Week 1: Introduction

- The space versus asset market: 4 Quadrant math.
- Real Estate Micro Economics: Hedonics, Location, density, government regulations.
- Real Estate Macro Economics: timing behavior (search, moving, contracts), cycles, regional growth.
The Role of Real Estate in the Economy

- Construction [6% of GDP]
- Service flow, “Shelter”, rent plus imputed rent [20% ± of GDP]
- Assets [55-60% of total national wealth]
- Land? Not part of GDP (we don’t make land), but it is part of wealth.
- Accounting, measurement difficulties [book versus market value]
## Value of New Construction Put in Place, 2002

<table>
<thead>
<tr>
<th>Category</th>
<th>Value (in Billions)</th>
<th>% of GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Private Construction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buildings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential buildings</td>
<td>422</td>
<td>4.0</td>
</tr>
<tr>
<td>Nonresidential buildings</td>
<td>167</td>
<td>1.6</td>
</tr>
<tr>
<td>&gt; Industrial</td>
<td>17</td>
<td>0.2</td>
</tr>
<tr>
<td>&gt; Office</td>
<td>38</td>
<td>0.4</td>
</tr>
<tr>
<td>&gt; Hotels/Motels</td>
<td>10</td>
<td>0.1</td>
</tr>
<tr>
<td>&gt; Other commercial</td>
<td>56</td>
<td>0.5</td>
</tr>
<tr>
<td>&gt; All other nonresidential</td>
<td>46</td>
<td>0.4</td>
</tr>
<tr>
<td>Nonbuilding construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public utilities</td>
<td>54</td>
<td>0.5</td>
</tr>
<tr>
<td>All other</td>
<td>7</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Public Construction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buildings</td>
<td>102</td>
<td>1.0</td>
</tr>
<tr>
<td>Housing and development</td>
<td>6</td>
<td>0.1</td>
</tr>
<tr>
<td>Industrial</td>
<td>2</td>
<td>0.0</td>
</tr>
<tr>
<td>Other</td>
<td>94</td>
<td>0.9</td>
</tr>
<tr>
<td>Nonbuilding construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td>97</td>
<td>0.9</td>
</tr>
<tr>
<td>All other</td>
<td>11</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Total new construction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>861</td>
<td>8.1</td>
</tr>
<tr>
<td><strong>Total GDP:</strong></td>
<td>10,624</td>
<td>100.0</td>
</tr>
</tbody>
</table>


Figure by MIT OpenCourseWare.
# The Value of US Real Estate Assets (1990)

<table>
<thead>
<tr>
<th>Type</th>
<th>Value (billion)</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Residential</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Family Homes</td>
<td>5,419</td>
<td>61.7</td>
</tr>
<tr>
<td>Multifamily</td>
<td>552</td>
<td>6.3</td>
</tr>
<tr>
<td>Condominiums/Coops</td>
<td>96</td>
<td>1.1</td>
</tr>
<tr>
<td>Mobile Homes</td>
<td>55</td>
<td>0.6</td>
</tr>
<tr>
<td><strong>Nonresidential</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retail</td>
<td>1,115</td>
<td>12.7</td>
</tr>
<tr>
<td>Office</td>
<td>1,009</td>
<td>11.5</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>308</td>
<td>3.5</td>
</tr>
<tr>
<td>Warehouse</td>
<td>223</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Total U.S. Real Estate</strong></td>
<td>8,777</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Adapted from DiPasquale and Wheaton (1996)
### U.S. Real Estate Ownership, 1990

