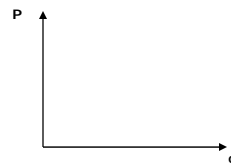


CONSUMPTION-LEISURE MODEL

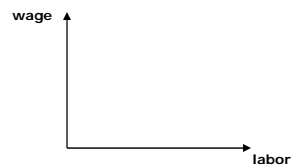
FEBRUARY 2, 2009

THE THREE MACRO (AGGREGATE) MARKETS

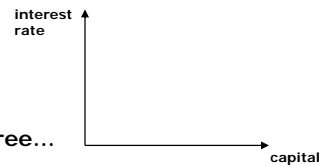
☐ Goods Markets



☐ Labor Markets



☐ Capital/Savings/Funds/Asset Markets



☐ Will put micro-foundations under all three...

BASICS

- ❑ Consumption-Leisure Model – provides foundation for
 - ❑ Labor-market supply function
 - ❑ Goods-market demand function
 - ❑ An application of the basic consumer theory model...
 - ❑ ...we will put a macro interpretation on it

BASICS

- ❑ Consumption-Leisure Model – provides foundation for
 - ❑ Labor-market supply function
 - ❑ Goods-market demand function
 - ❑ An application of the basic consumer theory model...
 - ❑ ...we will put a macro interpretation on it
 - ❑ Only one time period – no “future” for which to save

BASICS

- ❑ Consumption-Leisure Model – provides foundation for
 - ❑ Labor-market supply function
 - ❑ Goods-market demand function
 - ❑ An application of the basic consumer theory model...
 - ❑ ...we will put a macro interpretation on it
 - ❑ Only one time period – no “future” for which to save

- ❑ Notation
 - ❑ c : consumption (“all stuff”)
 - ❑ n : number of hours spent working per week
 - ❑ l : number of hours leisure per week (time spent not working)
 - ❑ P : dollar price of one unit of consumption (a nominal variable)
 - ❑ W : hourly wage rate in terms of dollars (a nominal variable)
 - ❑ t : tax rate on labor income

$n + l = 168$ {

February 2, 2009

5

BASICS

- ❑ Consumption-Leisure Model – provides foundation for
 - ❑ Labor-market supply function
 - ❑ Goods-market demand function
 - ❑ An application of the basic consumer theory model...
 - ❑ ...we will put a macro interpretation on it
 - ❑ Only one time period – no “future” for which to save

- ❑ Notation
 - ❑ c : consumption (“all stuff”)
 - ❑ n : number of hours spent working per week
 - ❑ l : number of hours leisure per week (time spent not working)
 - ❑ P : dollar price of one unit of consumption (a nominal variable)
 - ❑ W : hourly wage rate in terms of dollars (a nominal variable)
 - ❑ t : tax rate on labor income

- ❑ “Weekly” model a detail
 - ❑ Could have called it a daily model, a monthly model, a yearly model, ...
 - ❑ Just need to take SOME stand on the length of a “period”

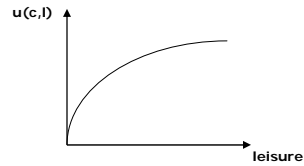
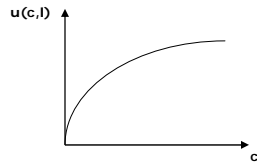
$n + l = 168$ {

February 2, 2009

6

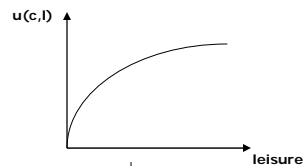
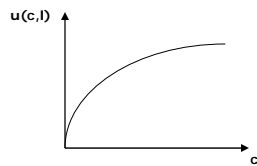
UTILITY

- ❑ Preferences $u(c, l)$ with all the “usual properties”
 - ❑ Strictly increasing in c
 - ❑ Strictly increasing in l
 - ❑ Diminishing marginal utility in c
 - ❑ Diminishing marginal utility in l
 - ❑ Plotted in good-by-good spaces:

