

# The Term Structure of Real Estate Leases

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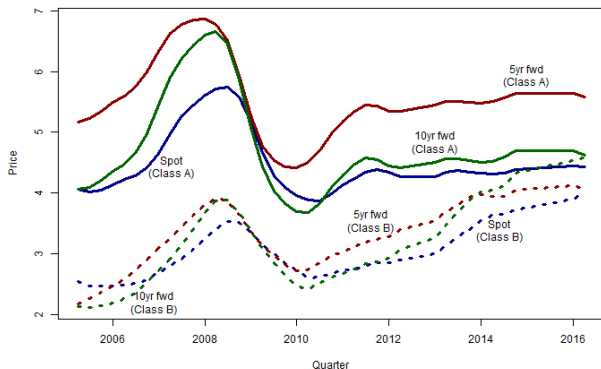
# The Term Structure of Real Estate Leases

## Introduction

- ▶ For several asset classes, forward contracts reflect market perception of future price dynamics.
  - ▶ The term structure of oil reflects market expectations about future prices and storage costs
  - ▶ The term structure of interest rates has been linked to expectations about future macroeconomic outcomes
- ▶ However, such tools are unavailable for less transparent markets, like commercial real estate
- ▶ Research objective: characterize the dynamics of the **term structure** of the price of commercial space
  - ▶ What's the *current* price of occupying 1 sf for 1 period at different times in the future?

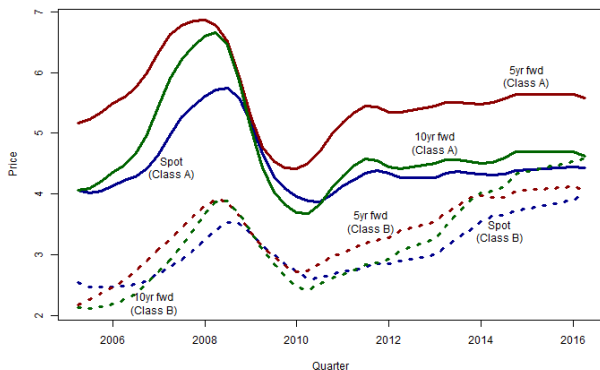
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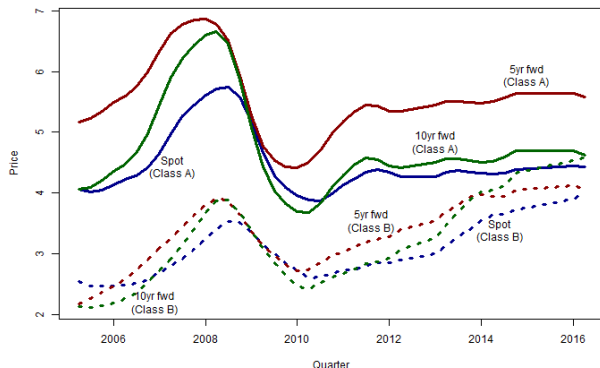


### ► How to read this graph?

- E.g., standing in Jan-2010, for high quality (Class A) properties:
  - Price of 1 month of short-term (immediate) occupancy: \$3.9 psf
  - Price of 1 month of medium-term (Jan-2015) occupancy: \$4.3 psf
  - Price of 1 month of long-term (Jan-2020) occupancy: \$3.7 psf

# The Term Structure of Real Estate Leases

## Introduction



- Where do we get these prices from?
  - The collection of **newly executed leases** at any given time represents the market's assessment of current and anticipated price of space

# The Term Structure of Real Estate Leases

## Leases

- ▶ A lease contract is a commitment to exchange the rights of space occupancy for cash at certain dates in the future
  - ▶ Essentially, a bundle of forward contracts on space
  - ▶ Rental prices (net of TI, concessions)  $\approx$  average of **forward lease rates**

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## Leases

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  - ▶ Essentially, a bundle of forward contracts on space
  - ▶ Rental prices (net of TI, concessions)  $\approx$  average of **forward lease rates**
- ▶ What's a **forward lease rate**?
  - ▶ Commit to occupy space  $\tau$  years from now for one period
  - ▶ Forward lease rate = today's "fair market" value of this commitment

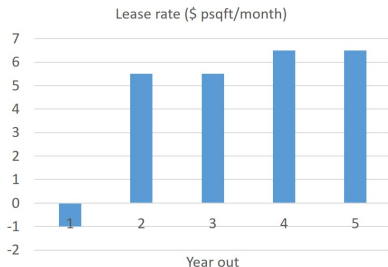
# Introduction

## Forward lease rates

- ▶ Lease = commitment to occupy and pay for space
  - ▶ Over multiple periods
- ▶ What's in a lease?

