11.433J / 15.021J Real Estate Economics
Fall 2008

# 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

| | $ (in Billions) | % of GDP |
|---|---|---|
| **Private Construction** | **650** | **6.1** |
| Buildings | | |
|    Residential buildings | 422 | 4.0 |
|    Nonresidential buildings | 167 | 1.6 |
|     ›Industrial | 17 | 0.2 |
|     ›Office | 38 | 0.4 |
|     ›Hotels/Motels | 10 | 0.1 |
|     ›Other commercial | 56 | 0.5 |
|     ›All other nonresidential | 46 | 0.4 |
| Nonbuilding construction | | |
|    Public utilities | 54 | 0.5 |
|    All other | 7 | 0.1 |
| **Public Construction** | **210** | **2.0** |
| Buildings | 102 | 1.0 |
|    Housing and development | 6 | 0.1 |
|    Industrial | 2 | 0.0 |
|    Other | 94 | 0.9 |
| Nonbuilding construction | 108 | 1.0 |
|    Infrastructure | 97 | 0.9 |
|    All other | 11 | 0.1 |
| **Total new construction** | **861** | **8.1** |
| **Total GDP:** | **10,624** | **100.0** |

*Source: Current Construction Reports, Series C30, U.S. Census Bureau. Gross Domestic Product from Economic Report of the President, 2004*

Figure by MIT OpenCourseWare.

## The Value of US Real Estate Assets (1990)

|  | $, in billions | % of Total |
|---|---|---|
| *Residential* | 6,122 | 69.8 |
|  |  |  |
| Single Family Homes | 5,419 | 61.7 |
| Multifamily | 552 | 6.3 |
| Condominiums/Coops | 96 | 1.1 |
| Mobile Homes | 55 | 0.6 |
|  |  |  |
| *Nonresidential* | 2,655 | 30.2 |
|  |  |  |
| Retail | 1,115 | 12.7 |
| Office | 1,009 | 11.5 |
| Manufacturing | 308 | 3.5 |
| Warehouse | 223 | 2.5 |
|  |  |  |
| Total U.S. Real Estate | 8,777 | 100.0 |

*Adapted from DiPasquale and Wheaton (1996)*

## U.S. Real Estate
### Ownership, 1990

| | All Real Estate | | Residential Only | | Nonresidential Only | |
|---|---|---|---|---|---|---|
| | $, in billions | % | $, in billions | % | $, in billions | % |
| Individuals | 5,088 | 58.0 | 5,071 | 82.8 | 17 | 0.6 |
| Corporations | 1,699 | 19.4 | 66 | 1.1 | 1,633 | 61.5 |
| Partnerships | 1,011 | 11.5 | 673 | 11.0 | 338 | 12.7 |
| Nonprofits | 411 | 4.7 | 104 | 1.7 | 307 | 11.6 |
| Government | 234 | 2.6 | 173 | 2.8 | 61 | 2.3 |
| Institutional Investors | 128 | 1.5 | 14 | 0.2 | 114 | 4.3 |
| Financial Institutions | 114 | 1.3 | 13 | 0.2 | 101 | 3.8 |
| Other (Including Foreign | 92 | 1.0 | 8 | 0.1 | 84 | 3.2 |
| Total: | 8,777 | 100.0 | 6,122 | 100.0 | 2,655 | 100.0 |
| % of All Real Estate | | 100.0 | | 69.8 | | 30.2 |

*Adapted from DiPasquale and Wheaton (1996)*

Exhibit 2-3: The DiPasquale-Wheaton 4-Quadrant Diagram…

D

Rent $

Asset Market:
Valuation

Space Market:
Rent Determination

R*

D

Price $

P*

Q*

Stock (SF)

C*

Asset Market:
Construction

Space Market:
Stock Adjustment

Construction (SF)
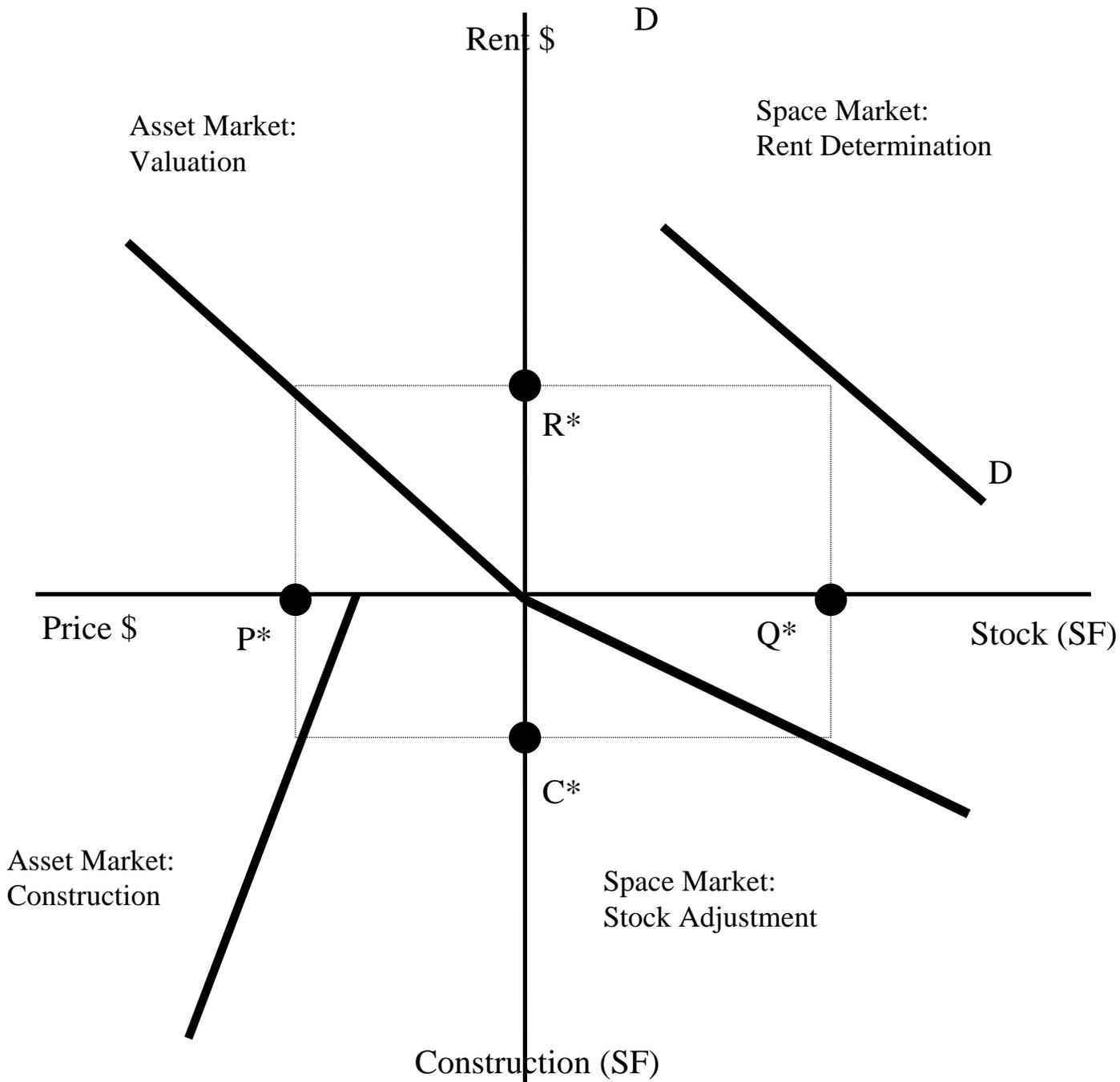
# Systems of Economic Equations

- 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.

# 1$^{\text{st}}$ 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). $P = R/i$

$i$ = all inclusive cap rate

5). Office Construction rate:

$C/S = \alpha_2 P^{\beta 2}$

$P$ = Asset Price per square foot

["Q" theory?]

$\beta_2$ = Price elasticity of supply:

[% change in construction rate/% change in price]

# 4ᵗʰ 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:

$\Delta E/E = \delta$, no losses

Hence: $\Delta S/S - \Delta E/E = C/S - \delta$

[what happens to S/E if $C/S >< \delta$ ?]
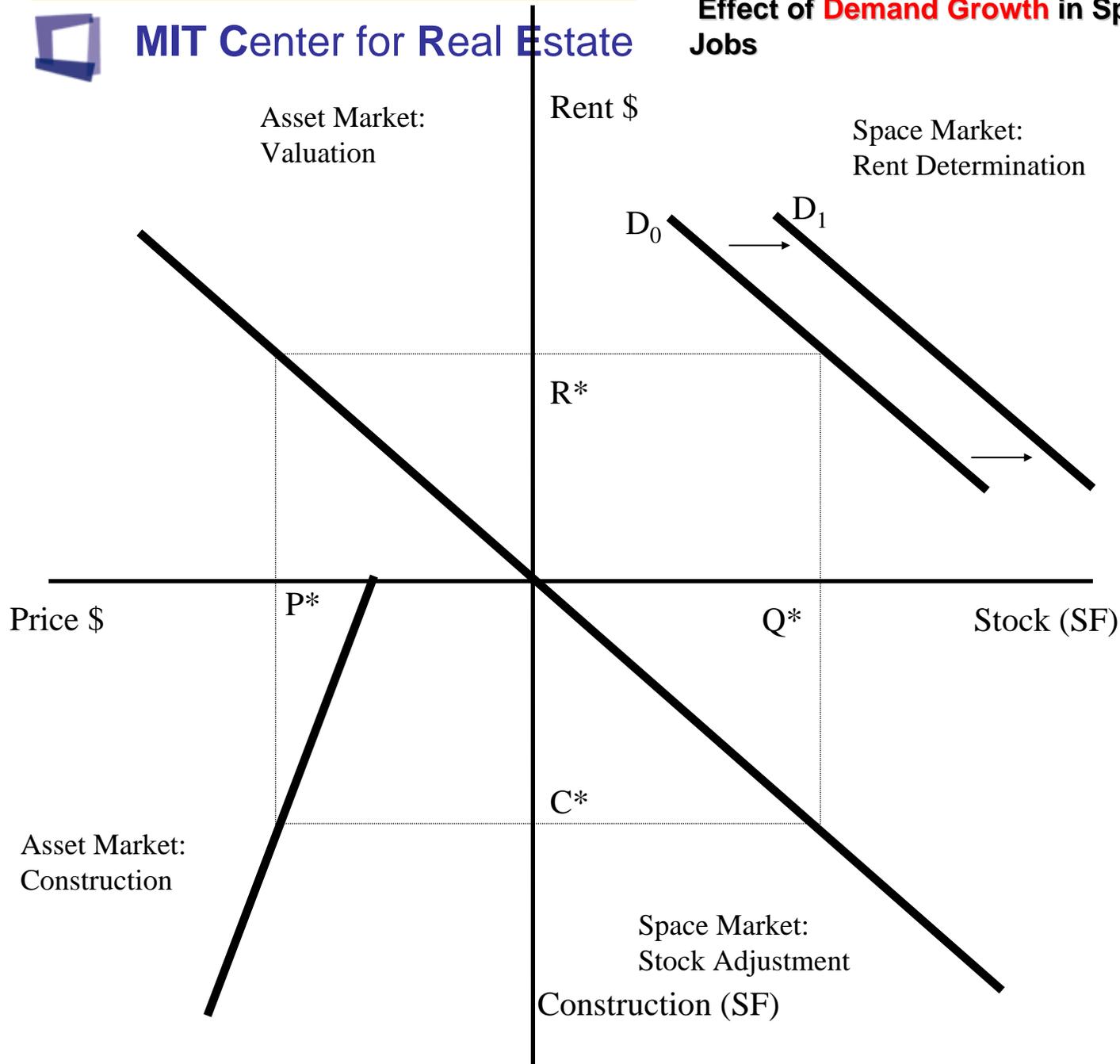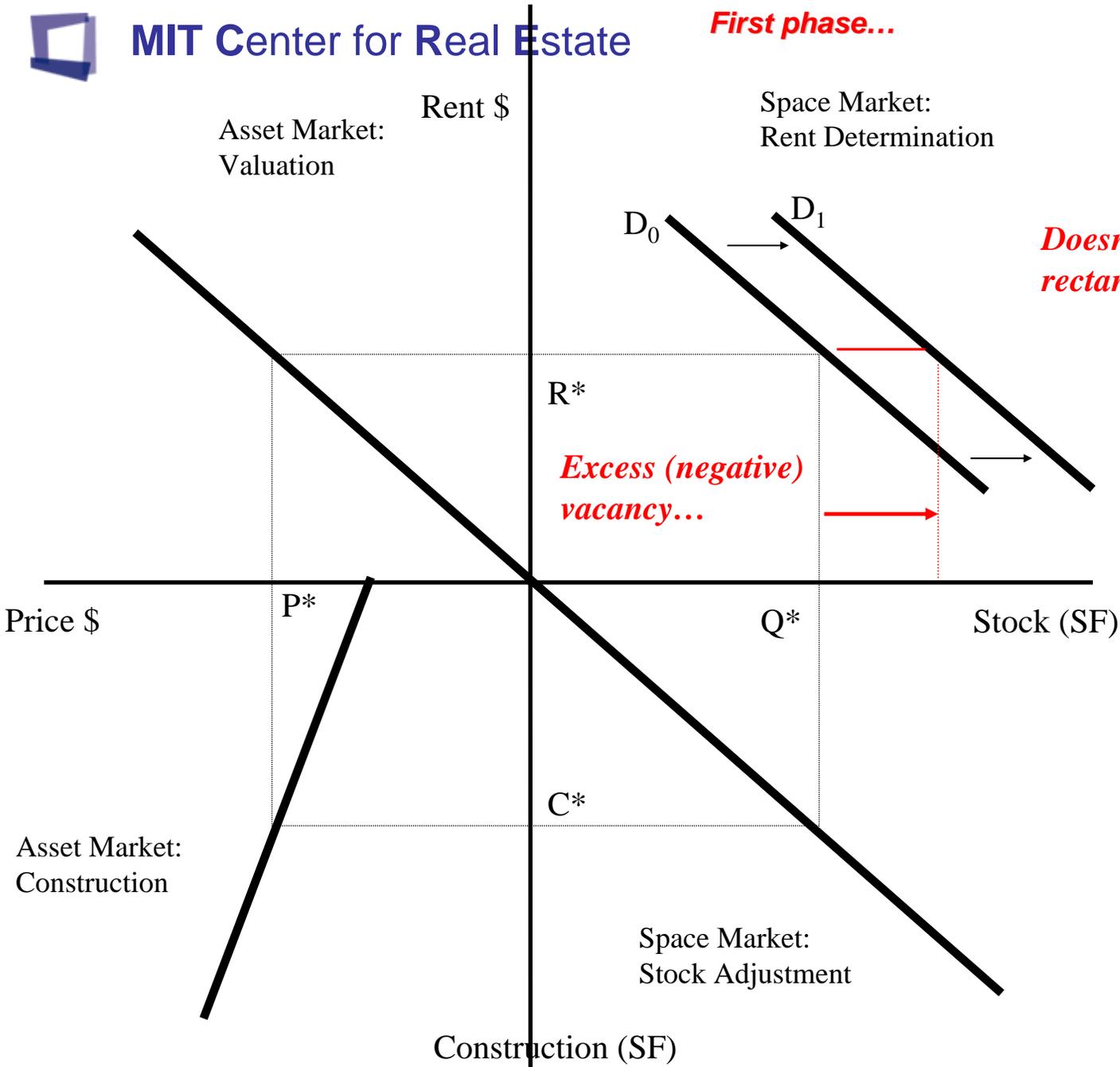
Asset Market:
Valuation