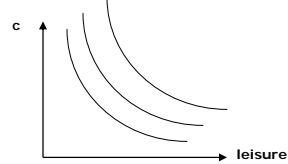


UTILITY

- ❑ Preferences $u(c, l)$ with all the “usual properties”
 - ❑ Strictly increasing in c
 - ❑ Strictly increasing in l
 - ❑ Diminishing marginal utility in c
 - ❑ Diminishing marginal utility in l
 - ❑ Plotted in good-by-good spaces:

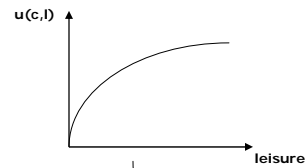
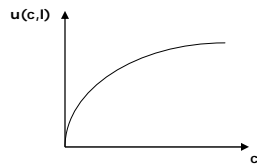


- ❑ Plotted as indifference curves

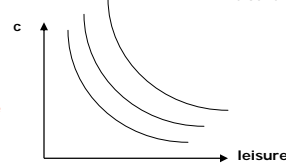


UTILITY

- Preferences $u(c, l)$ with all the “usual properties”
 - Strictly increasing in c
 - Strictly increasing in l
 - Diminishing marginal utility in c
 - Diminishing marginal utility in l
 - Plotted in good-by-good spaces:



- Plotted as indifference curves
- Utility side of consumption-leisure model no different than Chapter 1 model



February 2, 2009

9

BUDGET CONSTRAINT

- Consumer must **work** for his income
 - Y no longer “falls from the sky”

$$Pc = Y$$

February 2, 2009

10

BUDGET CONSTRAINT

- Consumer must **work** for his income
 - Y no longer “falls from the sky”

$$Pc = Y$$

↓ $Y = (1-t)Wn$ (all income is after-tax labor income)

$$Pc = (1-t)Wn$$

BUDGET CONSTRAINT

- Consumer must **work** for his income
 - Y no longer “falls from the sky”

$$Pc = Y$$

↓ $Y = (1-t)Wn$ (all income is after-tax labor income)

$$Pc = (1-t)Wn$$

↓ $n = 168 - l$

$$Pc = (1-t)W(168 - l)$$

BUDGET CONSTRAINT

- Consumer must **work** for his income
 - Y no longer “falls from the sky”

$$Pc = Y$$

↓ $Y = (1-t)Wn$ (all income is after-tax labor income)

$$Pc = (1-t)Wn$$

↓ $n = 168 - l$

$$Pc = (1-t)W(168 - l)$$

↓ Rearrange

$$Pc + (1-t)Wl = 168(1-t)W$$

⏟

Spending on consumption

⏟

“Spending” on leisure

⏟

A constant from the point of view of the individual (price-taker)

BUDGET CONSTRAINT

- Consumer must **work** for his income
 - Y no longer “falls from the sky”

$$Pc = Y$$

↓ $Y = (1-t)Wn$ (all income is after-tax labor income)

$$Pc = (1-t)Wn$$

↓ $n = 168 - l$

$$Pc = (1-t)W(168 - l)$$

↓ Rearrange

$$Pc + (1-t)Wl = 168(1-t)W$$

⏟

Spending on consumption

⏟

“Spending” on leisure

⏟

A constant from the point of view of the individual (price-taker)

Simply an application/re-interpretation of our basic consumer theory model

$$P_1c_1 + P_2c_2 = Y$$

⏟

Spending on c_1

⏟

Spending on c_2

⏟

A constant from the point of view of the individual

Chapter 1 budget constraint

BUDGET CONSTRAINT

- Consumer must **work** for his income
 - **Y** no longer “falls from the sky”

$$Pc = Y$$

$Y = (1-t)Wn$ (all income is after-tax labor income)

$$Pc = (1-t)Wn$$

$n = 168 - l$

$$Pc = (1-t)W(168 - l)$$

Rearrange

$$Pc + (1-t)Wl = 168(1-t)W$$

(After-tax) wage is *opportunity cost* of leisure, hence the “price” of leisure
- opportunity costs *are real economic costs/prices*

