Current readings

- Note: the 4QM is also discussed in Geltner and Miller, *Commercial Real Estate Analysis and Investments*, Chapter 2. Recommended.

You may have seen “a” four quadrant model of real estate before, in real estate finance:

<table>
<thead>
<tr>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt</td>
<td></td>
</tr>
<tr>
<td>Mortgage REITs; MBS and other structured debt</td>
<td>Whole mortgages</td>
</tr>
<tr>
<td>Equity</td>
<td></td>
</tr>
<tr>
<td>Equity REITs; Listed property companies</td>
<td>Direct property investments; Private equity funds; Private REITs</td>
</tr>
</tbody>
</table>

*This is a very useful taxonomy, but it is NOT the 4QM we’ll be using in Urban Economics!*
An Analytic Framework

• Now we will focus on the four quadrant model of DiPasquale and Wheaton.
  – Don’t confuse with the broadly similar model by Jeff Fisher, e.g. in Brueggeman and Fisher.
    • Conceptually similar, but different.
  – Don’t confuse with the four quadrants of real estate investment (public/private, by debt/equity).
    • See previous slide.
    • Nothing in common but the jargon.

A Fundamental Concept: Stocks and Flows

• Flows: Amounts per period yielded by an asset.
• Stocks: Corresponding total value of an asset at a particular time.
  Income, GDP  ⇒  Wealth
  Dividends  ⇒  Stock Price
  Rent  ⇒  Property Value

_The 4QM is a stock-flow model._ Considers both.
Figure 1  Demand for Stock of RE

Rent (Flow of Price)

Stock of Space

Figure 2  Annual Construction in the Steady State

Stock of Space

Construction

Figure 3  Supply of New Construction

Price (Asset Price, or Value)

Construction

Figure 4  Asset Price is Present Values of Rents

Asset Price

Rent

$p = \frac{R}{T}$
**Markets for the Use of Property, and Asset Markets**

- **Asset Market:** Valuation
- **Property Market:** Rent Determination

**Rent ($/SF)**

\[ P = \frac{R}{I} \]

**Rent ($) = f(Rent, the Economy)**

**Asset Price ($/SF)**

**Stock (Sq. Ft.)**

**Demand = f(Rent, the Economy)**

**Construction (Sq. Ft.)**

**Slope is rate of depreciation**

**Source:** DiPasquale and Wheaton

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**Some Insights of the 4 Quadrant Model**

- Integrates stocks and flows in a simple framework
- Comparative static model; not a true dynamic model
- Easy to “solve” graphically for qualitative changes
- It’s a little tricky to solve for actual numbers because the four equations are simultaneous.
  - Well, not too tricky. Four equations, four unknowns.
  - Spreadsheet model can do some of the work for us, using Excel’s Solver add-in.

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**Analysis with the 4QM**

- Demand for real estate by foreign investors increases.
  - 4QM → cap rates fall (QIV). Asset prices rise.
  - But supply response (QIII) increases stock of space, rents fall (QI), moderating original asset price increase.
- Demand for real estate increases from the office sector.
  - 4QM → Demand shifts out (QI), values rise. Note difference between shifts in space demand and asset demand!

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**Further Analysis with the 4QM**

- Mortgage rates fall.
  - 4QM → When long term rates fall, then existing yield from real estate becomes higher in relative terms. Investment demand increases. Cap rates fall (QIV), supply up (QIII), rents fall (QI).
- Short term interest rates fall.
  - 4QM → Higher short term rates (holding long term rates constant) shift the costs of development (QIII), lowers the stock of space (QII), rents rise (QI), asset prices rise with costs (QIV).
- Many other scenarios possible, e.g. an increase in public housing, growth management, tax changes.
Markets for the Use of Property, and Asset Markets

Calibrating the 4QM

- Following a textbook version of DiPasquale and Wheaton (1996, p. 8), we specify the relationships in our 4QM as follows:
  1. \( S = E(400-10R) \)
  2. \( C = \delta S \)
  3. \( P = 200 + 5C \)
  4. \( R = iP \)  (or \( P = R/i \))

Where do these numbers come from? How can we calibrate the model? We’ll discuss briefly now, more on this later.
Application of the 4QM to Country Economic Analysis: Russia, 1990s (Transition period)

- From World Bank Sector Report 14929-RU, Chapter 3 (summarized in Renaud, Urban Studies, Part II)
- Stabilization strategy in light of the 4QM:
  - QI: Demand is now “behind a veil.” Privatize the housing stock, reform rents, subsidies.
  - QII: Lower depreciation with better incented maintenance, rehabilitation (where feasible).
  - QIII: Improved regulatory framework and “industrial organization” of the real estate market will enhance supply.
  - QIV: Costs of funds must rise to opportunity cost, cap rates will rise, asset prices will fall to a sustainable equilibrium.
The 4QM helps us take a closer look at the market.
The 4QM Motivates Market Analysis

- What drives user demand for product? (Q1)
- What affects depreciation? (Q2)
- What determines responsiveness of supply? (Q3)
- What drives investment demand? (Q4)

— Can we put numbers on these?

Calibrating the 4QM

- Recently, following DiPasquale and Wheaton (1996, p. 8), we specified the relationships in our 4QM as follows:
  - (1) \( S = E(400-10R) \)
  - (2) \( C = \delta S \)
  - (3) \( P = 200 + 5C \)
  - (4) \( R = iP \)
- Where do these numbers come from? How can we calibrate the model?

Estimating the relationship in Q1

- What does the demand for space look like? Let’s estimate a D-W model (see equation 1, above), using Torto-Wheaton data from 1980 to 1993.
  — See dataset OFFICE.xlsx on course website
- The data are “panel data,” i.e. a “stacked” dataset of MSAs over time. We’ll used “fixed effects,” i.e. add a set of dummy variables for each separate MSA, as well as our variables of interest.
  — (Table will only present variables of interest.)
Here’s what the top of OFFICE.xls looks like…

Data are twice a year (“semester” data), which is unusual…

If rent is zero, it’s missing

Data are stacked: Atlanta, followed by
Baltimore, then Boston…

Demand drivers vary by property type

• What are the main Q1 demand drivers for:
  – Office?
  – Apartments?
  – Retail?
  – Hotel?
  – Industrial?
• Employment is a key driver in many markets. What kind of employment?

Table 1: Summary Regression Results, Simple Demand for Office Space

<table>
<thead>
<tr>
<th>Dependent Variable: Stock of Space, in 1000 Sq Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjusted R²</td>
</tr>
<tr>
<td>Degrees of freedom</td>
</tr>
<tr>
<td>Employment</td>
</tr>
<tr>
<td>Coefficient</td>
</tr>
<tr>
<td>Standard Error</td>
</tr>
<tr>
<td>t-Statistic</td>
</tr>
<tr>
<td>Prob &gt;</td>
</tr>
<tr>
<td>Std Coefficient</td>
</tr>
<tr>
<td>Tolerance</td>
</tr>
<tr>
<td>Employment*Rent</td>
</tr>
<tr>
<td>Coefficient</td>
</tr>
<tr>
<td>Standard Error</td>
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</table>

Employment in 1000s, rent in $/sq. ft.

Rent in interaction term is adjusted for inflation.

Model is estimated with fixed effects, e.g. a shift variable for each MSA.
An alternate look at employment

- Headline employment data are collected and presented monthly. They are net employment.
- Behind net employment: gross employment changes:
  
  + gains from new establishments
  + hiring at old establishments
  - losses from plant closures
  - losses from layoffs and firings
  = net employment change

- Since the 1990s, BEA has (separately) collected data on gross job flows as well as the net number.