Space Market:
Rent Determination

Rent $

$D_0$

$D_1$

R*

Price $

P*

Q*

Stock (SF)

Asset Market:
Construction

C*

Space Market:
Stock Adjustment

Construction (SF)

**MIT C**enter for **R**eal **E**state

*First phase…*

Rent $

Asset Market:
Valuation

Space Market:
Rent Determination

$D_0$   $D_1$

*Doesn't form a rectangle.*

R*

*Excess (negative) vacancy…*

Price $

P*

Q*   Stock (SF)

Asset Market:
Construction

C*

Space Market:
Stock Adjustment

Construction (SF)

**MIT Center for Real Estate**

Asset Market:
Valuation

Rent $

Space Market:
Rent Determination

$D_0$

$D_1$

$R_1$
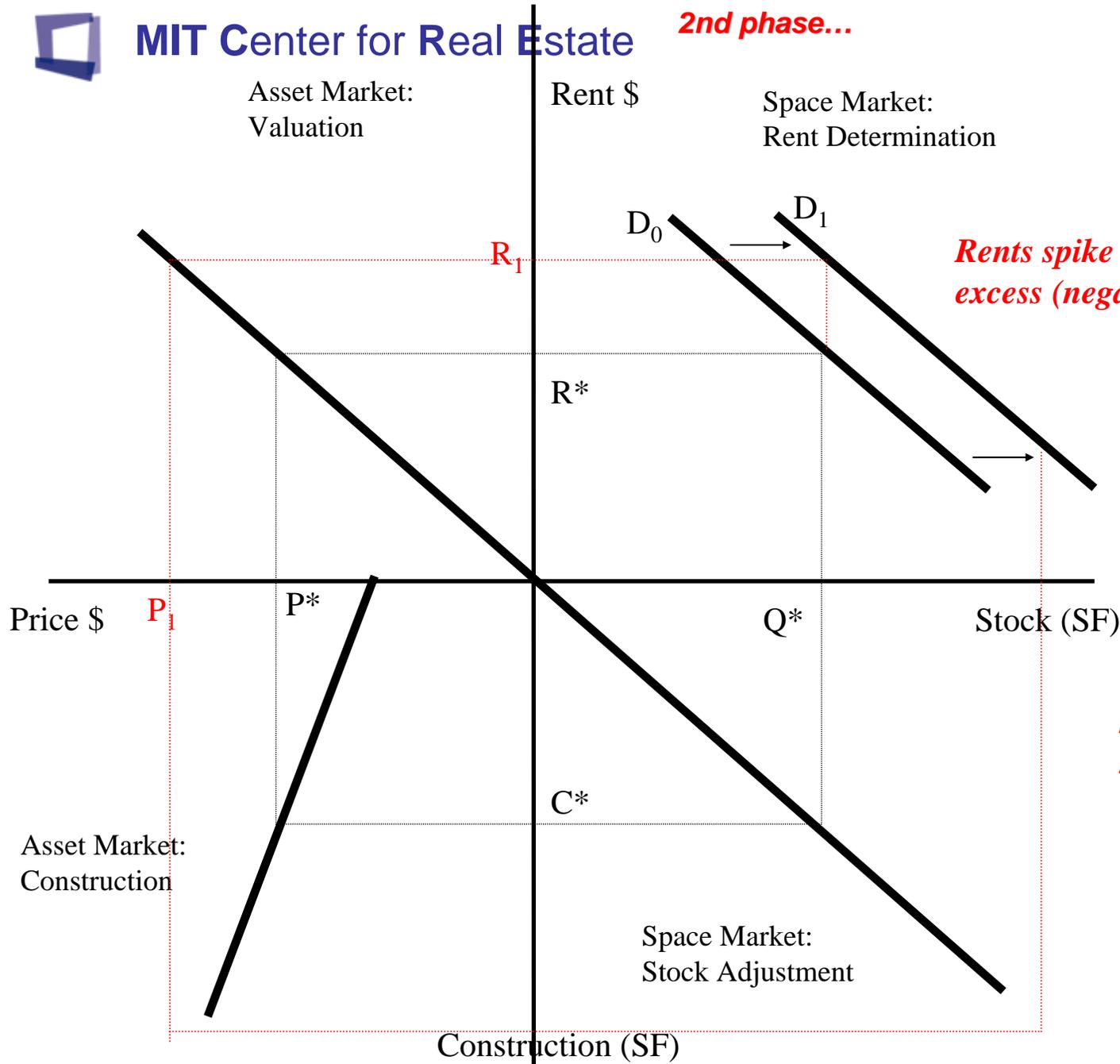
*Rents spike and get rid of excess (negative) vacancy*

R*

Price $

$P_1$

P*

Q*

Stock (SF)

*Can this be a long-run equilibrium result?…*

C*

*Doesn't form a rectangle.*

Asset Market:
Construction

Space Market:
Stock Adjustment

Construction (SF)

**MIT C**enter for **R**eal **E**state

Asset Market: Valuation

Rent $

Space Market: Rent Determination

$D_0$ $D_1$

$R_1$

$R**$

$R*$

$P**$

$P_1$ $P*$

Price $

$Q*$ $Q**$ Stock (SF)

$C*$

$C**$

Asset Market: Construction

Space Market: Stock Adjustment
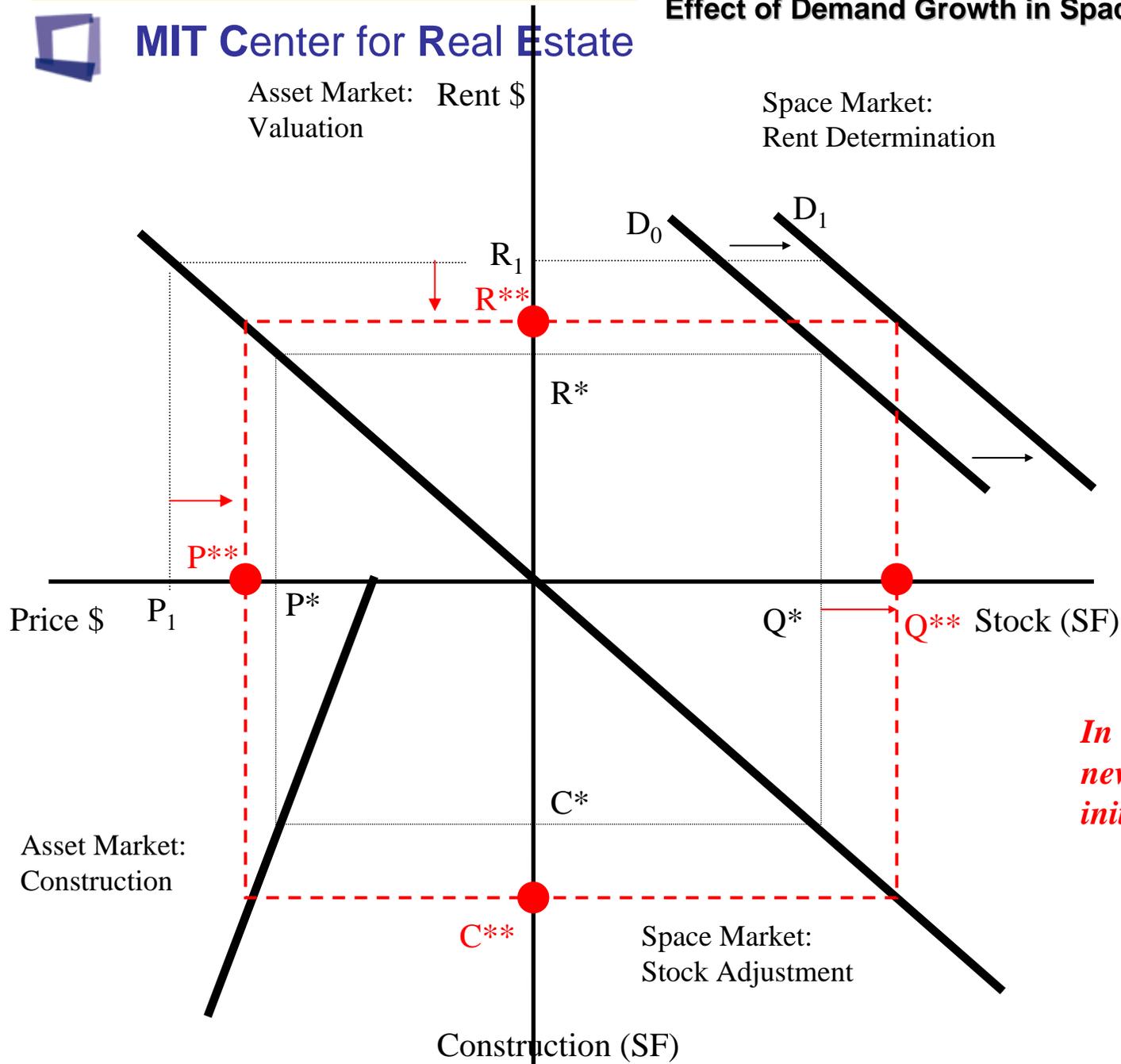
Construction (SF)

*In long run equilibrium new supply tempers initial rent spike*

**MIT Center for Real Estate**

Asset Market:
Valuation

Rent $

Space Market:
Rent Determination

$D_0$

11% CAP

$D_1$

$R*$

8%CAP

$R**$

SR

LR

$P_1$

$Q**$

$P**$   $P*$

$Q*$

Price $

Stock (SF)