Simply an application/re-interpretation of our basic consumer theory model

Spending on consumption “Spending” on leisure A constant from the point of view of the individual (price-taker)

$$P_1c_1 + P_2c_2 = Y$$

Chapter 1 budget constraint

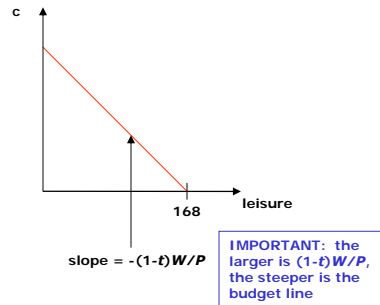
Spending on c_1 Spending on c_2 A constant from the point of view of the individual

CONSUMER OPTIMIZATION

- **Consumer’s decision problem:** maximize utility subject to budget constraint – bring together both **cost** side and **benefit** side
 - Choose c and l subject to $Pc + (1-t)Wl = 168(1-t)W$

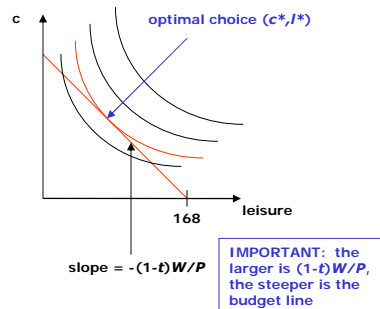
CONSUMER OPTIMIZATION

- ❑ **Consumer's decision problem:** maximize utility subject to budget constraint – bring together both **cost** side and **benefit** side
 - ❑ Choose c and l subject to $Pc + (1-t)Wl = 168(1-t)W$
 - ❑ Plot budget line



CONSUMER OPTIMIZATION

- ❑ **Consumer's decision problem:** maximize utility subject to budget constraint – bring together both **cost** side and **benefit** side
 - ❑ Choose c and l subject to $Pc + (1-t)Wl = 168(1-t)W$
 - ❑ Plot budget line
 - ❑ Superimpose indifference map



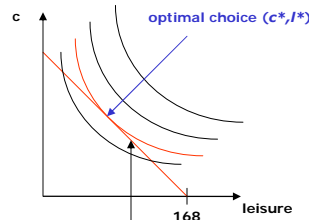
CONSUMER OPTIMIZATION

- ❑ **Consumer's decision problem:** maximize utility subject to budget constraint – bring together both **cost** side and **benefit** side

- ❑ Choose c and l subject to $Pc + (1-t)Wl = 168(1-t)W$

- ❑ Plot budget line

- ❑ Superimpose indifference map



- ❑ **At the optimal choice**

CONSUMPTION-LEISURE
OPTIMALITY CONDITION
- A key building block of
modern macro models

$$\frac{u_l(c^*, l^*)}{u_c(c^*, l^*)} = \frac{(1-t)W}{P}$$

slope = $-(1-t)W/P$

IMPORTANT: the larger is $(1-t)W/P$, the steeper is the budget line

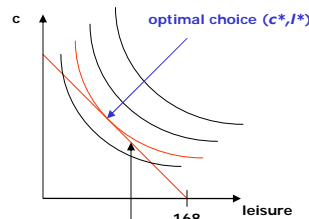
CONSUMER OPTIMIZATION

- ❑ **Consumer's decision problem:** maximize utility subject to budget constraint – bring together both **cost** side and **benefit** side

- ❑ Choose c and l subject to $Pc + (1-t)Wl = 168(1-t)W$

- ❑ Plot budget line

- ❑ Superimpose indifference map



- ❑ **At the optimal choice**

CONSUMPTION-LEISURE
OPTIMALITY CONDITION
- A key building block of
modern macro models

$$\frac{u_l(c^*, l^*)}{u_c(c^*, l^*)} = \frac{(1-t)W}{P}$$

slope = $-(1-t)W/P$

IMPORTANT: the larger is $(1-t)W/P$, the steeper is the budget line

MRS (between consumption and leisure) price ratio (inclusive of taxes)

REAL WAGE

- **W/P** a key variable for macroeconomic analysis
- **Unit Analysis** (i.e., analyze algebraic units of variables)
 - Units(W) = \$/hour of work
 - Units(P) = \$/unit of consumption

