Lecture 1
Introduction and Labor Supply

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Economics 312
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Introduction to Macroeconomics

- The study of aggregate economic behavior
- Issues:
  - economic growth
  - employment and unemployment
  - business cycles
  - inflation
  - macroeconomic policy
  - international trade and exchange rates
Real GDP, 1947-2015 (Quarterly)

Source: US. Bureau of Economic Analysis
research.stlouisfed.org
Real GDP Growth, 1960-2015 (Quarterly)

Source: US. Bureau of Economic Analysis
research.stlouisfed.org
Real GDP Relative to US for Selected Countries, 1950-2010
Gross Domestic Product

- Most widely used measure of economic activity.
- Measures market value of newly produced final goods and services.
- Each term is key:
  - market value
  - newly produced
  - final goods and services
- For the 3rd quarter of 2012, nominal GDP was:
  $15,811,000,000,000.
- The total population in Dec. 2012 was 315,255,000, so
  nominal GDP per capita was roughly: $50,153.
Computing GDP through Expenditure

\[ Y = C + I + G + (X - M) \]

- **Y** = Nominal GDP.
- **C** = Consumption: durables, non-durables, services.
- **I** = (Gross Private) Investment: Nonresidential fixed investment, residential fixed investment, inventories.
- **G** = Government Purchases: Sum of federal, state, and local purchases of goods and services, and government investment. Government transfer payments not included.
- **X** = Exports: deliveries of US goods and services to other countries.
- **M** = Imports: deliveries of goods and services from other countries to the US. Trade Balance = Exports − Imports.
## Composition of GDP, 2012 Q3

<table>
<thead>
<tr>
<th>Composition of GDP - Spending</th>
<th>in billion $</th>
<th>in % of GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Nom. GDP</td>
<td>15,811.0</td>
<td>100.0%</td>
</tr>
<tr>
<td>Consumption</td>
<td>11,154.4</td>
<td>70.5%</td>
</tr>
<tr>
<td>Durable Goods</td>
<td>1,218.9</td>
<td>7.7%</td>
</tr>
<tr>
<td>Nondurable Goods</td>
<td>2,573.6</td>
<td>16.3%</td>
</tr>
<tr>
<td>Services</td>
<td>7,361.9</td>
<td>46.5%</td>
</tr>
<tr>
<td>Gross Private Investment</td>
<td>2,080.1</td>
<td>13.2%</td>
</tr>
<tr>
<td>Nonresidential</td>
<td>1,610.0</td>
<td>10.2%</td>
</tr>
<tr>
<td>Residential</td>
<td>387.9</td>
<td>2.5%</td>
</tr>
<tr>
<td>Changes in Inventory</td>
<td>82.3</td>
<td>−0.0%</td>
</tr>
<tr>
<td>Government Purchases</td>
<td>3,093.3</td>
<td>19.6%</td>
</tr>
<tr>
<td>Federal Gov.</td>
<td>1,241.4</td>
<td>7.8%</td>
</tr>
<tr>
<td>State &amp; Local Gov.</td>
<td>1,851.9</td>
<td>11.7%</td>
</tr>
<tr>
<td>Net Exports</td>
<td>-516.8</td>
<td>-3.3%</td>
</tr>
<tr>
<td>Exports</td>
<td>2,198.7</td>
<td>13.9%</td>
</tr>
<tr>
<td>Imports</td>
<td>2,715.5</td>
<td>17.2%</td>
</tr>
</tbody>
</table>
Computing GDP through Income

- National Income: broadest measure of the total income

  Gross Domestic Product (15,811.0)  
  +Factor Inc. from abroad (775.8) − Factor Inc. to abroad (532.7)  
  = Gross National Product (16,054.2)  
  −Depreciation (2,019.8)  
  = Net National Product (14,034.4)  
  −Statistical Discrepancy (145.8)  
  = National Income (13,888.6)

- GNP: output produced by *domestically owned* factors, versus GDP which is output produced *within a nation*

- Difference between GDP and GNP for US is small (1.5%), larger for countries with many citizens working abroad.
In 2011, GDP in Ireland 158,993 million euros, but GNP was 127,016 million euros.