Asset Market:
Construction

$C*$

Space Market:
Stock Adjustment

$C**$
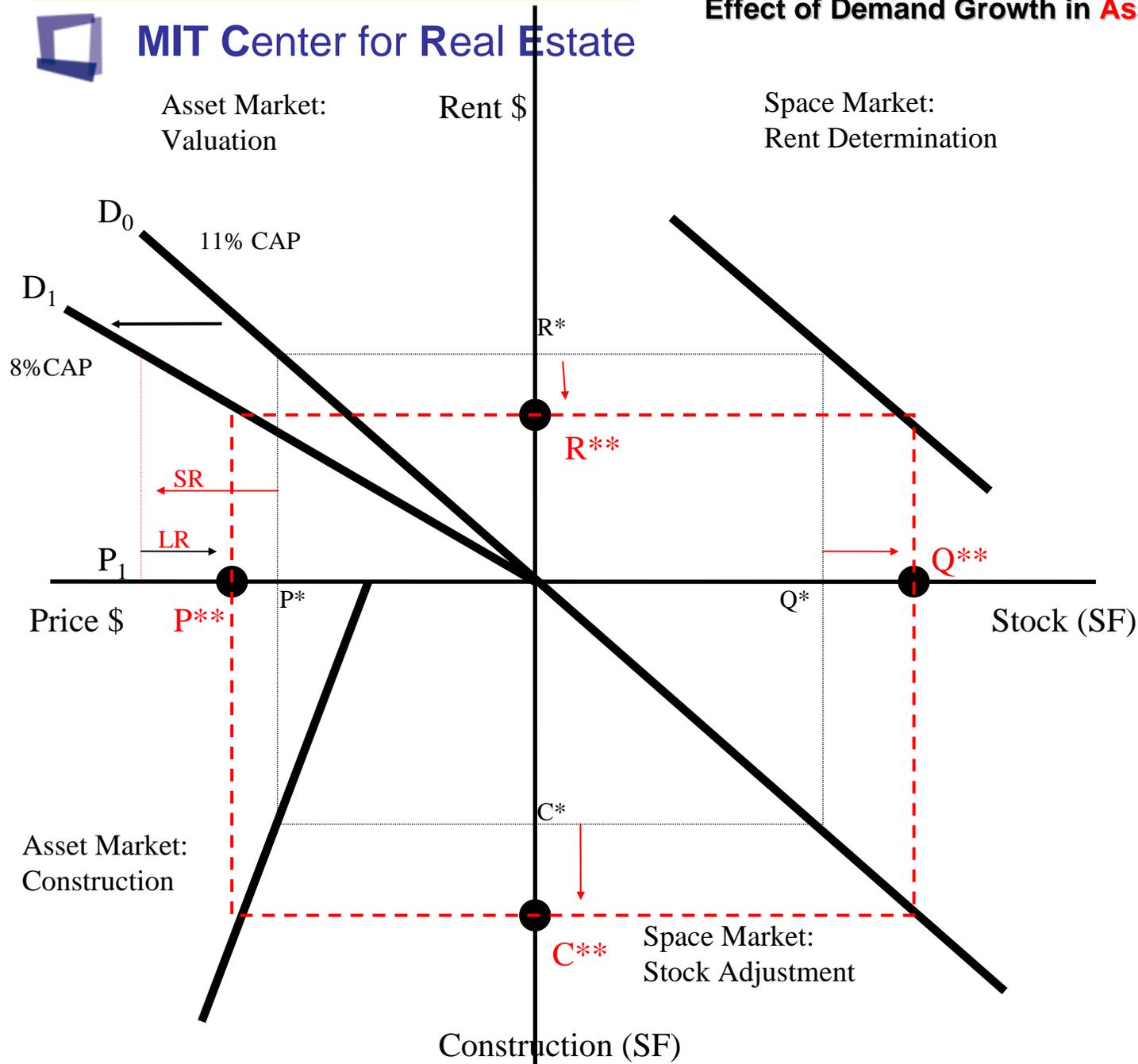
Construction (SF)

# 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
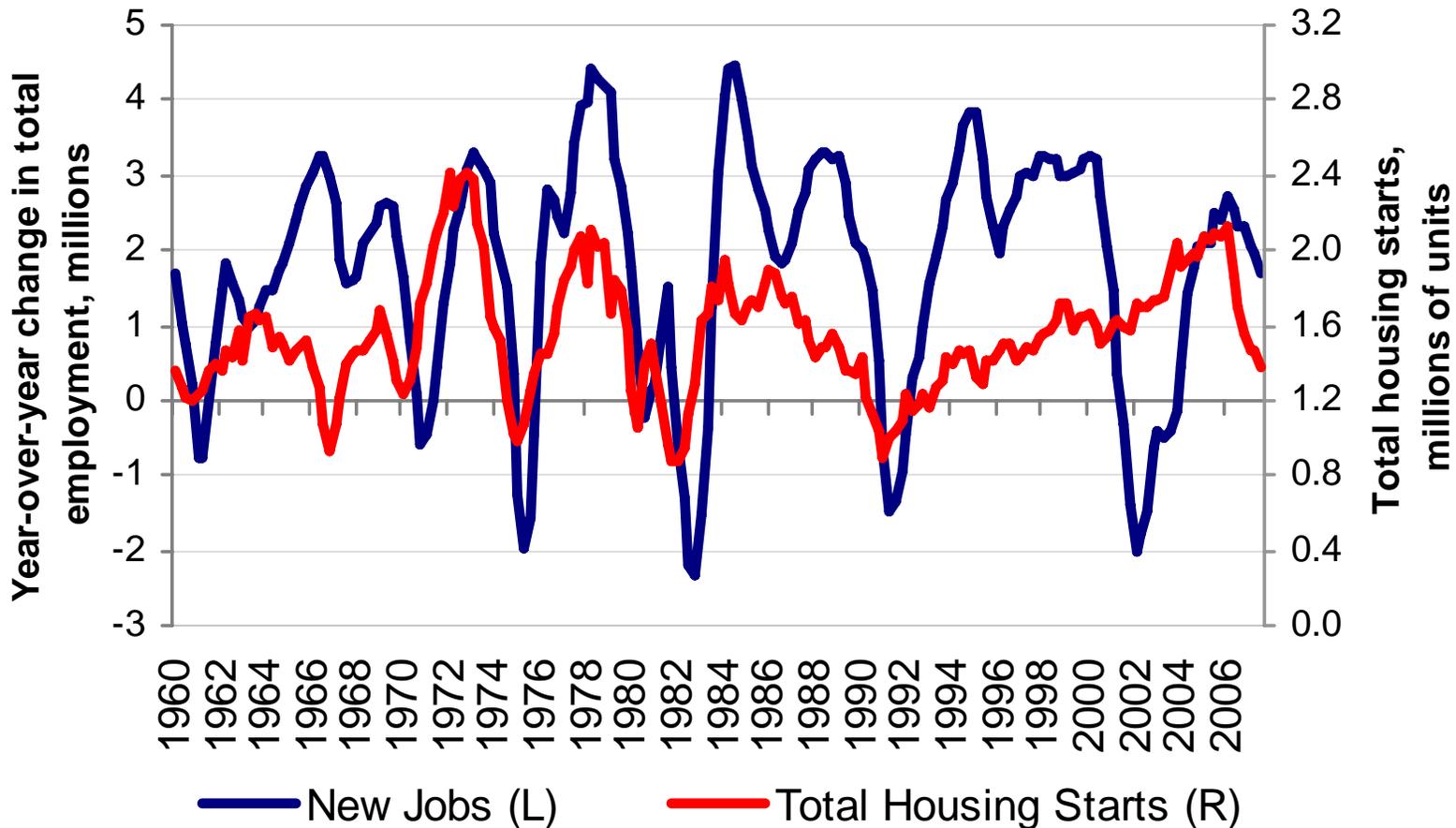


*Sources: BLS, BOC, TWR.*

# Prefect Historic correlation between economic recessions and Housing Prices – except for the last 5 years



**Housing and U.S. Job Growth**

based on 4-qtr moving averages

Job Growth     Real Median Home Price Growth (lagged)
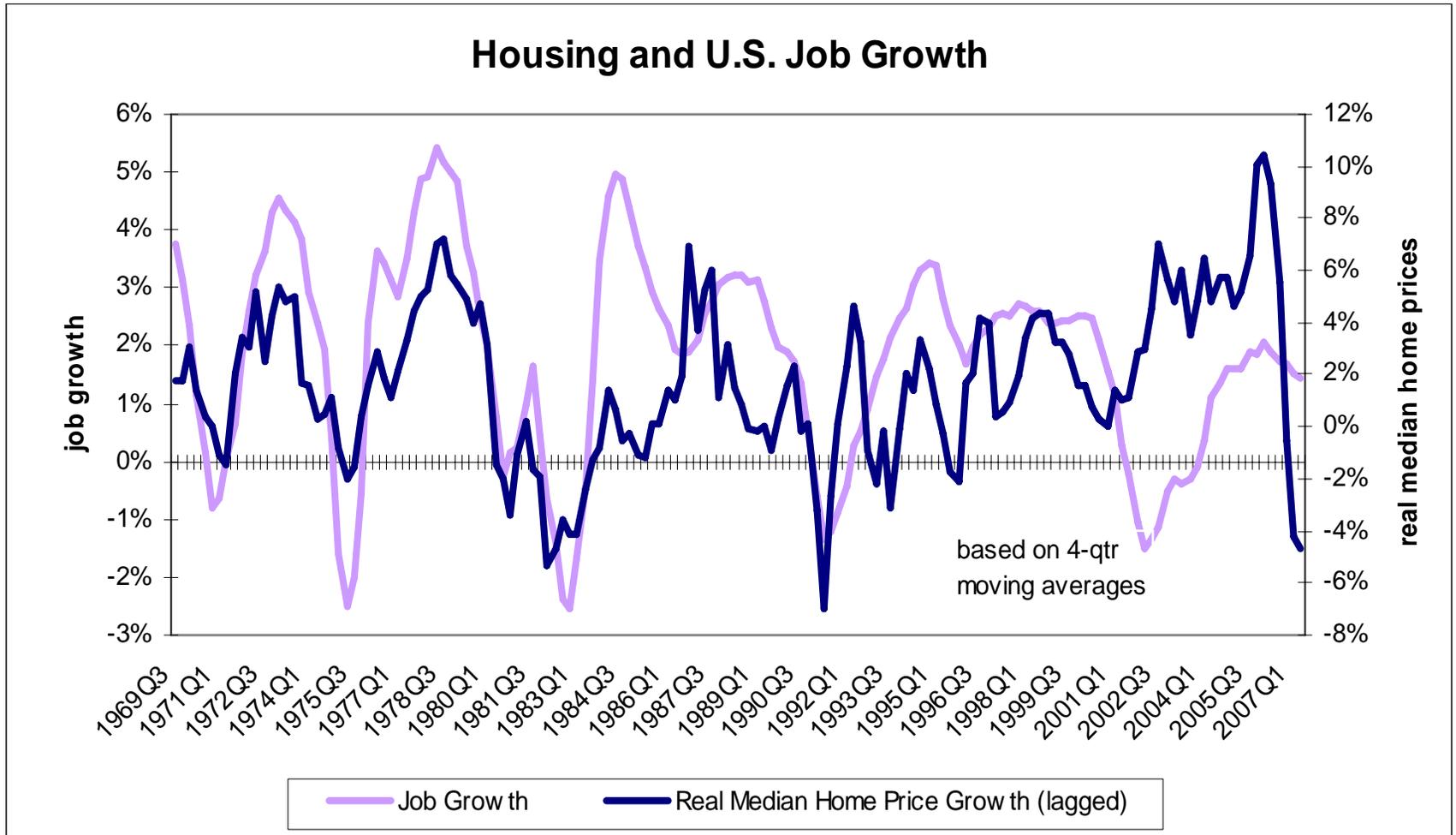
# With offices, building booms follow rents. The booms then generate falling rents = endogenous cycle?