REAL WAGE

- **W/P** a key variable for macroeconomic analysis
- **Unit Analysis** (i.e., analyze algebraic units of variables)
 - Units(W) = \$/hour of work
 - Units(P) = \$/unit of consumption
 - **Units(W/P)** =
$$\frac{\frac{\text{hour of work}}{\$}}{\text{unit of consumption}} = \frac{\cancel{\$}}{\text{hour of work}} \cdot \frac{\text{unit of consumption}}{\cancel{\$}}$$

$$= \frac{\text{unit of consumption}}{\text{hour of work}}$$

REAL WAGE

- W/P a key variable for macroeconomic analysis
- Unit Analysis (i.e., analyze algebraic units of variables)
 - Units(W) = \$/hour of work
 - Units(P) = \$/unit of consumption
 - Units(W/P) =
$$\frac{\frac{\text{hour of work}}{\$}}{\frac{\text{unit of consumption}}{\$}} = \frac{\cancel{\$} \text{ hour of work}}{\text{hour of work}} \cdot \frac{\text{unit of consumption}}{\cancel{\$}}$$

$$= \frac{\text{unit of consumption}}{\text{hour of work}}$$

Will sometimes denote using w (lower-case...)
- Economic decisions depend on **real wages (W/P)**, not nominal wages (W)
 - Measures the purchasing power of (nominal) wage earnings...
 - ...which is presumably what people most care about

February 2, 2009

23

REAL WAGE

- W/P a key variable for macroeconomic analysis
- Unit Analysis (i.e., analyze algebraic units of variables)
 - Units(W) = \$/hour of work
 - Units(P) = \$/unit of consumption
 - Units(W/P) =
$$\frac{\frac{\text{hour of work}}{\$}}{\frac{\text{unit of consumption}}{\$}} = \frac{\cancel{\$} \text{ hour of work}}{\text{hour of work}} \cdot \frac{\text{unit of consumption}}{\cancel{\$}}$$

$$= \frac{\text{unit of consumption}}{\text{hour of work}}$$

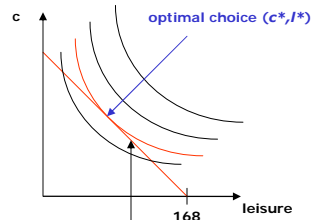
Will sometimes denote using w (lower-case...)
- Economic decisions depend on **real wages (W/P)**, not nominal wages (W)
 - Measures the purchasing power of (nominal) wage earnings...
 - ...which is presumably what people most care about
- 2008: nominal P (CPI) rose by 0.1%, nominal W rose by 2.9%
 - Real wages rose in 2008...but doesn't mean real **income** rose

February 2, 2009

24

CONSUMER OPTIMIZATION

- ❑ **Consumer's decision problem:** maximize utility subject to budget constraint – bring together both **cost** side and **benefit** side
 - ❑ Choose c and l subject to $Pc + (1-t)Wl = 168(1-t)W$
 - ❑ Plot budget line
 - ❑ Superimpose indifference map



- ❑ **At the optimal choice**

CONSUMPTION-LEISURE OPTIMALITY CONDITION
- key building block of modern macro models

$$\frac{u_l(c^*, l^*)}{u_c(c^*, l^*)} = \frac{(1-t)W}{P}$$

MRS (between consumption and leisure)
After-tax real wage

slope = $-(1-t)W/P$

IMPORTANT: the larger is $(1-t)W/P$, the steeper is the budget line

Derive consumption-leisure optimality condition using Lagrange analysis

LAGRANGE ANALYSIS

- ❑ Apply Lagrange tools to consumption-leisure optimization
- ❑ Objective function: $u(c, l)$
- ❑ Constraint: $g(c, l) = 168(1-t)W - Pc - (1-t)Wl = 0$

LAGRANGE ANALYSIS

- ❑ Apply Lagrange tools to consumption-leisure optimization
- ❑ Objective function: $u(c, l)$
- ❑ Constraint: $g(c, l) = 168(1-t)W - Pc - (1-t)Wl = 0$

