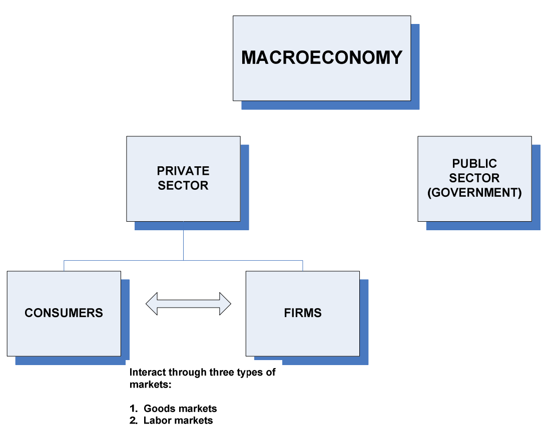
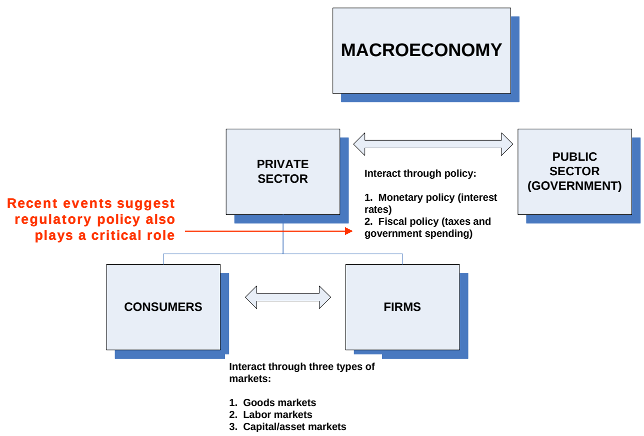
MACROECONOMIC THEORY AND POLICY: OVERVIEW

JANUARY 23, 2012

BUILDING BLOCKS OF AN ECONOMY



Building Blocks of an Economy



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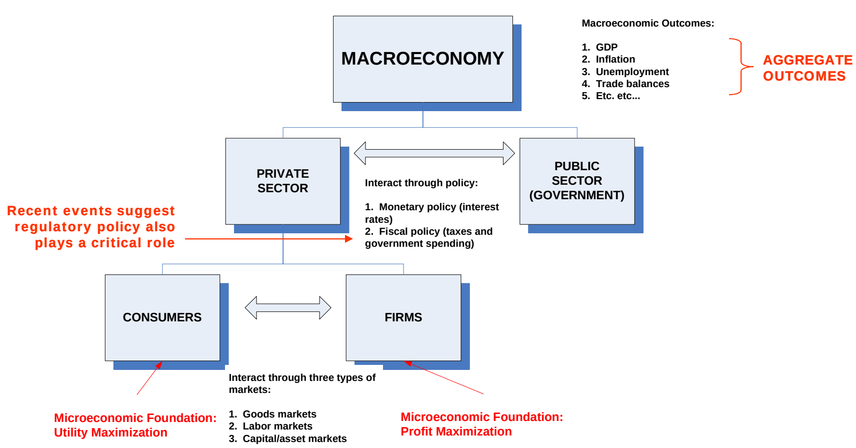

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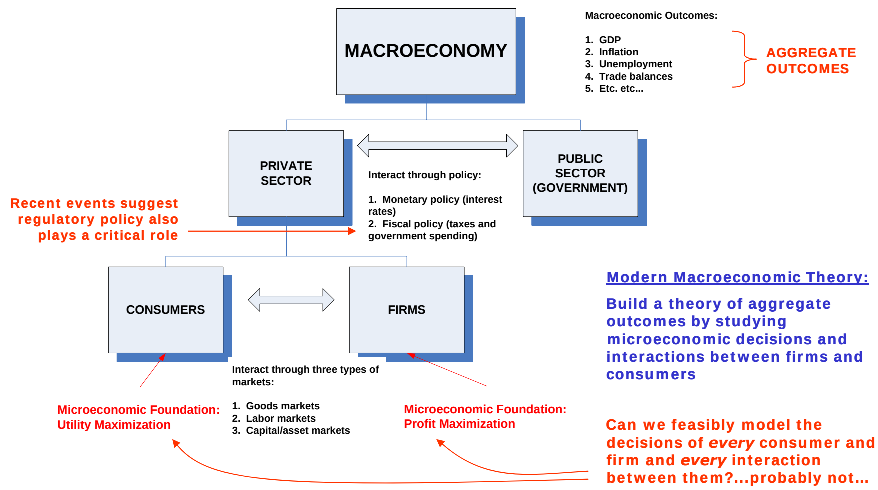