Office construction and rent growth (TWR sum of markets)

Completions -
Historical average

Forecast

Legend: Completions in msf (L) — TWR rent inflation in % (R)

Figure by MIT OpenCourseWare.
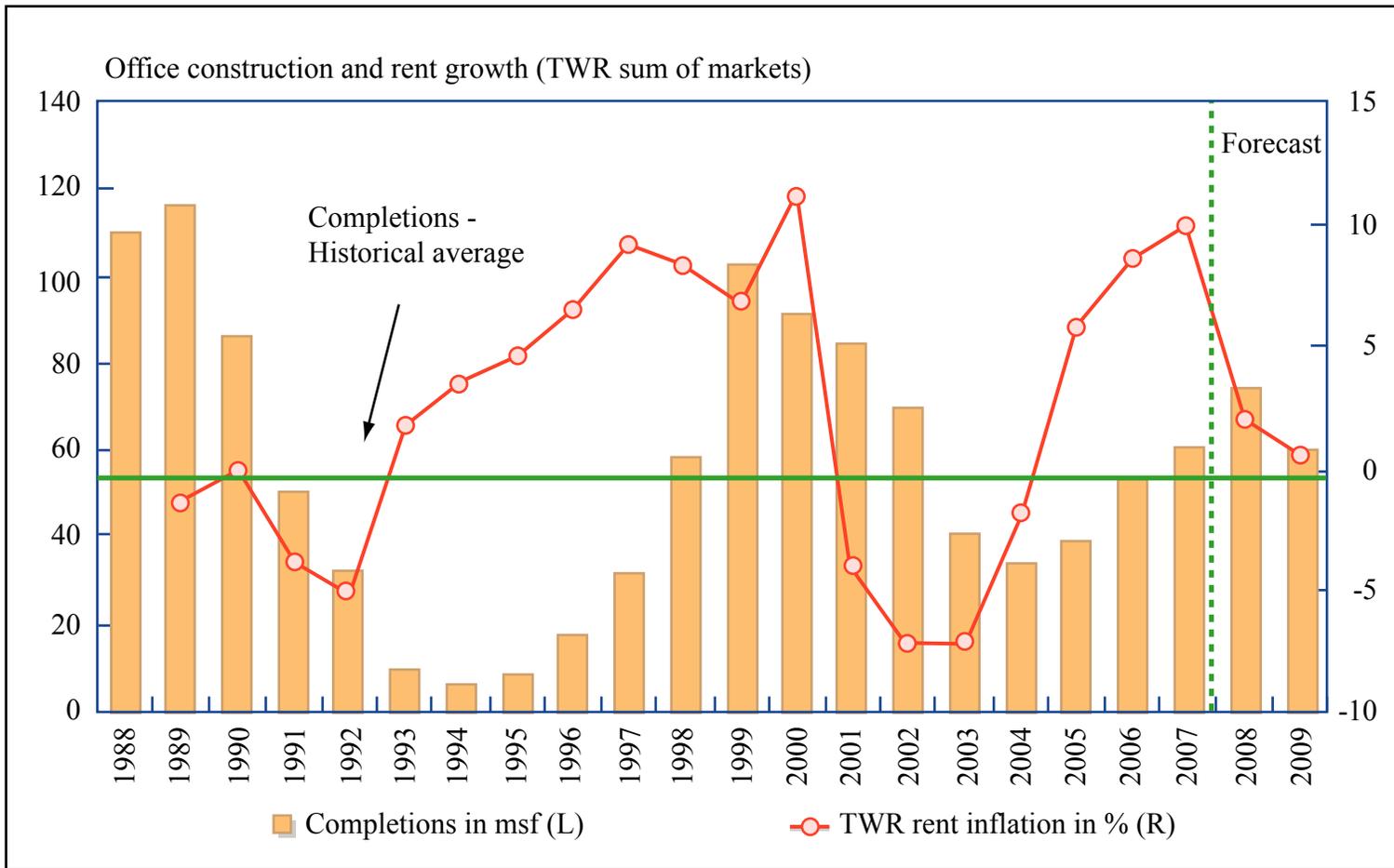
National Office Market
Completions Rate vs. Real Rent
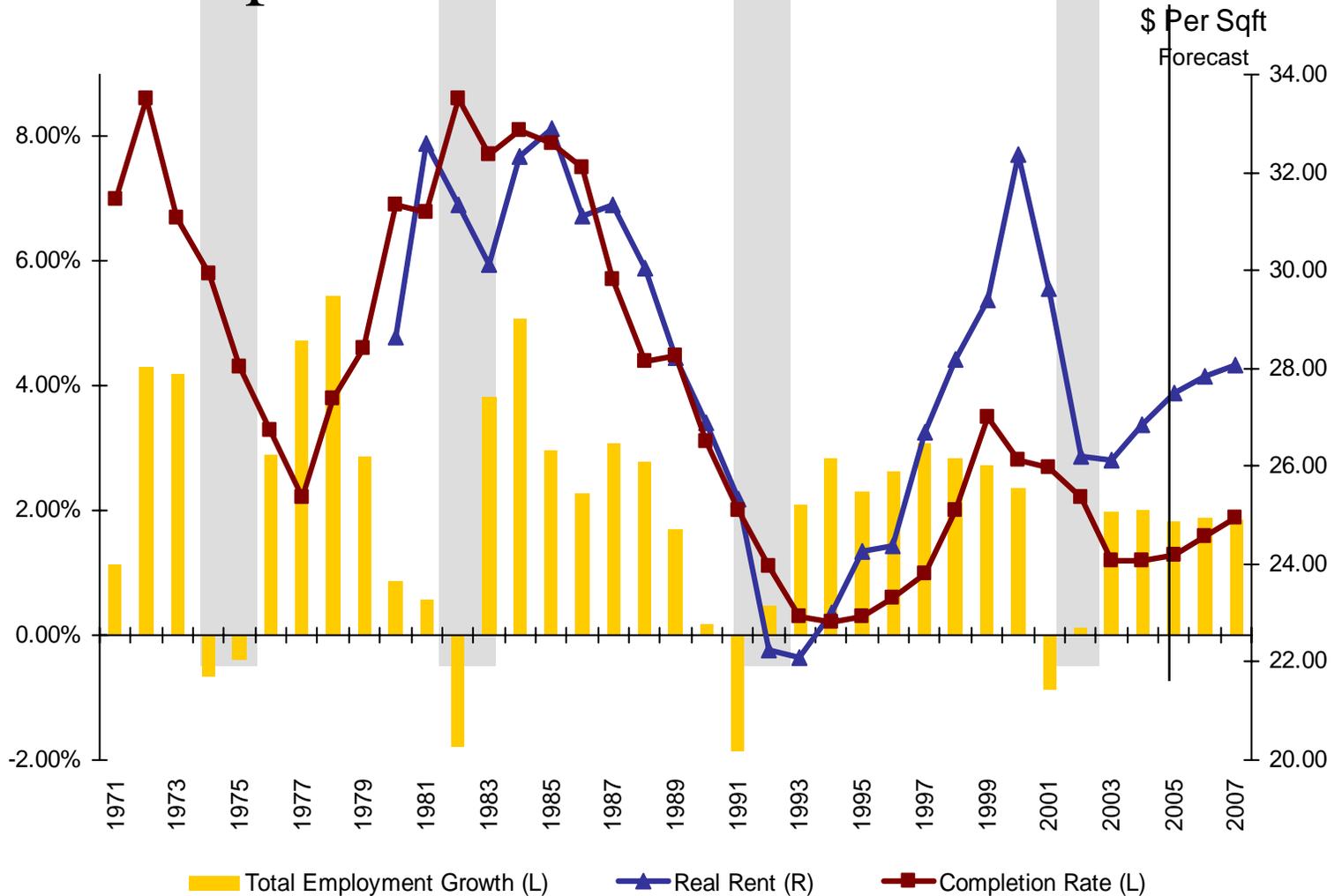
# Historically: Rents over the "cycle" mean revert around Development costs



PPI: Construction                                                    TWR Rent Index

Legend: PPI: Construction Materials and Components — TWR Rent Index
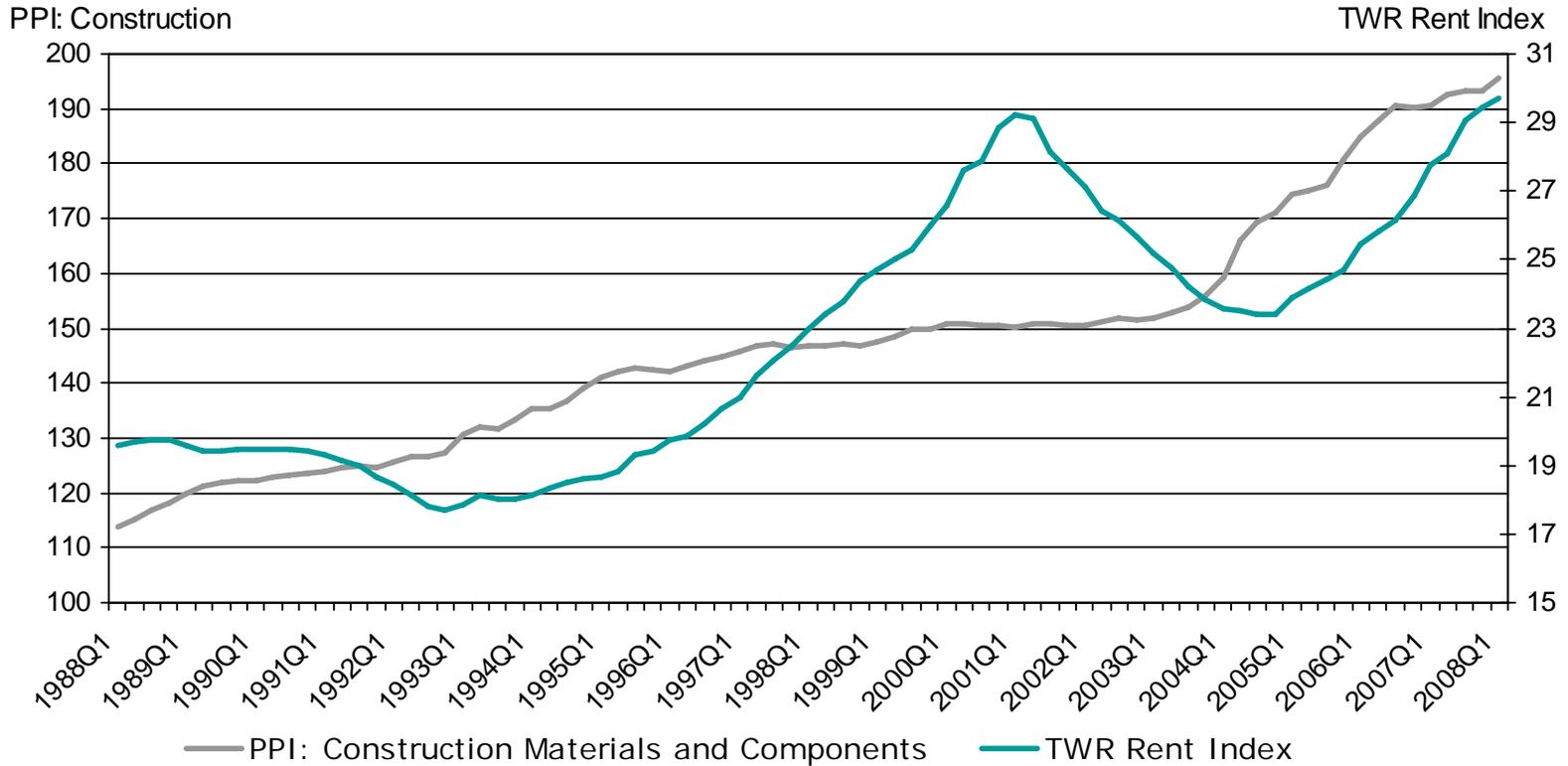
*Source: BLS, TWR Office Outlook XL, Summer 2008*
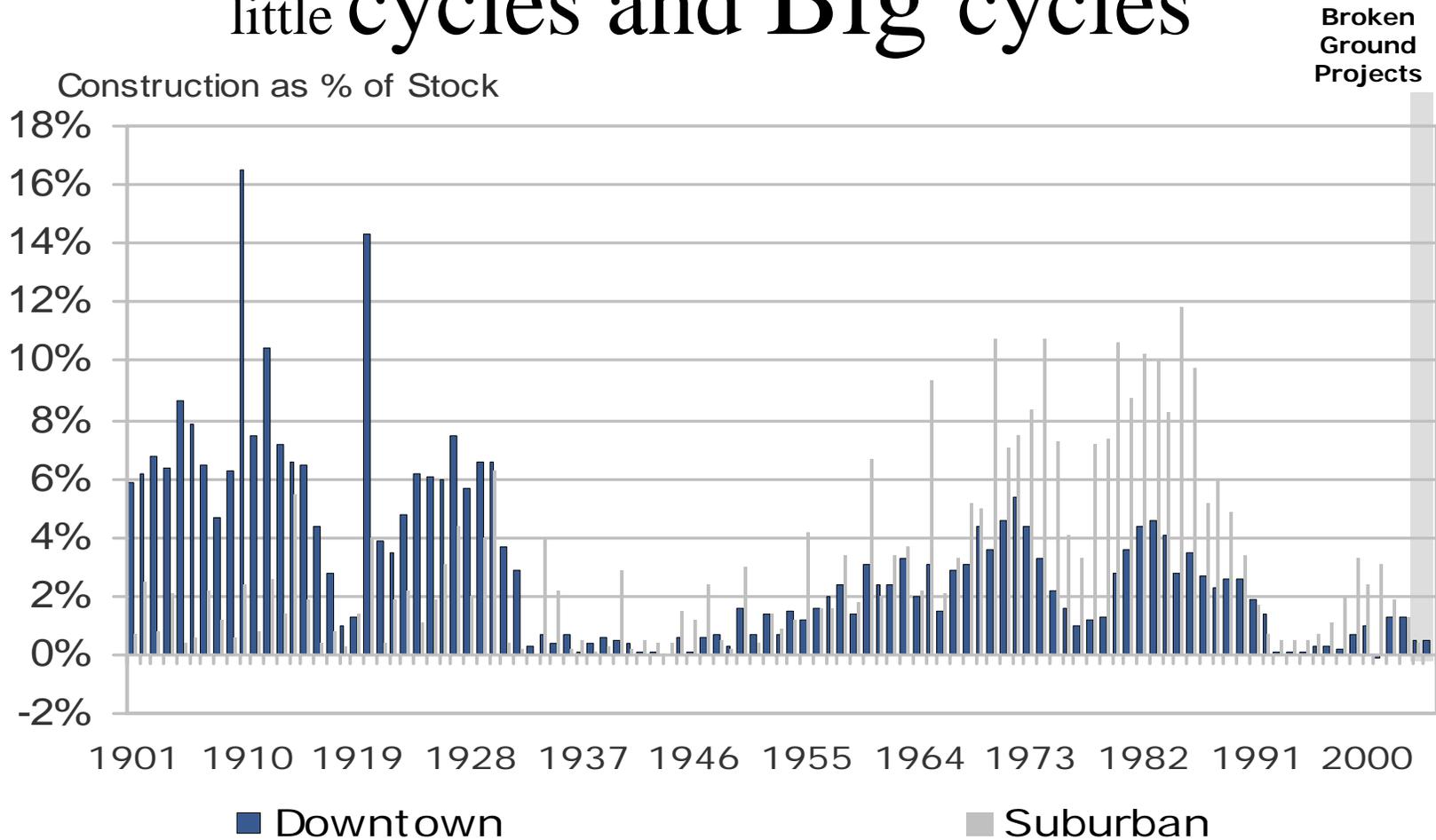
# Index of Historic Housing Prices in Amsterdam (Real Guilders)