- ❑ **Step 1:** Construct Lagrange function

$$L(c, l, \lambda) = u(c, l) + \lambda [168(1-t)W - Pc - (1-t)Wl]$$

- ❑ **Step 2:** Compute first-order conditions with respect to c, l, λ

LAGRANGE ANALYSIS

- ❑ Apply Lagrange tools to consumption-leisure optimization
- ❑ Objective function: $u(c, l)$
- ❑ Constraint: $g(c, l) = 168(1-t)W - Pc - (1-t)Wl = 0$

- ❑ **Step 1:** Construct Lagrange function

$$L(c, l, \lambda) = u(c, l) + \lambda [168(1-t)W - Pc - (1-t)Wl]$$

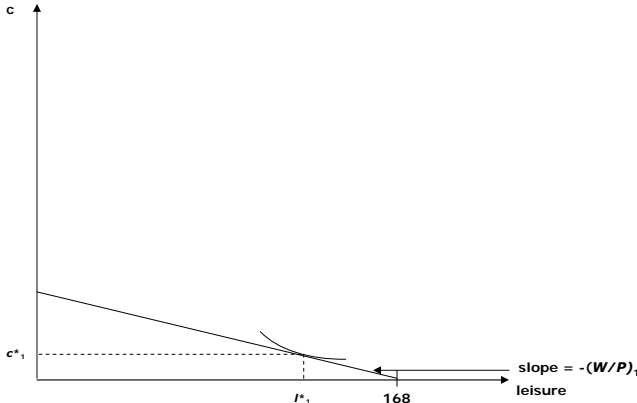
- ❑ **Step 2:** Compute first-order conditions with respect to c, l, λ

- ❑ **Step 3:** Solve (with focus on eliminating multiplier)

$$\underbrace{\frac{u_c(c^*, l^*)}{u_l(c^*, l^*)}}_{\text{MRS (between consumption and leisure)}} = \underbrace{\frac{(1-t)W}{P}}_{\text{After-tax real wage}} \quad \text{CONSUMPTION-LEISURE OPTIMALITY CONDITION}$$

MICRO-LEVEL LABOR SUPPLY

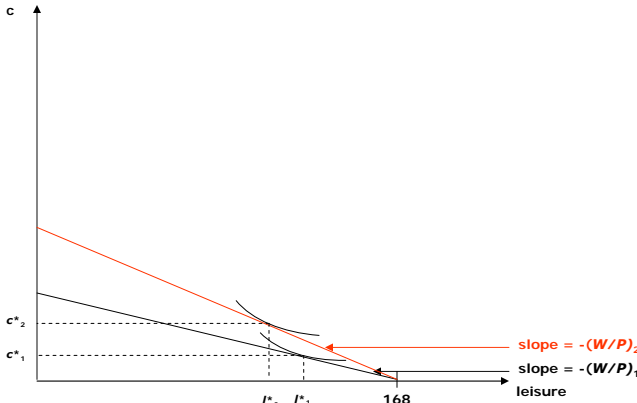
An experiment: how do micro-level consumption/leisure choices change as the real wage changes (assume $t = 0$ here for simplicity)



MICRO-LEVEL LABOR SUPPLY

An experiment: how do micro-level consumption/leisure choices change as the real wage changes (assume $t = 0$ here for simplicity)

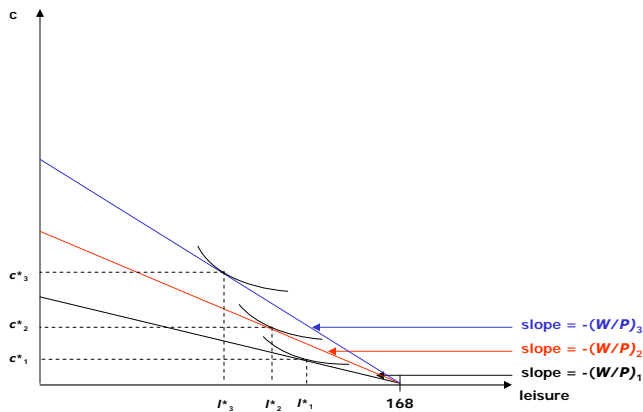
REAL WAGES: $(W/P)_1 < (W/P)_2$



MICRO-LEVEL LABOR SUPPLY

An experiment: how do micro-level consumption/leisure choices change as the real wage changes (assume $t = 0$ here for simplicity)