REPRESENTATIVE-AGENT MACROECONOMICS

- Consumer A: Consumed $50 in Year X
- Consumer B: Consumed $75 in Year X
- Consumer C: Consumed $100 in Year X
- Consumer D: Consumed $125 in Year X
- Consumer E: Consumed $150 in Year X

No other consumers in the economy

- Aggregate (i.e., economy-wide) consumption = $500
- Average consumption = $100

- Macroeconomics often most concerned with aggregate outcomes

REPRESENTATIVE-AGENT MACROECONOMICS

- Consumer A: Consumed $50 in Year X — No other consumers in the economy
- Consumer B: Consumed $75 in Year X
- Consumer C: Consumed $100 in Year X — THE REPRESENTATIVE CONSUMER
- Consumer D: Consumed $125 in Year X
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- Aggregate (i.e., economy-wide) consumption = $500
- Average consumption = $100

- Macroeconomics often most concerned with aggregate outcomes

- If we want to take a micro-based approach to explaining aggregate outcomes…
- …model Consumer C's behavior / decision-making

- Very simple approach
  - Turns out to yield surprisingly rich results, insights, and predictions
  - Mastering it allows replication up to many orders of people / parties

REVIEW OF CONSUMER THEORY

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UTILITY FUNCTIONS

- Describe how much "happiness" or "satisfaction" an individual experiences from "consuming" goods – the benefit of consumption
- Marginal Utility
  - The extra total utility resulting from consumption of a small/incremental extra unit of a good
  - Mathematically, the (partial) slope of utility with respect to that good

Review of Consumer Theory

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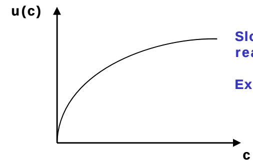
Alternative notation: du/dc OR $u'(c)$ OR $u_c(c)$ OR $u_1(c)$

- One-good case: $u(c)$, with $du/dc > 0$ and $d^2u/dc^2 < 0$
  - Recall interpretation: strictly increasing at a strictly decreasing rate
  - Diminishing marginal utility
- Two-good case: $u(c_1, c_2)$, with $u_i(c_1, c_2) > 0$ and $u_{ii}(c_1, c_2) < 0$ for each of $i = 1,2$
  - Utility strictly increasing in each good individually (partial)
  - Diminishing marginal utility in each good individually
- Easily extends to N-good case: $u(c_1, c_2, c_3, c_4,\ldots, c_N)$

UTILITY FUNCTIONS

- **One-good case**

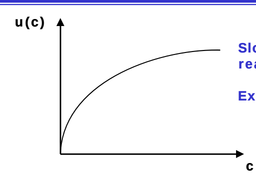


Slope (marginal utility) asymptotes to (but never reaches...) zero

Example: $u(c) = \ln c$ or $u(c) = \text{sqrt}(c)$

UTILITY FUNCTIONS

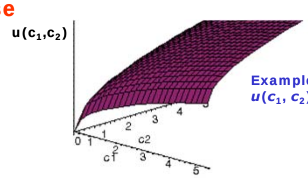
- **One-good case**



Slope (marginal utility) asymptotes to (but never reaches...) zero

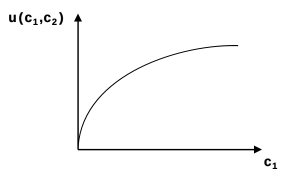
Example: $u(c) = \ln c$ or $u(c) = \text{sqrt}(c)$

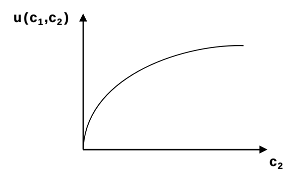
- **Two-good case**



Example: $u(c_1, c_2) = \ln c_1 + \ln c_2$ or $u(c_1, c_2) = \text{sqrt}(c_1) + \text{sqrt}(c_2)$

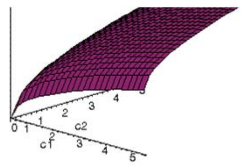
Viewed in good-by-good space





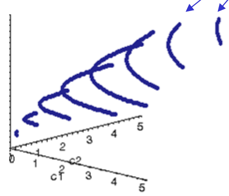
UTILITY FUNCTIONS

Alternative views



Emphasizing
the contours

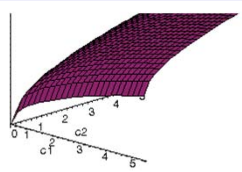
__Indifference Curve:__ the set of all consumption bundles that deliver a particular level of utility / happiness



