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?
The Term Structure of Real Estate Leases

Introduction

▶ 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
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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
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) ≈ average of forward lease rates.
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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

![Bar chart showing lease rates over five years.](image-url)
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

**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

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>S.D.</th>
<th>1%</th>
<th>25%</th>
<th>50%</th>
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<td><strong>Class A</strong></td>
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<td>Tenant improvements (USD)</td>
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<td>17.75</td>
<td>40.00</td>
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<tr>
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<td>4.62</td>
<td>3.52</td>
<td>0.00</td>
<td>2.00</td>
<td>4.00</td>
<td>6.00</td>
<td>14.00</td>
</tr>
</tbody>
</table>
Estimation of the term structure

Key assumption

\[
\text{PV of contract CF} = \text{PV of contract occupancy}
\]

\[
\text{Sum of discounted cash flows} = \text{Sum of discounted forward lease rates}
\]
Estimation of the term structure

Key assumption

\[
\text{PV of contract CF} = \text{PV of contract occupancy}
\]

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?

\[
F_1, F_2, \ldots, F_{120} \\
F_1, F_2, \ldots, F_{60} \\
F_{13}, F_{14}, \ldots, F_{72}
\]
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

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

\[
\text{PV of contract CF} = w_{t,0}iF_{t,0} + w_{t,60}iF_{t,60} + w_{t,120}iF_{t,120}
\]
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
Estimation of the term structure

Results: Shape of the term structure

Class A

Slope

Curvature
Estimation of the term structure

Results: Shape of the term structure

Class A
Slope

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...
Application: co-working strategy

- Consider the following investment strategy at date $t$:
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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 ≈ 0.5

Class A
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

![Graph showing Sharpe ratio for Class A with different scenarios over the years.]

Class B

![Graph showing Sharpe ratio for Class B with different scenarios over the years.]

COVID-19

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

<table>
<thead>
<tr>
<th>Quarter</th>
<th>F0</th>
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<table>
<thead>
<tr>
<th>Quarter</th>
<th>F5</th>
</tr>
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<table>
<thead>
<tr>
<th>Quarter</th>
<th>F10</th>
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</table>

Price of space responds sluggishly (*trickles*). Short-term has the slowest reaction.

From application: co-working more exposed to shocks than regular offices (Similar to hotels).
COVID-19

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

- However, there are some insights we can provide,
  - Price of space responds sluggishly to shocks (short term has slowest reaction)

```
+-----------------+-----------------+-----------------+
| Quarter | F0 | F5 | F10 |
+-----------------+-----------------+-----------------+
| 0      | 4.4 | 5.0 | 6.0 |
| 5      | 4.4 | 5.0 | 6.0 |
| 10     | 4.4 | 5.0 | 6.0 |
| 15     | 4.4 | 5.0 | 6.0 |
| 20     | 4.4 | 5.0 | 6.0 |
| 25     | 4.4 | 5.0 | 6.0 |
| 30     | 4.4 | 5.0 | 6.0 |
| 35     | 4.4 | 5.0 | 6.0 |
| 40     | 4.4 | 5.0 | 6.0 |
| 45     | 4.4 | 5.0 | 6.0 |
```

- From application: co-working more exposed to shocks than regular offices (Similar to hotels)
COVID-19

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

- However, there are some insights we can provide,
  - Price of space responds sluggishly to shocks (short term has slowest reaction)

- 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.