**MIT C**enter for **R**eal **E**state
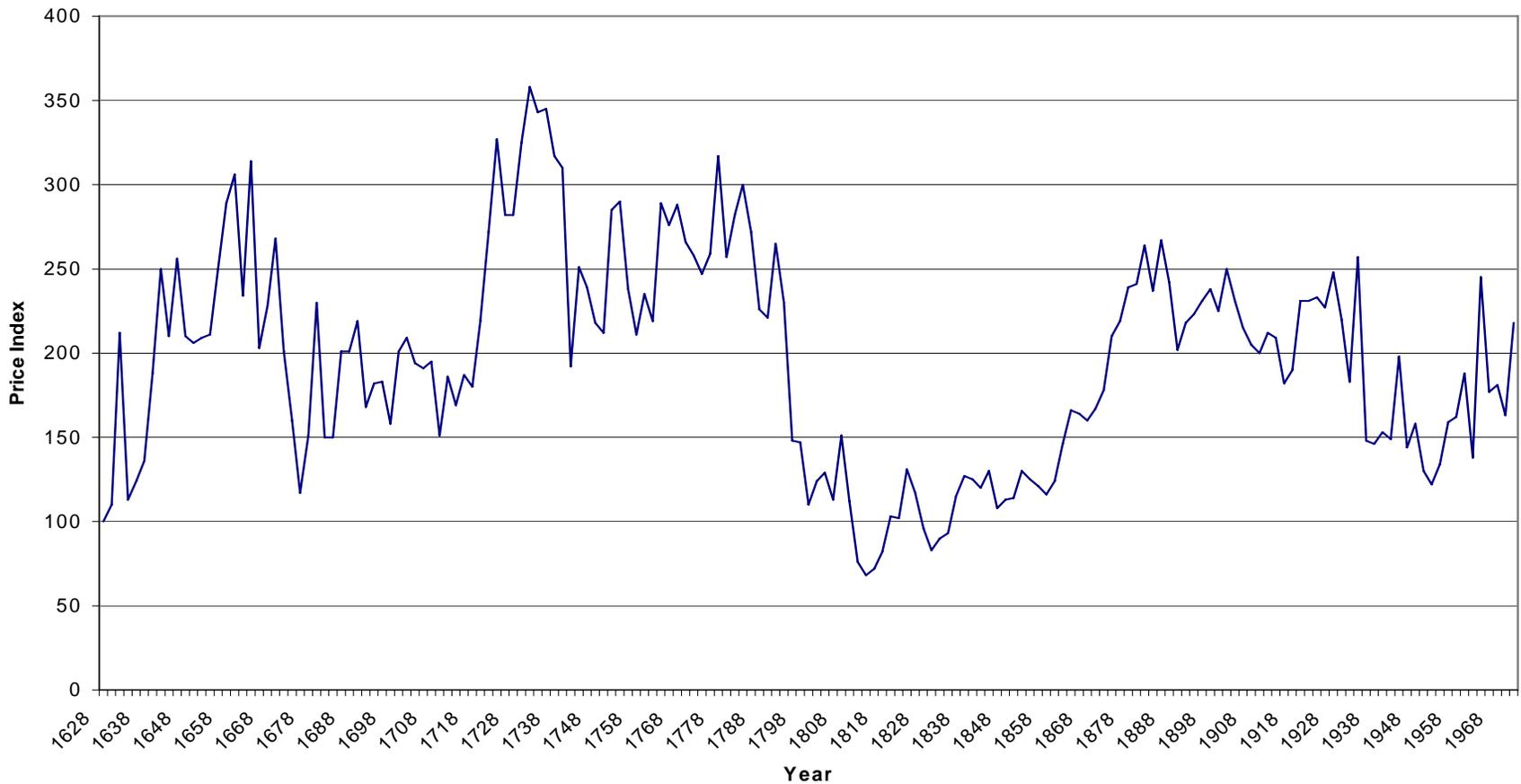
CPI Apartment Rent Indices for Selected "traditional" Cities: 1918-1999 (constant $)

NEW YORK — BOSTON — CHICAGO — WASHINGTON D. C. — SAN FRANCISCO
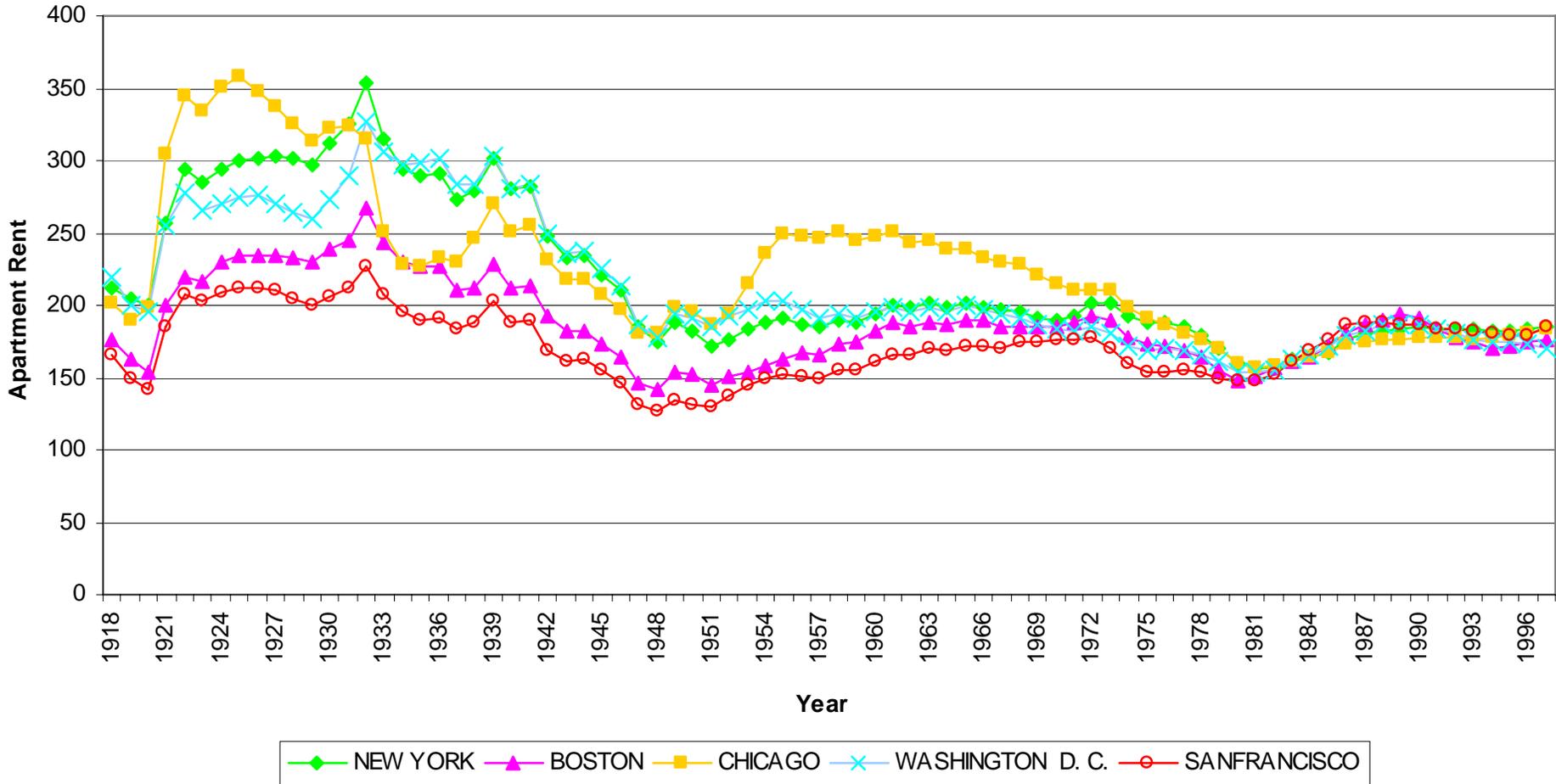
# Long run Appreciation? Just inflation (3.5%) *for 100 years in NYC,* but lots of decade risk