Review of Consumer Theory

UTILITY FUNCTIONS

Alternative views



Emphasizing
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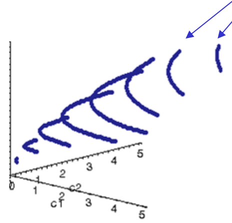
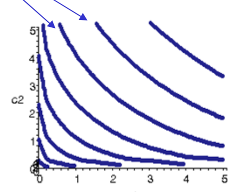
__Indifference Curve:__ the set of all consumption bundles that deliver a particular level of utility / happiness

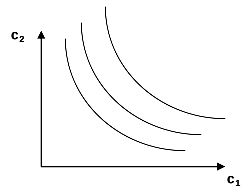
Viewing only the contours from directly overhead





UTILITY FUNCTIONS

- **Marginal Rate of Substitution (MRS)**
  - **Maximum quantity of one good consumer is willing to give up to obtain one extra unit of the other good**
  - **Graphically, the (negative of the) slope of an indifference curve**
  - **MRS is itself a function of c_1 and c_2 (i.e., $MRS(c_1, c_2)$)**



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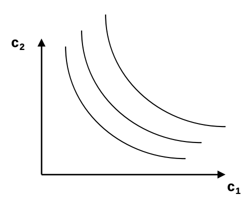
  - **MRS is itself a function of c_1 and c_2 (i.e., $MRS(c_1, c_2)$)**
  - **MRS equals ratio of marginal utilities**
    - $MRS(c_1, c_2) = \frac{u_1(c_1, c_2)}{u_2(c_1, c_2)}$
    - **Using Implicit Function Theorem (see Problem Set 1)**



- **Summary: whether graphically- or mathematically-formulated, utility functions describe the benefit side of consumer optimization**

BUDGET CONSTRAINTS

- **Describe the cost side of consumption**
- **One-good case (trivial):** $Pc = Y$
  - **Assume income Y is taken as given by consumer for now**
- **Two-good case (interesting):** $P_1c_1 + P_2c_2 = Y$
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The Graphics of Consumer Theory

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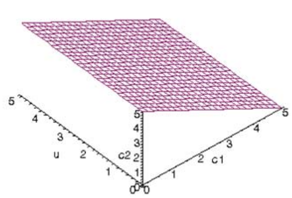
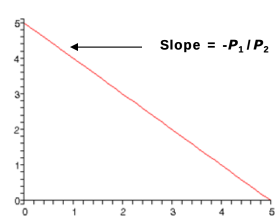
Plotted in 3D-consumption-space

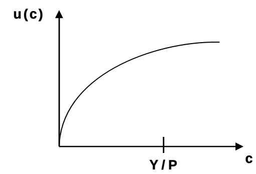


Plotted in 2D-consumption-space



Consumer Optimization

- **Consumer's decision problem:** **maximize utility subject to budget constraint – bring together both cost side and benefit side**
- **One-good case**
  - **Trivially, $c = Y / P$ is optimal choice**
  - **No decision to make here…**



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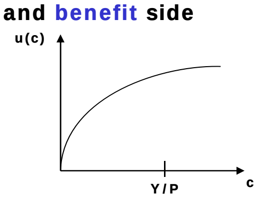
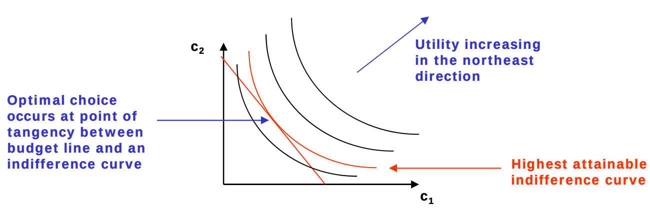


- **Two-good case**
  - **How to optimally allocate Y across the two goods c_1 and c_2?**
  - **A non-trivial decision problem…**



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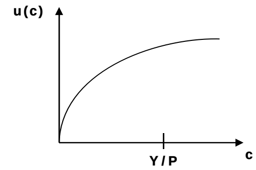