GNP is more than 20% smaller than GDP.

Simon Johnson, “Due to its role as a tax haven, many foreign companies have set up operations in Ireland, with a controlling shell company located in a tax-free nation, in order to take advantage of Ireland’s regulations that specify that the controlling owner, rather than the resident company, is subject to tax. For this reason companies channel license revenues and royalties through Irish subsidiaries. These royalties and revenues are in large part excluded from the tax base in Ireland. These companies would move if Ireland changed rules and made such revenues taxable. Since the relevant concept for fiscal sustainability is the taxable base, it makes sense that this should be used to measure Ireland’s indicators.”
Employment and Unemployment

- Why important: a main determinant of individual experience of workers
- Large secular trends in employment, especially female labor force participation.
- US experience: no strong trend in unemployment rates, mostly cyclical
- European experience: growth in unemployment rates post-WWII
- Recent downward trend in labor force participation
Labor Force Participation Rate, 1948-2015

Source: US. Bureau of Labor Statistics
research.stlouisfed.org

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Unemployment Rate, 1948-2015

Source: US. Bureau of Labor Statistics
research.stlouisfed.org
Figure 1.03  The U.S. unemployment rate, 1890-1998
Unemployment Rates in France and Spain

Adjusted Unemployment Rate in France (FRAURNAA)
Harmonized Unemployment Rate: All Persons for Spain (ESPURHARMQDSMEI)

2014 research.stlouisfed.org
We will now begin formal modeling by considering individual household behavior.

As an abstraction, we will think of one representative household as a stand in for the whole economy.

Justification: aggregation. Limitations.

Will define household preferences.

Then think about household constraints.

Finally, what will household do given preferences and constraints.
2 goods, consumption $c$ and leisure $l$.

Total time of $h$ hours, $N=$labor $\Rightarrow N = h - l$.

Each good’s set:

1. $c \in \mathbb{R}_+$
2. $l \in [0, h]

Then $(c, l) \in \mathbb{R}_+ \times [0, h]$
• Preferences: binary relation $\succeq$ defined over pairs $(c, l)$:

$$(c_i, l_i) \succeq (c_j, l_j)$$

• Working directly with binary relations difficult.

• **Definition:** a real-valued function $u : \mathbb{R}^2 \rightarrow \mathbb{R}$ is called a utility function representing the binary relation $\succeq$ defined over pairs $(c, l)$ if for $\forall (c_i, l_i), (c_j, l_j) \in \mathbb{R}_+ \times [0, h]$, $(c_i, l_i) \succeq (c_j, l_j) \iff u(c_i, l_i) \geq u(c_j, l_j)$.

• **Theorem:** if the binary relation $\succeq$ is complete, reflexive, transitive, strictly monotone and continuous, there exist a continuous real-valued function $u$ that represents $\succeq$. 

• $u$ simply represents the indifference curves. Indifference curves are level sets $\{(c, l) : u(c, l) = \bar{u}\}$.

• We’ll always assume $u$ is continuous and differentiable.

• $u(c, l)$ is a function of two variables. To consider properties of $u$ and so optimal choices, we’ll need to consider how it varies separately with $c$ and $l$.

• To do so, we’ll use partial derivatives of the utility function. We’ll write these in one of two ways:

$$u_c(c, l) = \frac{\partial u}{\partial c}(c, l), \quad u_l(c, l) = \frac{\partial u}{\partial l}(c, l)$$
Utility Function and Indifference Curves

Utility Function

Indifference Curves
Leisure $l \Rightarrow$ labor supply $N = h - l$.

Wage $w$. Unearned income $\pi$.