**Price Index 1899 = 1.0**
*constant dollars/square ft.*
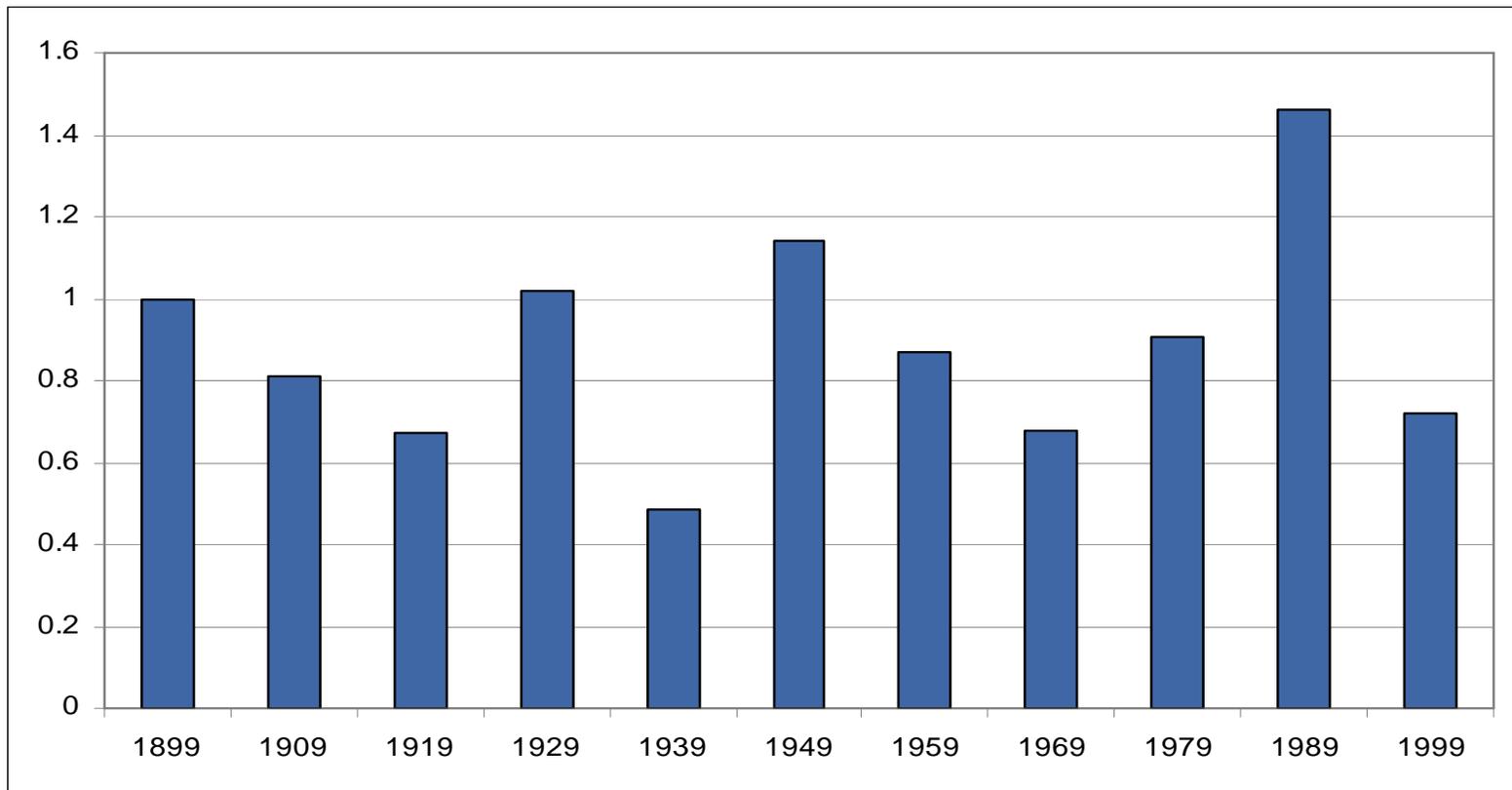
# Real Estate Micro-economics: Cities and Land Markets

- 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



Sale amount against square feet, Phoenix
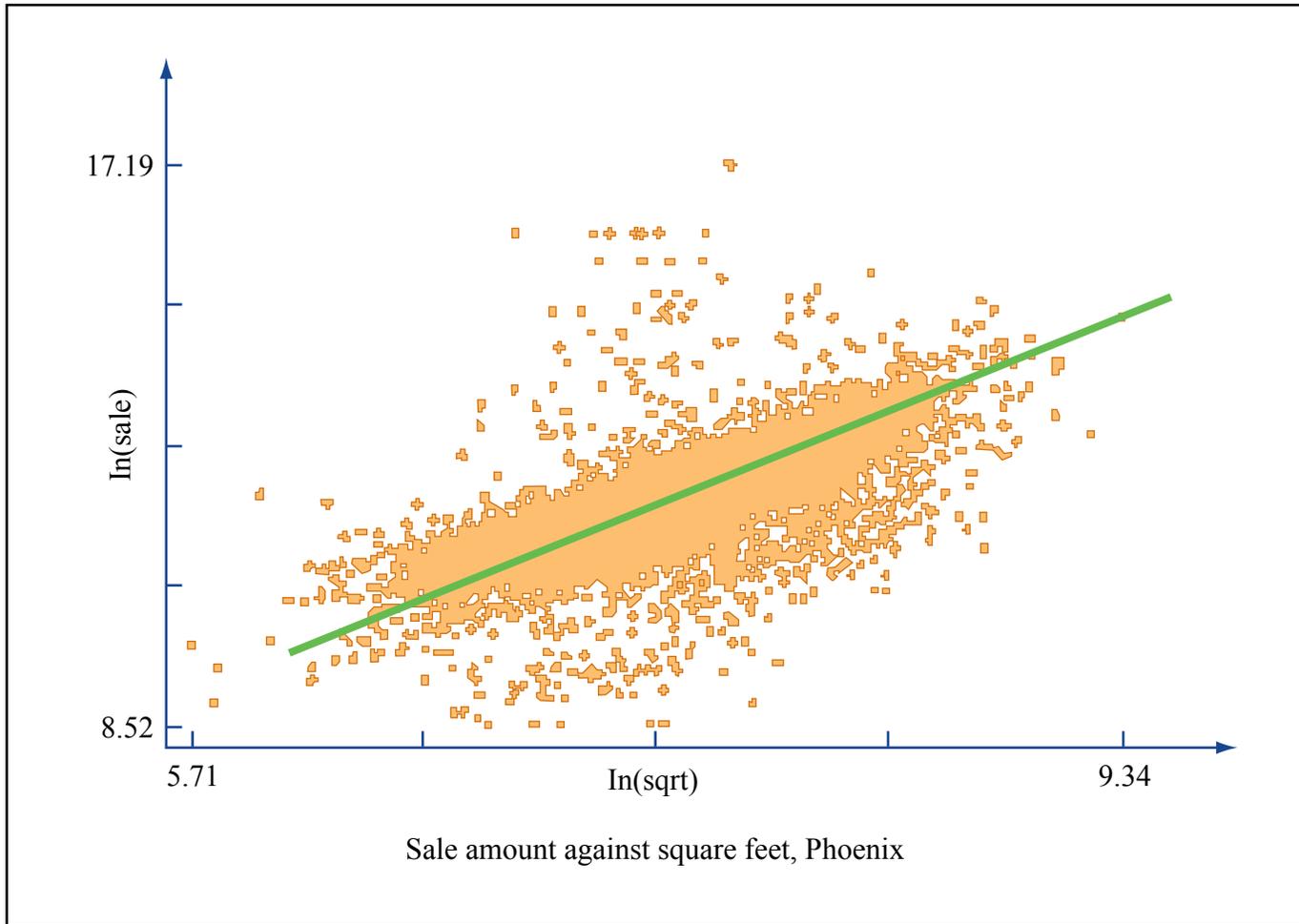
Figure by MIT OpenCourseWare.

Repeat-Sale House price indices (CSW) for 15 submarkets within the greater Boston CMSA: 1982-2002 (current $)