### **Actual 5-year gross lease payments**

**Includes: TI, concessions, escalations**



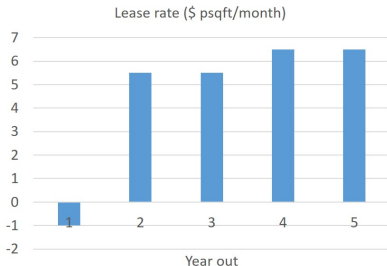


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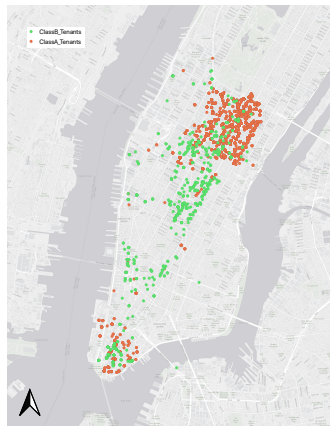
### Unbundled version of same space commitment



These should be equivalent (in present value terms)

# Data

- ▶ Data on NYC gross leases on office properties from CompStak
  - ▶ Executed between 2005.2 and 2016.2
  - ▶ Rent schedule (including rent bumps)
  - ▶ Concessions: free rent, TIs
  - ▶ Commencement date, lease term
- ▶ Two quality classes
  - ▶ Class A: 2,595 leases
  - ▶ Class B: 789 leases



# Data

## Summary statistics

	Mean	S.D.	1%	25%	50%	75%	99%
Class A							
Lease term (years)	8.95	3.80	2.00	5.25	10.00	10.50	20.00
Time to commencement (months)	2.49	5.29	0.00	0.00	1.00	3.00	28.00
Time to expiration (years)	9.16	3.87	2.00	5.42	10.00	10.75	20.28
Starting rent (USD)	5.54	1.96	2.58	4.08	5.17	6.62	11.20
Average rent (USD)	5.21	1.95	2.41	3.76	4.77	6.20	10.94
Average rent increase (USD per yr)	0.04	0.05	0.00	0.00	0.04	0.05	0.14
Number of rent bumps	0.93	0.78	0.00	0.00	1.00	1.00	3.00
Average bump duration (months)	54.40	16.95	13.64	46.00	57.00	60.00	120.00
Tenant improvements (USD)	31.15	29.27	0.00	0.00	27.00	55.00	100.00
Free rent (months)	5.04	4.05	0.00	2.00	4.00	7.00	15.00
Class B							
Lease term (years)	8.86	4.02	1.08	5.00	10.00	10.50	20.60
Time to commencement (months)	1.97	3.71	0.00	0.00	1.00	3.00	12.00
Time to expiration (years)	9.02	4.05	1.42	5.33	10.00	10.58	20.72
Starting rent (USD)	3.53	0.91	2.00	2.83	3.33	4.08	6.04
Average rent (USD)	3.31	0.87	1.91	2.62	3.18	3.88	5.59
Average rent increase (USD per yr)	0.02	0.03	0.00	0.00	0.02	0.04	0.10
Number of rent bumps	0.91	0.89	0.00	0.00	1.00	1.00	4.00
Average bump duration (months)	56.99	24.61	11.55	48.00	58.00	60.00	126.24
Tenant improvements (USD)	23.01	23.08	0.00	0.00	17.75	40.00	75.00
Free rent (months)	4.62	3.52	0.00	2.00	4.00	6.00	14.00

# Estimation of the term structure

Key assumption

**PV of contract CF**

=

**PV of contract occupancy**

Sum of discounted cash flows

Sum of discounted forward  
lease rates

# Estimation of the term structure

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**PV of contract CF**

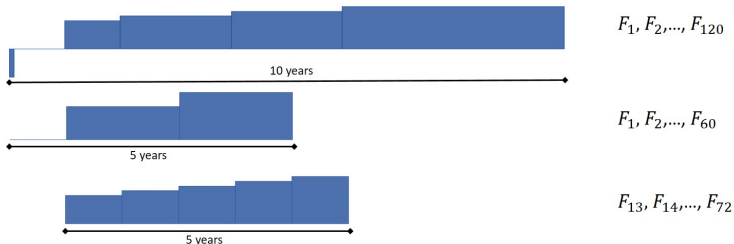
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**PV of contract occupancy**

Sum of discounted cash flows

Sum of discounted forward  
lease rates

- ▶ A lease is a **bundle of forward contracts** on space
  - ▶ Example: 3 different leases executed today
  - ▶ What's in each bundle?