<table>
<thead>
<tr>
<th></th>
<th>All Real Estate</th>
<th>Residential Only</th>
<th>Nonresidential Only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$, in billions</td>
<td>%</td>
<td>$, in billions</td>
</tr>
<tr>
<td>Individuals</td>
<td>5,088</td>
<td>58.0</td>
<td>5,071</td>
</tr>
<tr>
<td>Corporations</td>
<td>1,699</td>
<td>19.4</td>
<td>66</td>
</tr>
<tr>
<td>Partnerships</td>
<td>1,011</td>
<td>11.5</td>
<td>673</td>
</tr>
<tr>
<td>Nonprofits</td>
<td>411</td>
<td>4.7</td>
<td>104</td>
</tr>
<tr>
<td>Government</td>
<td>234</td>
<td>2.6</td>
<td>173</td>
</tr>
<tr>
<td>Institutional Investors</td>
<td>128</td>
<td>1.5</td>
<td>14</td>
</tr>
<tr>
<td>Financial Institutions</td>
<td>114</td>
<td>1.3</td>
<td>13</td>
</tr>
<tr>
<td>Other (Including Foreign)</td>
<td>92</td>
<td>1.0</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>8,777</strong></td>
<td><strong>100.0</strong></td>
<td><strong>6,122</strong></td>
</tr>
<tr>
<td><strong>% of All Real Estate</strong></td>
<td><strong>100.0</strong></td>
<td></td>
<td><strong>69.8</strong></td>
</tr>
</tbody>
</table>

*Adapted from DiPasquale and Wheaton (1996)*
Systems of Economic Equations

• Parameters: Constants that reflect underlying behavior, \( \alpha, \beta, \delta \).

• Endogenous variables: values that the model “determines: \( C, S, R, P \).

• Exogenous variables: values that determine the model’s variables, but which the models variables in turn do not influence: \( i, E \).

• Equilibrium: Solution to the endogenous variables given exogenous values and parameters.

• Comparative Statics: How changes in exogenous variables change equilibrium endogenous ones.
1st quadrant

1). Office Demand = \( \alpha_1 ER^{-\beta_1} \)
   
   E = office employment
   
   R = rent per square foot
   
   \( \beta_1 \) = rental elasticity of demand, % change in sqft per worker/% change in rent
   
   \( \alpha_1 \) = sqft / E when R = $1

2). Demand = Stock = S

3). Hence: \( R = (S/\alpha_1 E)^{-1/\beta_1} \)  {downward sloping schedule}
2nd and 3rd Quadrants

4). \( P = \frac{R}{i} \)
   \[ i = \text{all inclusive cap rate} \]

5). Office Construction rate:

\[ \frac{C}{S} = \alpha_2 P^{\beta_2} \]

\( P = \text{Asset Price per square foot} \)

[“Q” theory?]

\( \beta_2 = \text{Price elasticity of supply:} \)

[\% change in construction rate/\% change in price]
4\textsuperscript{th} Quadrant

6). Replacement version (graph):

E = fixed, \(\delta S\) = building losses

\[\Delta S/S = C/S - \delta\] [Construction rate – loss rate equals net additions = 0 in equilibrium]

7). Steady Demand growth version:

\[\Delta E/E = \delta,\text{ no losses}\]

Hence:

\[\Delta S/S - \Delta E/E = C/S - \delta\]

[what happens to S/E if C/S \(\gg\) \(\delta\) ?]
Effect of Demand Growth in Space Market: More Jobs

Asset Market: Valuation

Space Market: Rent Determination

Effect of Demand Growth in Space Market: More Jobs

Asset Market: Construction

Space Market: Stock Adjustment

Construction (SF)
Effect of Demand Growth in Space Market:

First phase...

Doesn’t form a rectangle.

Excess (negative) vacancy…
Effect of Demand Growth in Space Market:

2nd phase...

Rents spike and get rid of excess (negative) vacancy

Can this be a long-run equilibrium result?...

Doesn’t form a rectangle.
In long run equilibrium, new supply tempers initial rent spike.
Effect of Demand Growth in Asset Market...
Using the 4-Quadrant Model to assess the impact of other changes.

- What happens if Construction costs rise or the supply schedule shifts?
- Suppose depreciation speeds up (functional obsolescence dictates shorter life spans of buildings)?
- How to interpret owner occupied space (e.g. Single Family Housing)?
- EXERCISE #1.
Current Issues: using the diagram

• Zero (or negative) population and labor force growth in: Japan, Germany, Italy, Spain…?

• Increasing use of the Internet for retail shopping?

• Expanded availability of (subprime) mortgage credit to households previously ineligible?