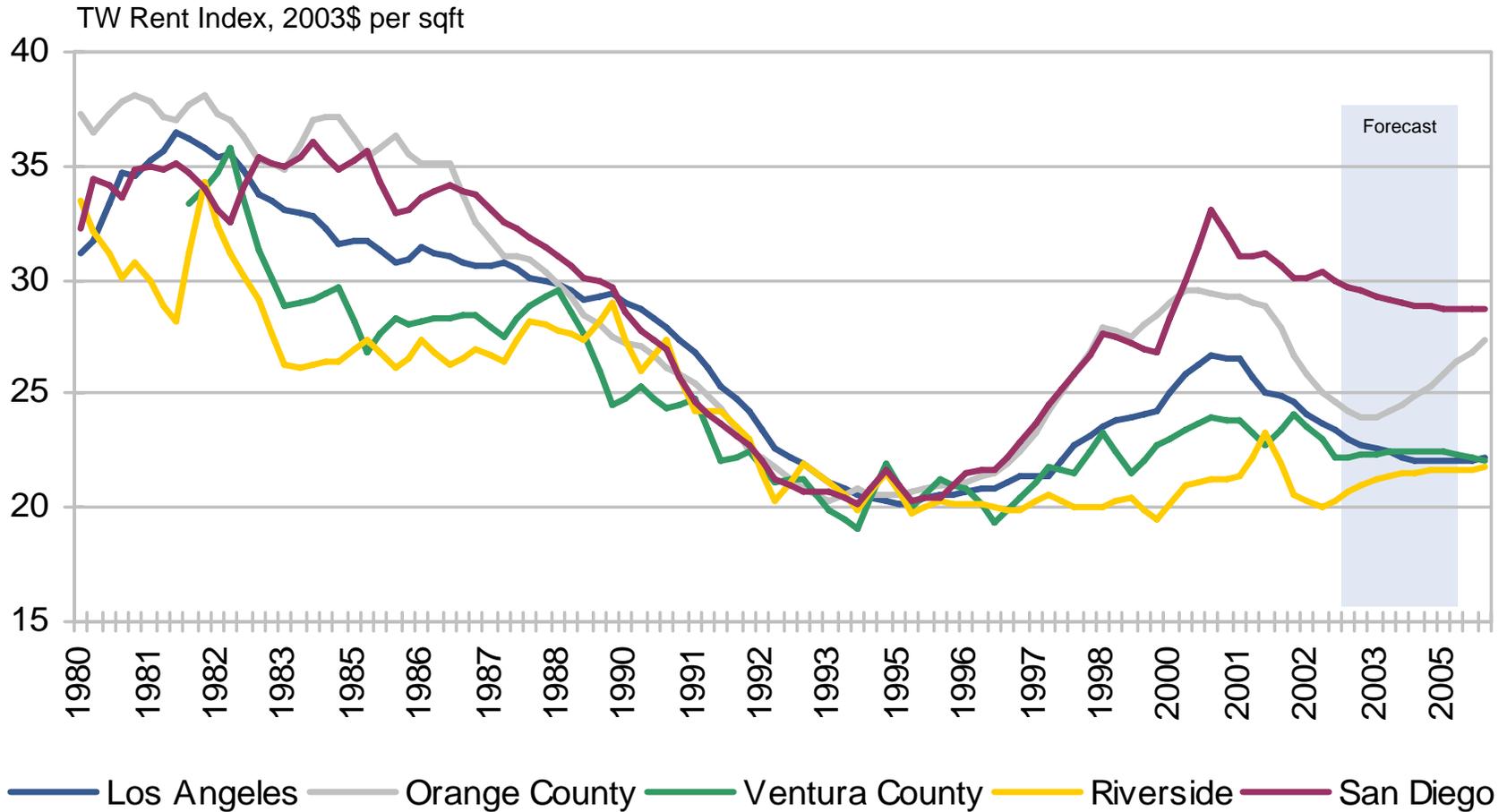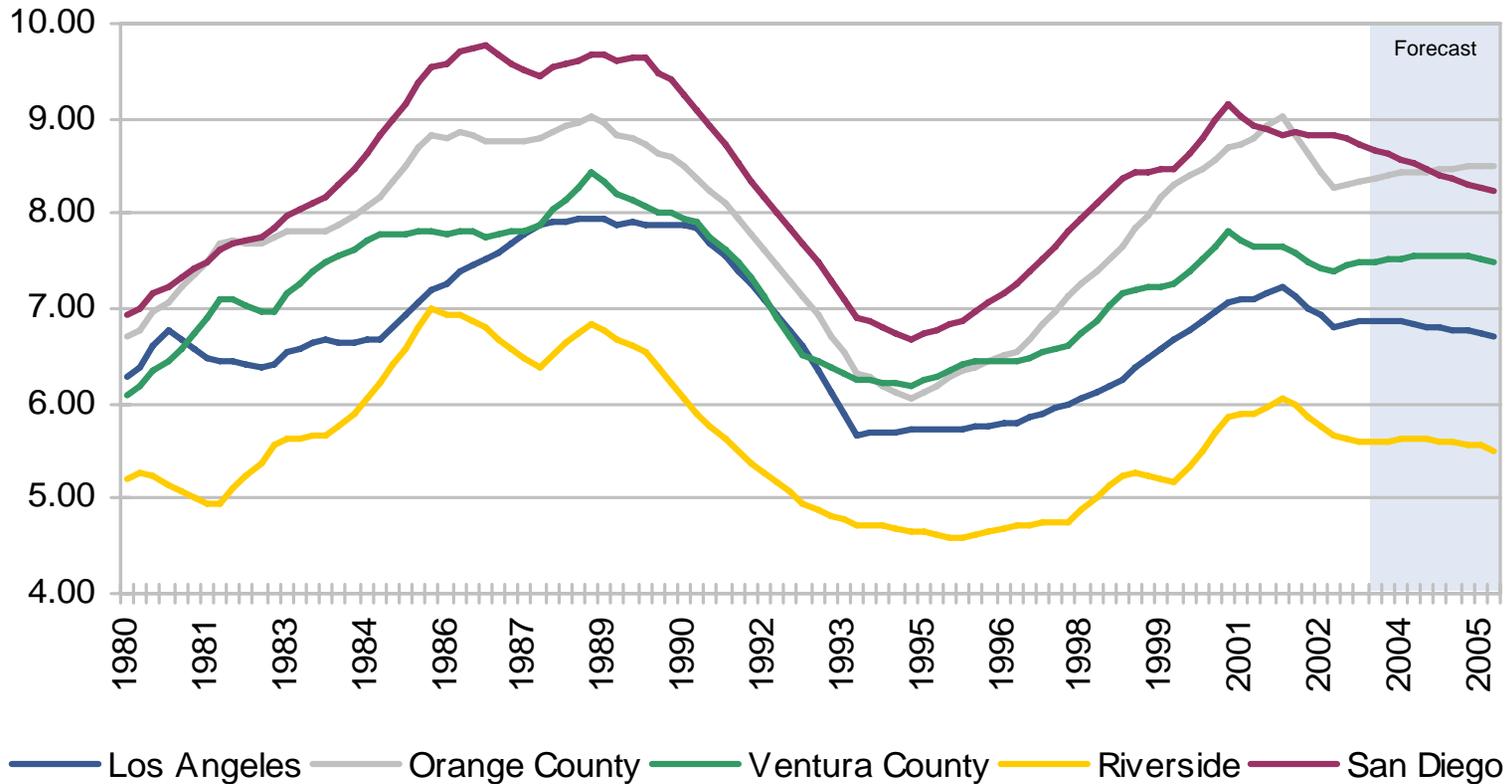House Price Indexes, Eastern Massachusetts, by City/Town Location
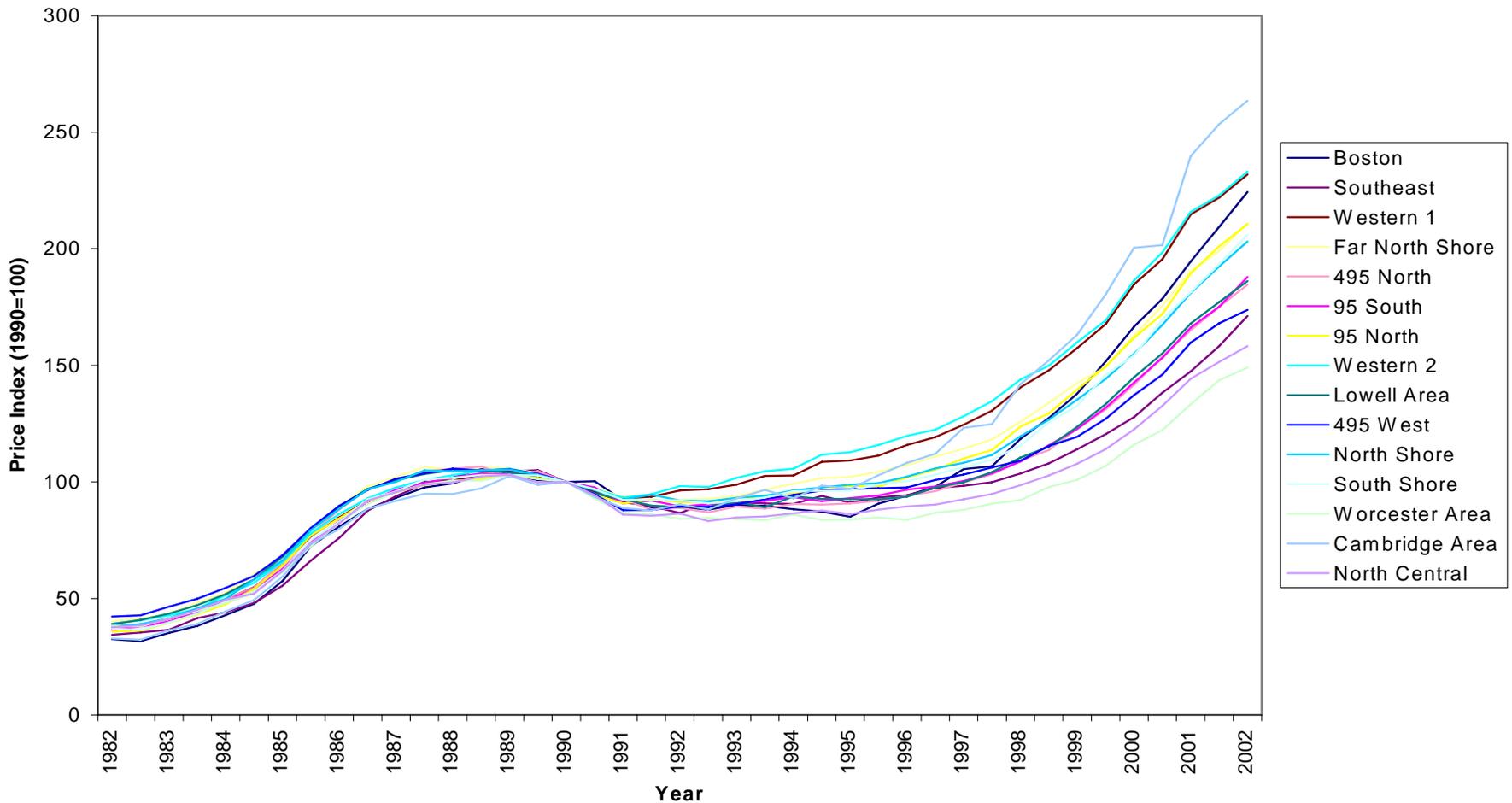
Home Prices within South California
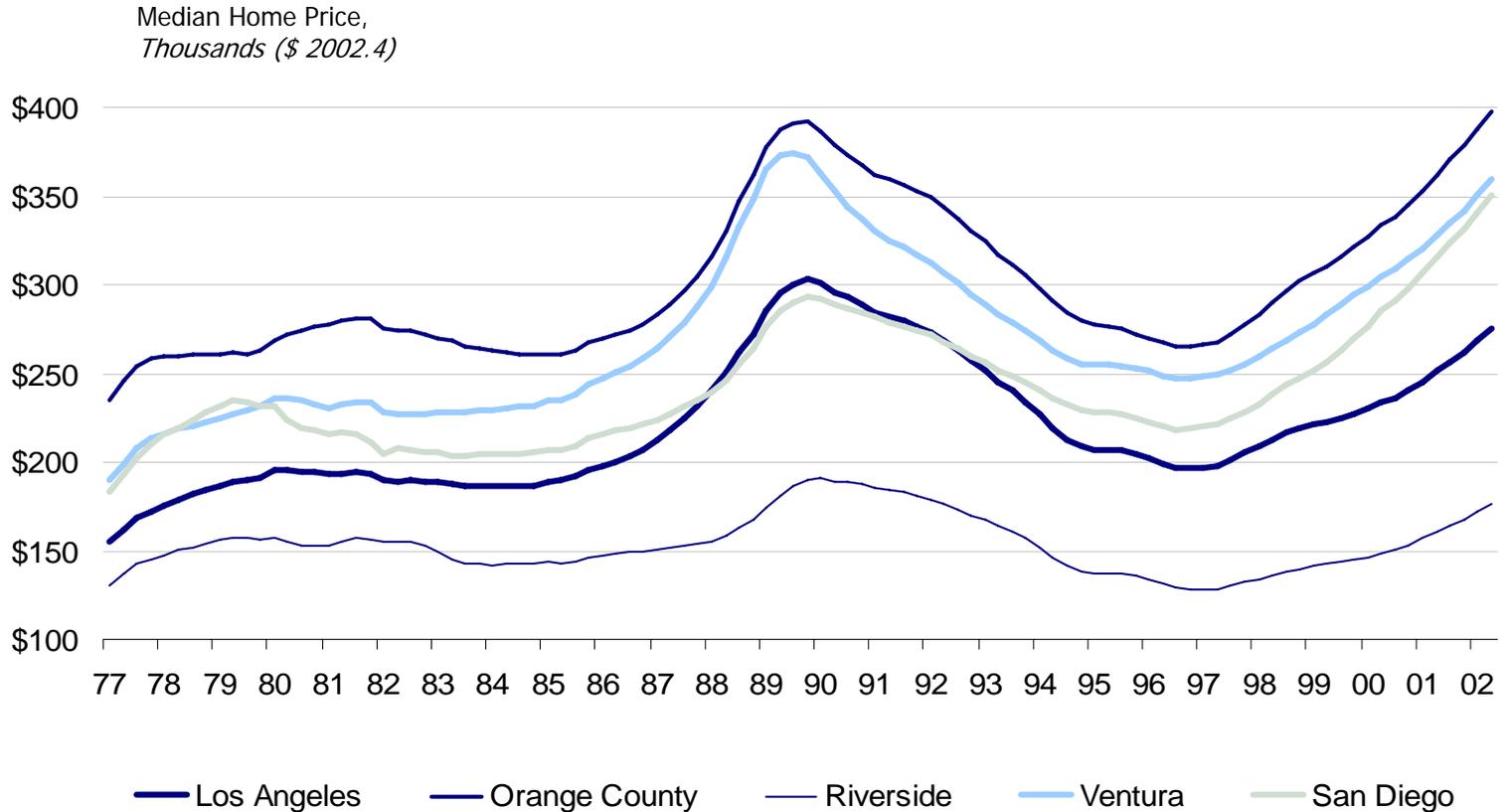
Office Rents Move together Cyclically but not always secularly