REAL WAGES: $(W/P)_1 < (W/P)_2 < (W/P)_3$



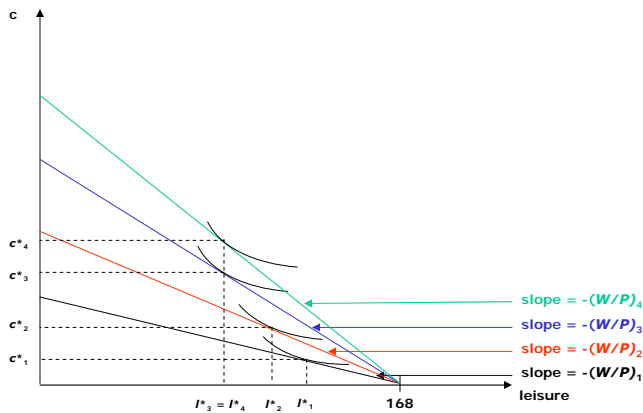
February 2, 2009

31

MICRO-LEVEL LABOR SUPPLY

An experiment: how do micro-level consumption/leisure choices change as the real wage changes (assume $t = 0$ here for simplicity)

REAL WAGES: $(W/P)_1 < (W/P)_2 < (W/P)_3 < (W/P)_4$

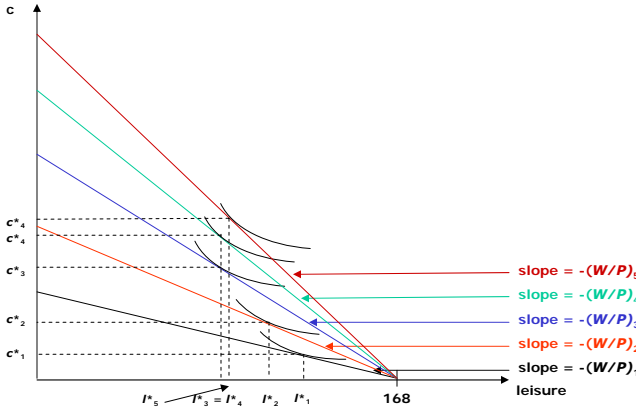


February 2, 2009

32

MICRO-LEVEL LABOR SUPPLY

An experiment: how do micro-level consumption/leisure choices change as the real wage changes (assume $t = 0$ here for simplicity)
REAL WAGES: $(W/P)_1 < (W/P)_2 < (W/P)_3 < (W/P)_4 < (W/P)_5$

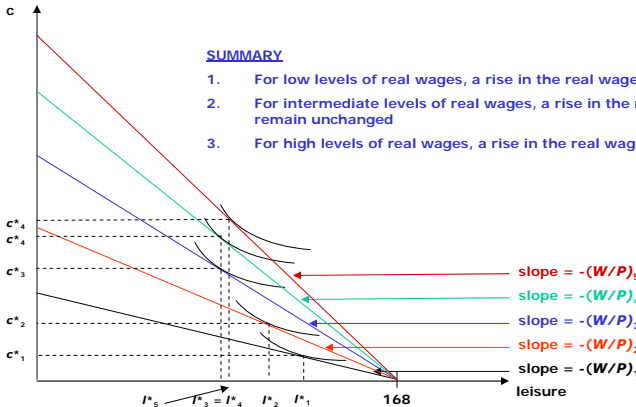


February 2, 2009

33

MICRO-LEVEL LABOR SUPPLY

An experiment: how do micro-level consumption/leisure choices change as the real wage changes (assume $t = 0$ here for simplicity)
REAL WAGES: $(W/P)_1 < (W/P)_2 < (W/P)_3 < (W/P)_4 < (W/P)_5$