• Continued global saving glut from growth in Asia – where savings rates are 20%+
Real Estate Macro-economics: Real Estate Cycles and Secular Trends

- What are real estate cycles? Truly independent oscillations or just reactions to the economy.
- Cycles vary with Property type.
- Cycles are related to broader capital markets.
- Secular trend: growth rates of the stock (construction) slow as economy matures.
- Secular trend: Prices adjusted for inflation rise over time?
Prefect Historic correlation between economic recessions and Housing Production – except for the last 5 years

Sources: BLS, BOC, TWR.
 prefect Historic correlation between economic recessions and Housing Prices – except for the last 5 years
With offices, building booms follow rents. The booms then generate falling rents = endogenous cycle?

Figure by MIT OpenCourseWare.
National Office Market
Completions Rate vs. Real Rent

- Total Employment Growth (L)
- Real Rent (R)
- Completion Rate (L)

$ Per Sqft
Forecast

20.00 22.00 24.00 26.00 28.00 30.00 32.00 34.00
20.00 22.00 24.00 26.00 28.00 30.00 32.00 34.00

$ Per Sqft
Forecast

20.00 22.00 24.00 26.00 28.00 30.00 32.00 34.00
20.00 22.00 24.00 26.00 28.00 30.00 32.00 34.00

- Total Employment Growth (L)
- Real Rent (R)
- Completion Rate (L)
Historically: Rents over the “cycle” mean revert around Development costs

Source: BLS, TWR Office Outlook XL, Summer 2008
Over the long run there also are:

little cycles and Big cycles

Construction as % of Stock

Downtown

Suburban

Broken Ground Projects
Index of Historic Housing Prices in Amsterdam (Real Guilders)
CPI Apartment Rent Indices for Selected "traditional" Cities: 1918-1999 (constant $)
Long run Appreciation? Just inflation (3.5%) for 100 years in NYC, but lots of decade risk

Price Index 1899 = 1.0
constant dollars/square ft.

Source: MIT 2002 Thesis
Real Estate Micro-economics: Cities and Land Markets

• No two properties are identical [complete product differentiation]

• Properties are close if not perfect substitutes for each other – at some price differential.

• Price differentials are extremely large, and very predictable.

• Price differentials tend to be stable over time: local neighborhoods do not have independent cyclic movements.
House prices reflect both unit characteristics and location attributes.
Repeat-Sale House price indices (CSW) for 15 submarkets within the greater Boston CMSA: 1982-2002 (current $)

House Price Indexes, Eastern Massachusetts, by City/Town Location
Home Prices within South California

Median Home Price, Thousands ($ 2002.4)

Sources: OFHEO, Torto Wheaton Research
Office Rents Move together Cyclically but not always secularly

TW Rent Index, 2003$ per sqft

- Los Angeles
- Orange County
- Ventura County
- Riverside
- San Diego

Forecast
Closely Correlated Industrial Rent Movements: few secular differences

TW Rent Index, 2003$ per sqft

Forecast

Los Angeles, Orange County, Ventura County, Riverside, San Diego
Manhattan Office Rents vs. NJ and Conn. Suburbs

TW Index, $2002 per sqft

Suburban Markets
Manhattan
Office Suburban Rents in Detail

TW Index, $2002 per sqft

- Northern New Jersey
- Long Island
- Stamford
- Westchester
Prices and Development

• Prices bring forth development: of any urban land use..

• Development occurs so as to maximize the residual value between: Price-capital costs (construction).

• This residual is “land value”. Development maximizes land value.

• Land Development is a natural real option: incur heavy capital costs to realize an income stream – or- wait (to do the same later) ?
What is a real Estate Market?

• Within “markets” all properties should move together: high substitutability, easy mobility.

• Between markets there exists frictions, transportation costs, immobility of resources and low substitutability.

• MSA as “market”? CMSA?
Between Markets – there can be huge differences in both long term growth and cyclic risk
FIGURE 5. Repeat Sale House Price Indices for Selected “new” Cities: 1975-1999 (constant $)

Metropolitan Housing Markets can even move independently
Although sometimes they are subject to a common economy wide Shock