - Can't study unemployment
  - Maybe wages don't adjust that quickly
- Differences in tax rates can explain why French work less than Americans