# Estimation of the term structure

## Unbundling contract occupancy

- ▶ We assume all forward prices can be derived from a small set of key rates:
  - ▶ Short term:  $F_{t,0}$  (Spot)
  - ▶ Medium term:  $F_{t,60}$  (5yr forward)
  - ▶ Long term:  $F_{t,120}$  (10yr forward)
- ▶ Sum of forward lease rates becomes a weighted sum of the key rates

# Estimation of the term structure

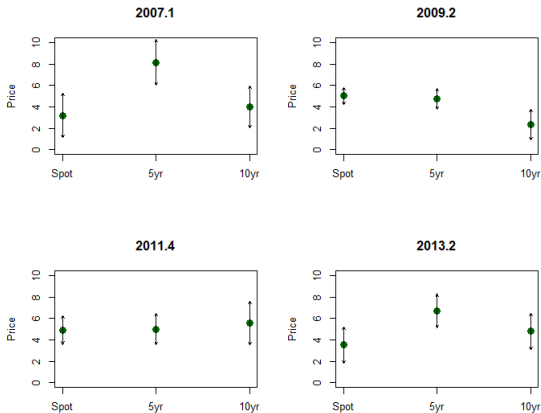
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$$\text{PV of contract CF} = w_{t,0,i} F_{t,0} + w_{t,60,i} F_{t,60} + w_{t,120,i} F_{t,120}$$

# Estimation of the term structure

Results: OLS



- ▶ Noisy estimates, N varies from quarter to quarter
- ▶ Fails to capture time-series dynamics (autocorrelation)



# Estimation of the term structure

## State-space model

- ▶ We impose an autoregressive structure in key rates by specifying a linear state-space model

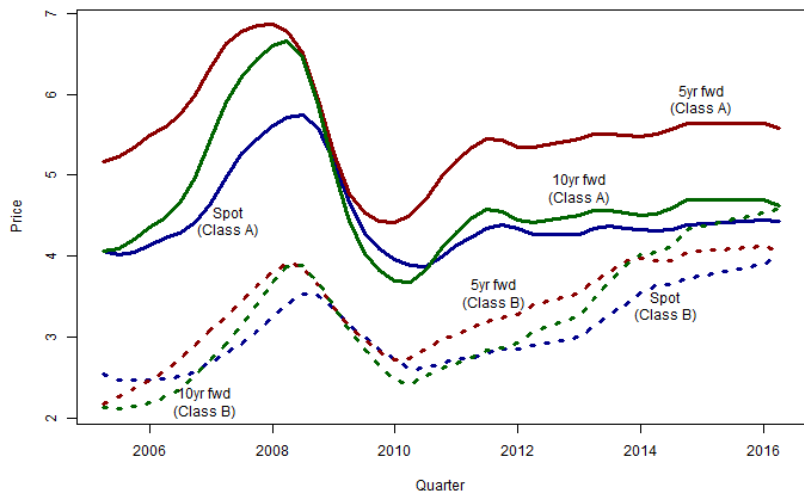
- ▶ State equation

$$F_{t+1} = \bar{F} + \rho F_t + \epsilon_{t+1}$$

- ▶ The observation equations are given by our present value equivalence
  - ▶ We use the Kalman Filter to back out the term structure
  - ▶ Unknown parameters are estimated via MLE

# Estimation of the term structure

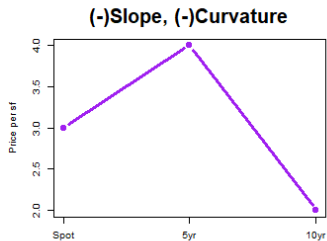
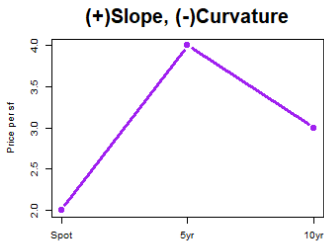
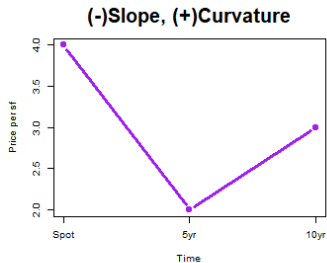
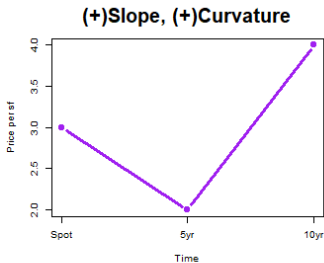
Results: State-space model



# Estimation of the term structure

Key measures: Slope and curvature

- ▶ The **slope** is related to the spread between short and long terms
- ▶ The **curvature** captures the behavior of the medium term