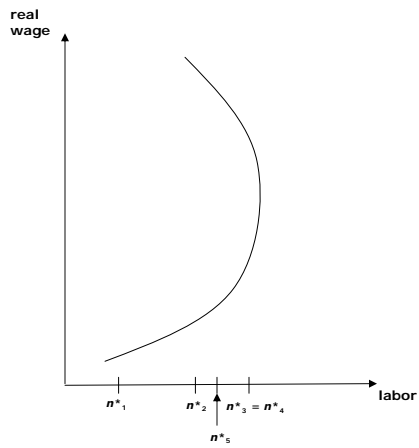


February 2, 2009

34

MICRO-LEVEL LABOR SUPPLY

Using the relation $n = 168 - l$

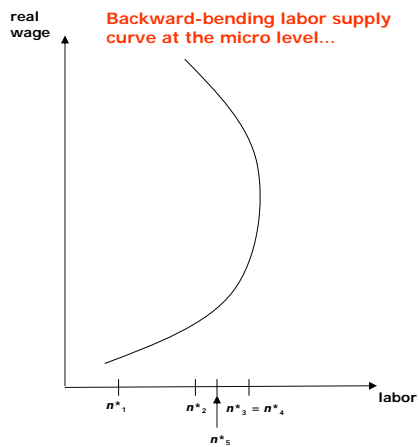


February 2, 2009

35

MICRO-LEVEL LABOR SUPPLY

Using the relation $n = 168 - l$

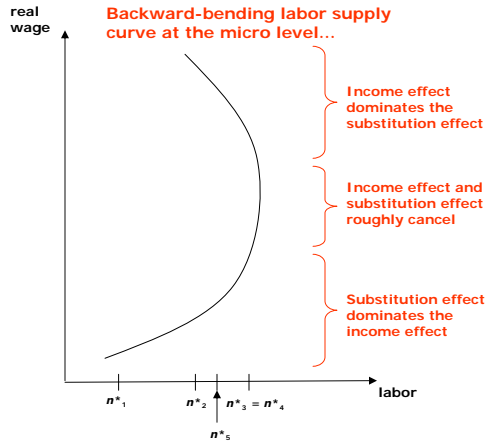


February 2, 2009

36

MICRO-LEVEL LABOR SUPPLY

Using the relation $n = 168 - l$

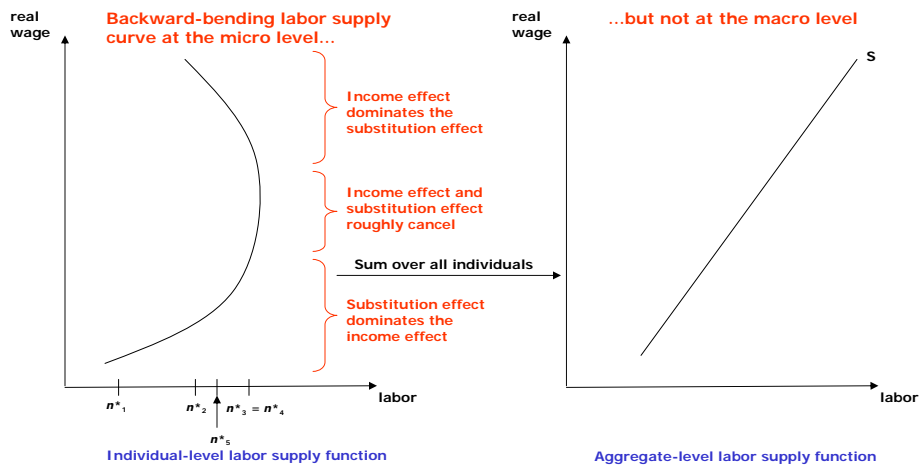


February 2, 2009

37

LABOR SUPPLY

Using the relation $n = 168 - l$

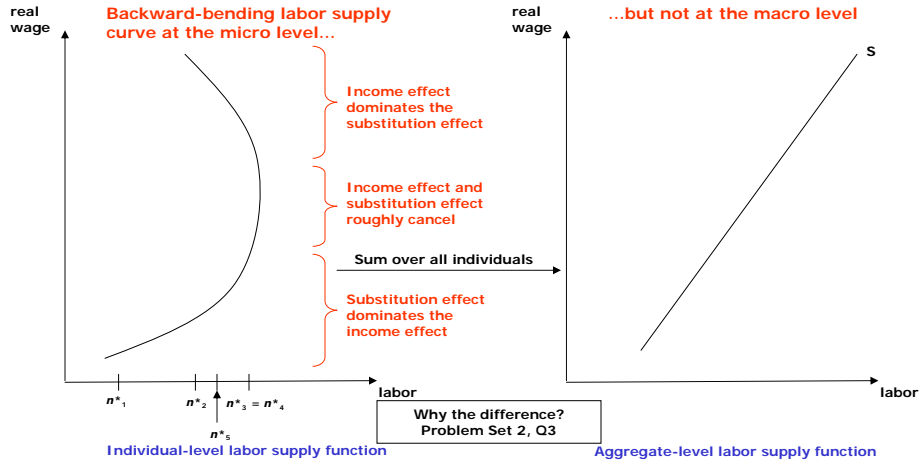


February 2, 2009

38

LABOR SUPPLY

Using the relation $n = 168 - l$



February 2, 2009

39

CONSUMPTION DEMAND

- ❑ Optimal choice of consumption was always rising as real wage was rising
- ❑ Could have conducted the entire analysis assuming nominal W was held fixed and nominal P was falling
 - ❑ Which means real wage W/P is rising

February 2, 2009

40

CONSUMPTION DEMAND

- ❑ Optimal choice of consumption was always rising as real wage was rising

- ❑ Could have conducted the entire analysis assuming nominal W was held fixed and nominal P was falling
 - ❑ Which means real wage W/P is rising

- ❑ Result: Fall in $P \rightarrow$ rise in optimal c always
 - ❑ Implies downward-sloping consumption demand function at the micro level...
 - ❑ ...and at the aggregate level

CONSUMPTION DEMAND

- ❑ Optimal choice of consumption was always rising as real wage was rising

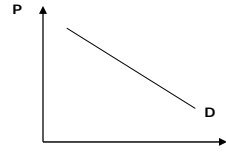
- ❑ Could have conducted the entire analysis assuming nominal W was held fixed and nominal P was falling
 - ❑ Which means real wage W/P is rising