# Closely Correlated Industrial Rent Movements: few secular differences
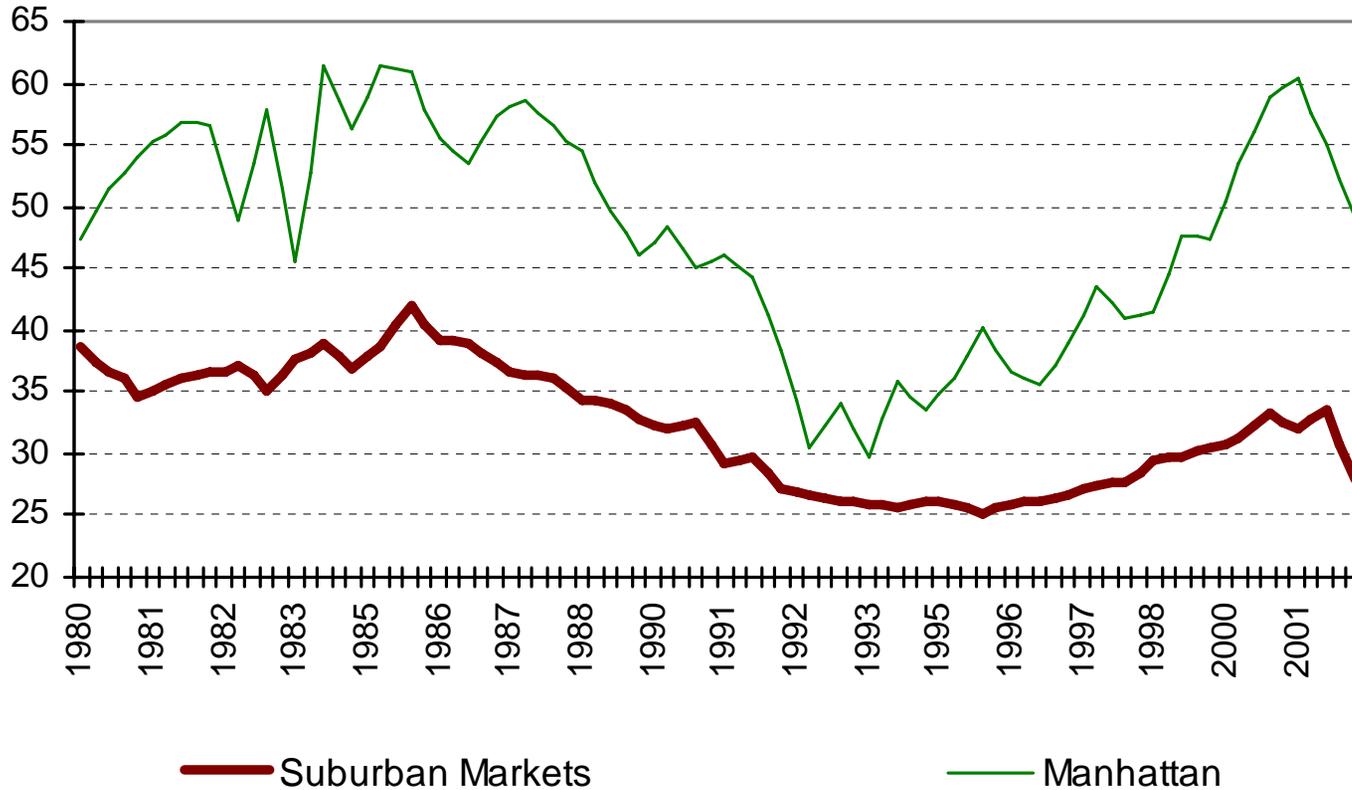


TW Rent Index, 2003$ per sqft

Legend: Los Angeles — Orange County — Ventura County — Riverside — San Diego

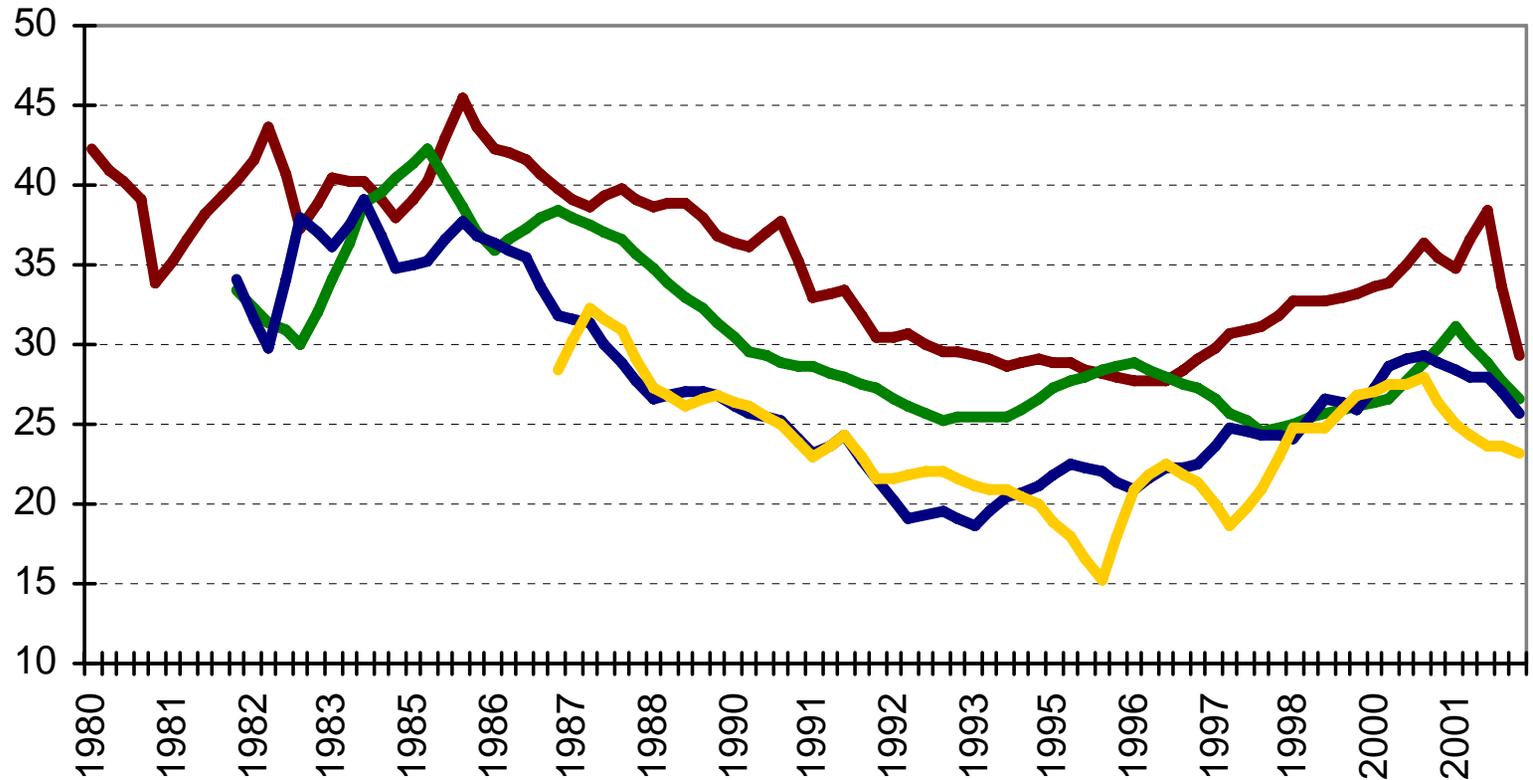# Manhattan Office Rents vs. NJ and Conn. Suburbs

**TW Index, $2002 per sqft**

# Office Suburban Rents in Detail



TW Index, $2002 per sqft

Legend: 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) ?
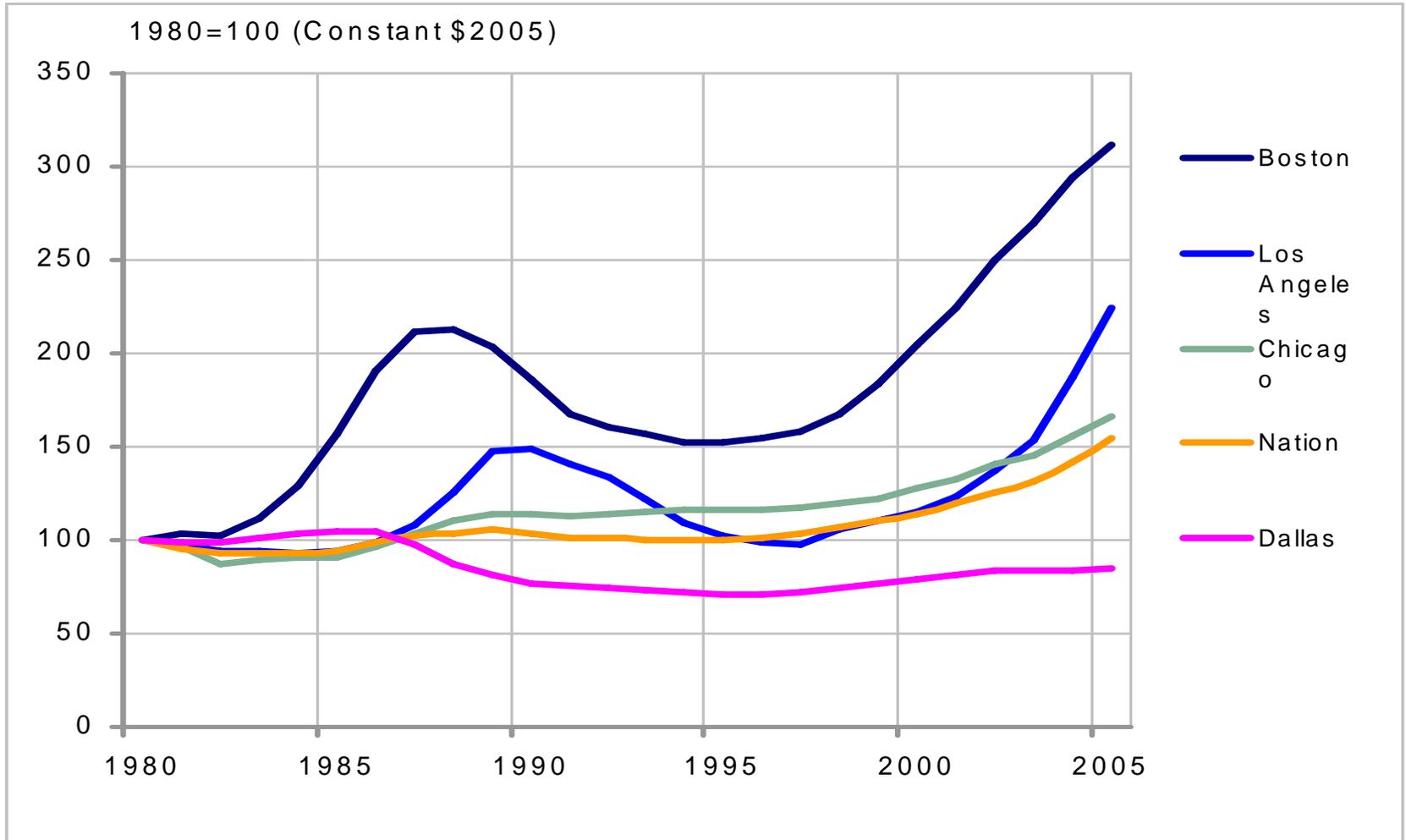
# What is a real Estate Market?

- Within "markets" all properties should move together: high substitutability, easy mobility.

- Between markets there exists frictions, transportation costs, immobility of resources and low substitutability.
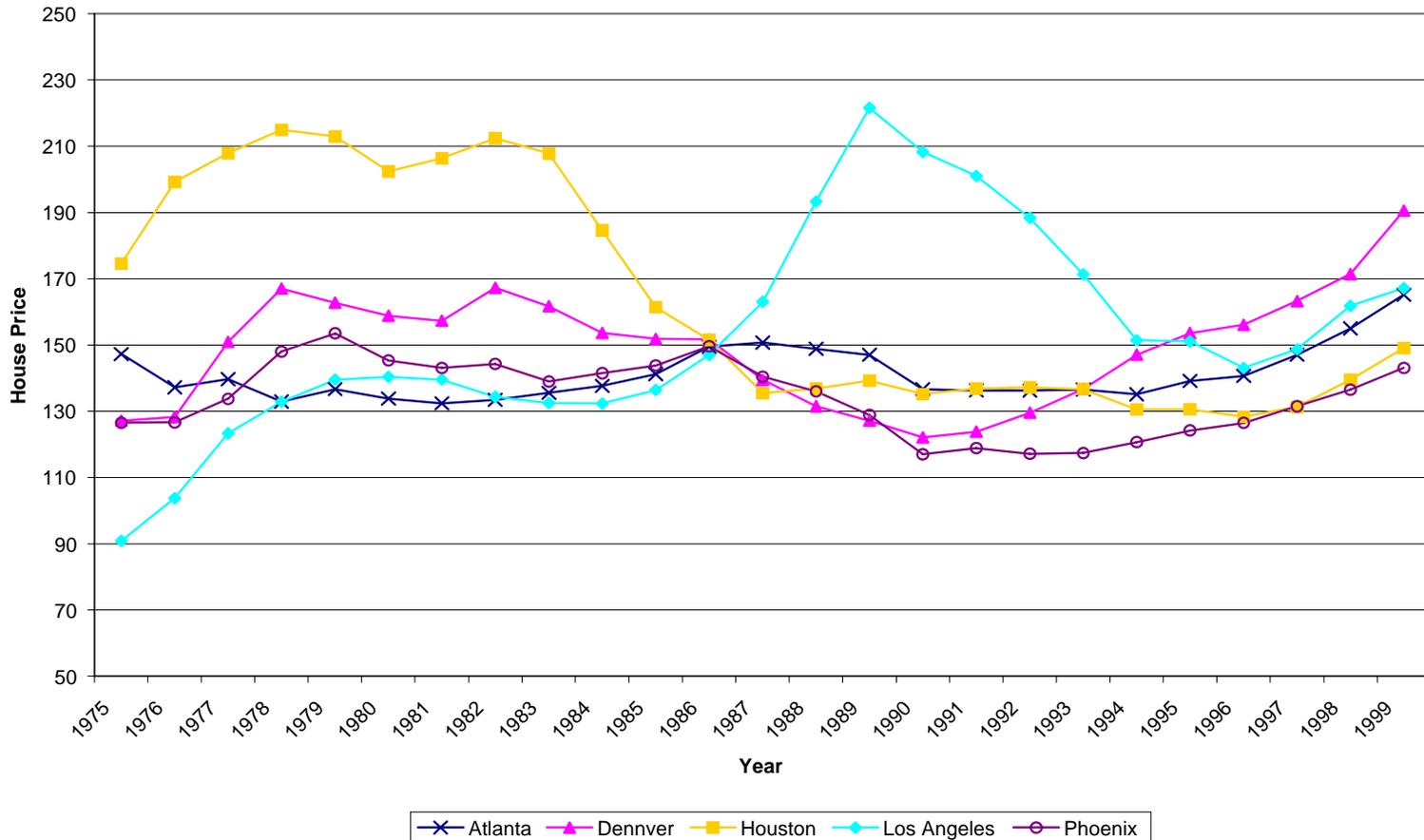
- MSA as "market"? CMSA?

# *Between Markets* – there can be huge differences in both long term growth and cyclic risk

# Metropolitan Housing Markets can even move independently

**FIGURE 5.   Repeat Sale House Price Indices for Selected "new" Cities: 1975-1999 (constant $)**



Legend: Atlanta, Dennver, Houston, Los Angeles, Phoenix

# Although sometimes they are subject to a common economy wide Shock



FIGURE 4. Repeat Sale House Price Indices for Selected "Traditional" Cities: 1975-1999 (constant $)