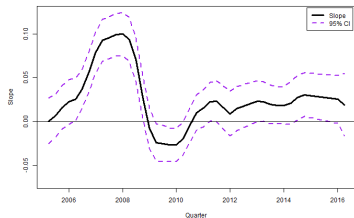


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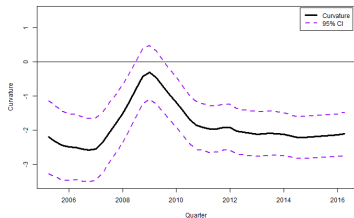
Results: Shape of the term structure

## Class A

Slope



Curvature

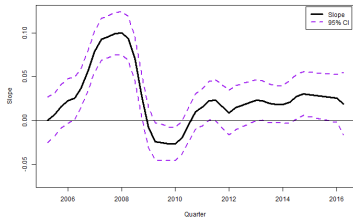


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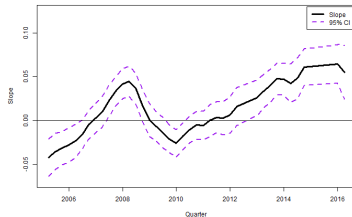
## Class A

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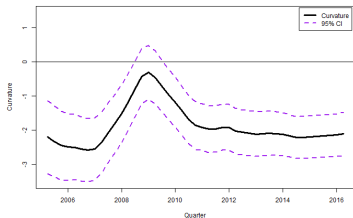


## Class B

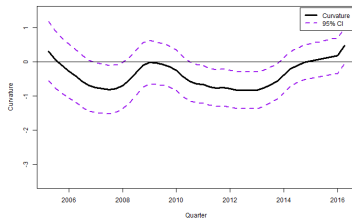
Slope



Curvature



Curvature



## Application: co-working strategy

- ▶ Consider the following investment strategy at date  $t$ :
  - ▶ Short position in a long-term lease (10 years)
  - ▶ Long position in a sequence of short-term leases (one quarter)
- ▶ This looks essentially like a co-working company...

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  1. Intensified use of space
  2. Services provided (utilities, equipment, staff)

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- ▶ This looks essentially like a co-working company... with some important differences
  1. Intensified use of space
  2. Services provided (utilities, equipment, staff)
- ▶ We can use the properties of the state-space model to obtain the distribution of expected cash flows for this strategy
- ▶ Is this profitable? When?



# Application: co-working strategy

## Profitability

- ▶ Is this ever profitable?
  - ▶ We compute the Sharpe ratio of the strategy in every quarter
    - ▶ Ratio of annualized expected profit to standard deviation
    - ▶ Typical SR of diversified portfolio  $\approx 0.5$

### Class A



# Application: co-working strategy

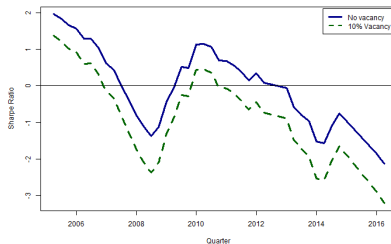
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**Class B**

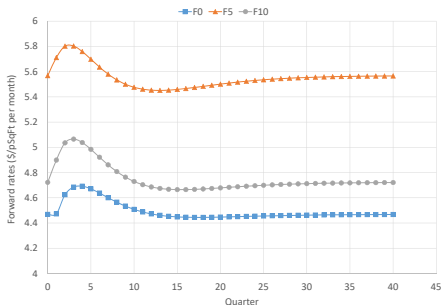


# COVID-19

- ▶ Lease transaction information slowly *trickles* into the CompStak records
  - ▶ We do not observe the full set of transactions after February

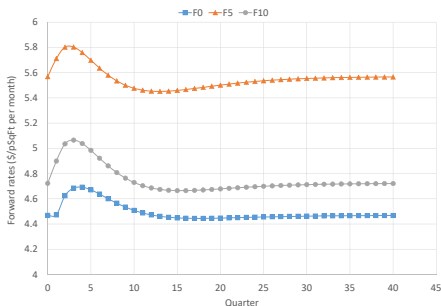
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- ▶ From application: co-working more exposed to shocks than regular offices (Similar to hotels)

# Conclusion

- ▶ We estimate a state-space model to study the dynamics of the term structure of CRE leases
- ▶ Term structure has, generally, a positive slope and negative curvature:  $\cap$ -shape
- ▶ Results are roughly consistent across quality classes
- ▶ Leasing market takes several quarters to fully price unexpected shocks
- ▶ The long-short (co-working) strategy described is generally unprofitable from a real estate perspective