- ❑ Result: Fall in $P \rightarrow$ rise in optimal c always
 - ❑ Implies downward-sloping consumption demand function at the micro level...
 - ❑ ...and at the aggregate level

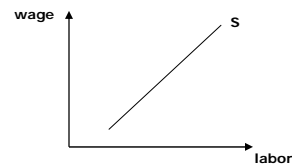
- ❑ Consumption demand over two-thirds of aggregate demand in developed countries

THE THREE MACRO (AGGREGATE) MARKETS

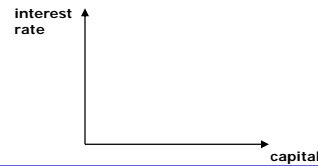
- ❑ **Goods Markets**
 - ❑ Demand derived from C-L model



- ❑ **Labor Markets**
 - ❑ Supply derived from C-L model



- ❑ **Capital/Savings/Funds/Asset Markets (aka Financial Markets)**



THE MACROECONOMICS OF TIME

- ❑ Consumption-leisure model a **static** (i.e., one time period) model
- ❑ **Dynamic** models the core of modern macroeconomic theory
- ❑ Explicit consideration of how economic decisions/behaviors/outcomes unfold over multiple time periods

THE MACROECONOMICS OF TIME

- ❑ Consumption-leisure model a **static** (i.e., one time period) model
- ❑ **Dynamic** models the core of modern macroeconomic theory
- ❑ Explicit consideration of how economic decisions/behaviors/outcomes unfold over multiple time periods
- ❑ Two-period model (Chapters 3 and 4) the simplest possible multi-period framework
 - ❑ Will allow us to begin analyzing issues regarding interest rates and inflation (phenomena that occur **across time**)
 - ❑ Will allow us to think about credit restrictions and the “credit crunch”
- ❑ Infinite-period model (Chapter 8)
 - ❑ Allows a richer quantitative description of the macroeconomy
 - ❑ Highlights the role of assets and the intersection between finance and macroeconomics