Then

$$c = Nw + \pi = (h - l)w + \pi$$
Household’s Problem

- Problem for household is then:

\[
\max_{c,l} u(c, l) \\
\text{s.t. } c = (h - l)w + \pi
\]

- Form Lagrangian with multiplier \( \lambda > 0 \) on constraint:

\[
\max_{c,l} u(c, l) + \lambda[(h - l)w + \pi - c]
\]

- First order conditions:

\[
\begin{align*}
    u_c &= \lambda \\
    u_l &= \lambda w \\
    \Rightarrow \frac{u_l}{u_c} &= w
\end{align*}
\]

- marginal rate of substitution = relative price of leisure.
Figure 4.5  Consumer Optimization
In previous we assumed an interior solution, $l < h$ or $N > 0$. But if $\pi > 0$ there may be corner solutions of individuals who choose not to work.

Impose additional constraint $l < h$ via Kuhn-Tucker multiplier $\mu$. $\mu = 0$ if $l < h$, $\mu > 0$ if $l = h$.

$$\max_{c,l} u(c, l) + \lambda[(h - l)w + \pi - c] + \mu[h - l]$$

First order conditions:

$$u_c = \lambda$$

$$u_l = \lambda w + \mu$$

$$\Rightarrow \frac{u_l}{u_c} = w + \frac{\mu}{\lambda} \geq w$$

For non-participant, marginal rate of substitution $> \text{wage}$. 
Figure 4.6  The Representative Consumer Chooses Not to Work
A Parametric Example

- \( u(c, l) = \log c + \gamma \log l \)

\[
MRS = \frac{u_l}{u_c} = \frac{\gamma \frac{1}{l}}{1} = \gamma \frac{c}{l}
\]

- FOC+Budget constraint:

\[
\gamma \frac{c^*}{h - N^*} = w \\
N^* = wh - \gamma \pi \\
\]

- Then:

\[
N^* = \frac{wh - \gamma \pi}{(1 + \gamma)w}
\]
We will follow the Hicksian decomposition.

**Income Effect:** changes in $w$ induce changes in total income even if $l^*$ stays constant. Reduces work incentive: use more income to “buy” leisure.

**Pure income effect:** Increase in $\pi$.

**Substitution Effect:** changes in $w$ make leisure change its relative price with total utility constant. Increases work incentive.

**(Almost) pure substitution effect:** One-time change in wage, say in peak sales period.
Figure 4.7  An Increase $\pi - T$ for the Consumer
Figure 4.8  Increase in the Real Wage Rate—Income and Substitution Effects
Income and Substitution Effects in the Example

\[ N^* = \frac{wh - \gamma \pi}{(1 + \gamma)w} \]

- **Income effect:**

\[ \frac{\partial N^*}{\partial \pi} = -\frac{\gamma}{(1 + \gamma)w} < 0 \]

- **Suppose \( \pi = 0 \), then**

\[ N^* = \frac{h}{1 + \gamma} \]

Labor supply does not respond to the wage at all! So income and substitution effects completely offset.

- **With \( \pi > 0 \) income effect only partly offsets substitution effect.**
Labor supply curve $N(w)$ plots response of labor supplied by households to a change in wage, holding fixed unearned income (and preferences).

For individual workers, slope of labor supply unclear. Depends on income and substitution effects. For high enough wage, may be backward bending. That is $N'(w) > 0$ for low $w$ but $N'(w) < 0$ for $w$ high enough.

May also be discontinuous if there are fixed costs of work (commuting costs). Won’t work low number of hours.
In the aggregate, labor supply supply curve embodies both intensive and extensive margins, and is upward sloping.

Intensive margin: for those already working, increase in wage has income and substitution effects.

Extensive margin: increases in wages may induce some who were not in labor force to enter and supply labor. Always increasing in $w$.

Aggregate labor supply curve also smooths out kinks in individual supply, for example due to fixed costs of work.