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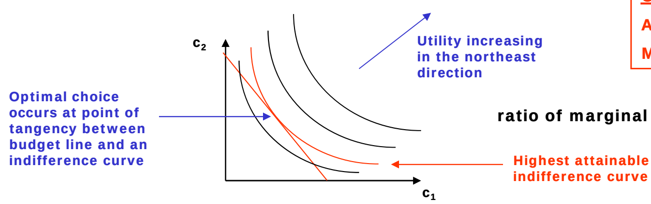

OPTIMALITY CONDITION:
At the optimal choice,
MRS = slope of budget line

ratio of marginal utilities = price ratio

LAGRANGE ANALYSIS

- Consumer optimization a **constrained optimization** problem
  - Maximize some function (utility function)…
  - …taking into account some restriction on the objects to be maximized over (budget constraint)
- **Lagrange Method:** mathematical tool to solve constrained optimization problems
- General mathematical formulation
  - Choose (x, y) to maximize a given objective function $f(x,y)$…
  - …subject to the constraint $g(x,y) = 0$ (Note formulation of constraint)
  - **Step 1:** Construct Lagrange function — Lagrange multiplier

$$L(x, y, \lambda) = f(x, y) + \lambda g(x, y)$$

  - **Step 2:** Compute first-order conditions with respect to x, y, and λ

Lagrange Analysis

- **Consumer optimization a constrained optimization problem**
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- **Lagrange Method: mathematical tool to solve constrained optimization problems**

- **General mathematical formulation**
  - **Choose (*x*, *y*) to maximize a given objective function *f*(*x*,*y*)…**
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  - **Step 1: Construct Lagrange function**

    Lagrange multiplier

    $$L(x, y, \lambda) = f(x, y) + \lambda g(x, y)$$

  - **Step 2: Compute first-order conditions with respect to *x*, *y*, and *λ***

    1) $f_x(x, y) + \lambda g_x(x, y) = 0$

    2) $f_y(x, y) + \lambda g_y(x, y) = 0$

    3) $g(x, y) = 0$

    Rationale: setting first derivatives to zero isolates maxima (or minima…technically, need to check second-order condition…)

The Mathematics of Consumer Theory

Lagrange Analysis

- **Step 3: Solve the system of first-order conditions for *x*, *y*, and *λ***
  - **Often most interested in simply eliminating the multiplier…**
  - **…**
  - **…**
  - **…**
  - **Optimality condition: at the optimum (*x**, *y**)**

    $$\frac{f_x(x^*, y^*)}{f_y(x^*, y^*)} = \frac{g_x(x^*, y^*)}{g_y(x^*, y^*)}$$

LAGRANGE ANALYSIS

- **Step 3:** Solve the system of first-order conditions for ***x***, ***y***, and ***λ***
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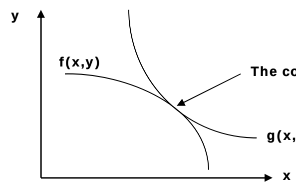
$$\frac{f_x(x^*, y^*)}{f_y(x^*, y^*)} = \frac{g_x(x^*, y^*)}{g_y(x^*, y^*)}$$

Graphical interpretation: at the constrained optimum, the function *f*(.) is tangent to the function *g*(.)



LAGRANGE ANALYSIS

- Apply Lagrange tools to consumer optimization
- Objective function: $u(c_1,c_2)$
- Constraint: $g(c_1,c_2) = Y - P_1c_1 - P_2c_2 = 0$

- **Step 1:** Construct Lagrange function

$$L(c_1, c_2, \lambda) = u(c_1, c_2) + \lambda\left[Y - P_1c_1 - P_2c_2\right]$$

- **Step 2:** Compute first-order conditions with respect to c_1, c_2, λ

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

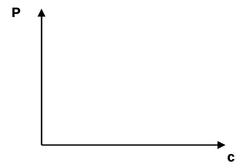
$$\frac{u_1(c_1^*, c_2^*)}{u_2(c_1^*, c_2^*)} = \frac{P_1}{P_2}$$

OPTIMALITY CONDITION

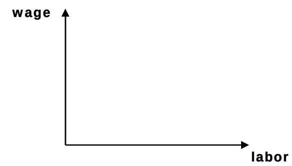
i.e., MRS = price ratio

THE THREE MACRO (AGGREGATE) MARKETS

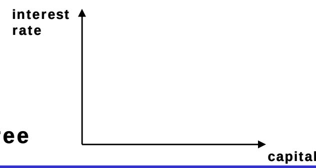
- Goods Markets



- Labor Markets



- Capital / Savings / Funds / Asset Markets



- Will put micro-foundations under all three