Uniwersytet Ekonomiczny

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Building and estimating models
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Agenda

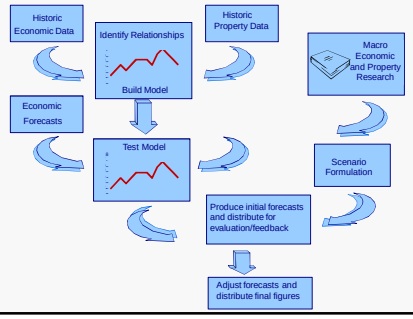
- Modelling and forecasting commercial real estate markets
  - Modelling process
  - Model specification
    - Drivers of property market variables

    Modelling yields

    Multi-equation models
    - short term models
    - long term models

Modelling & Forecasting Process

Modelling & forecasting process components



Stages in the modelling/forecasting process

- Define forecasting problem
- Look at relevant theory & techniques
- Collect and analyse data
- Define/specify and estimate the model
  - test robustness/diagnostics, forecast and evaluate
- 'Present' initial forecasts and revise on feedback
- Distribute final forecast
- Monitor and evaluate the forecasts when actual values are know!

Modelling and forecasting

Three broad stages:

- Identify causal relationships between economic variables and the property markets
- Forecast using the identified relationships
- Scenario formulation

Cyclical activity in property markets

- Property markets subject to cyclical activity
  - rents, vacancy, take-up, availability, yields/capital values, total returns etc
- How does this arise?
- Requirement for an understanding of the underlying *dynamics* of property market cycles and the *linkages* between property markets, the financial markets and the wider economy

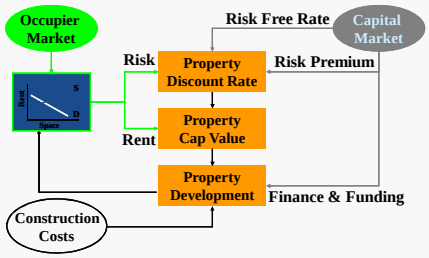
Links between property variables and the economy

- Rental growth is a function of economic growth
- different sectors have different growth expectations
- Inflation affects rental growth
- Interest rates affect corporate profit/demand & cost of supply
- Target rates are based on returns in other capital markets
- Discount rates reflect Government Bond rates/yield curve + risk premia

Example: office market modelling framework

- The Space Market
  - determination of demand/supply and development of office space relationships
- The Capital Market
  - property pricing relative to other assets (investors supply finance capital)
- Modelling linkages between the two markets important
  - short run and long run (equilibrium) considerations

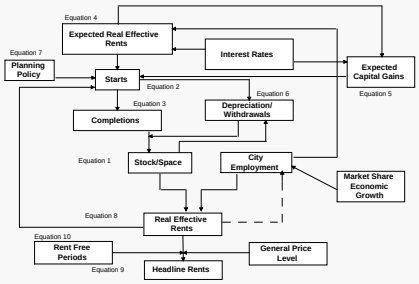
Occupier Market, Capital Market & Property Market interaction



Variables

- Variables that are determined within a system of equations are called *endogenous variables*
  - *Endogenous variables are those which the model seeks to explain*
- Variables that are determined outside a system of equations are called *exogenous variables*
  - *Exogenous variables are those which the model takes as given*

Example: City of London Office Model



Modelling commercial property yields: a framework

Why model & forecast yields?

- Investment performance, rate of return, is driven by rental growth and changes in yields

Commercial Property Yields

- Do you think that property markets are currently over-priced, fairly priced or under-priced?

Why?

Framework for analysis: DCF profile

$$V = \frac{c}{(1+r)} + \frac{c(1+g)}{(1+r)^2} + \frac{c(1+g)^2}{(1+r)^3} + .. \Rightarrow \infty$$

if r > g

- k = r-g ⇒ cap rate (market info/comparables etc)
- r and g are anticipated *future values – if constant each period then*

$$V = \frac{c}{(r-g)}$$

where k = c/V = (r-g)

Unbundling the all risks yield

k = Rf + Rp + E(d) - E(g)
Rf = risk free rate of return
Rp = risk premium
E(d) = expected depreciation
E(g) = expected rental growth

•What are these values?
•Explicit DCF framework (one approach)
short term/long term value distinction
•Market view *v intrinsic (*fundamental*)* assessment

Modelling yields in theory

- The initial yield (cap rate) can be expressed as:

k = RF + RP - g + d

- A change in the yield can be the result of a change in any of these
- Thus, modelling yields requires a link to the *investment* market (through the risk free rate) as well as the *occupier* market

An approach to yield determination

- Combination of
  - modelled 'technical' forecasts
    - short term adjustments
  - fundamental values (equilibrium values)
    - long term values
- Reversion of modelled (technical) forecasts towards underlying fundamental values

Yield drivers

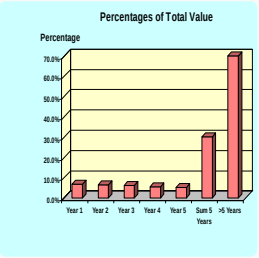
- Considerations:
  - DCF (fundamental)components
    - Can we get a fix on the risk premium? Historic returns profile may provide some insights
  - Sentiment/weight of money/market variables
  - Random component – it's always there!
- Are there differences in yields between property types – retail/office/industrials etc?
- Are there differences in yields across locations?

Yield assessment: summary

- Short-term
  - rental growth outlook
  - required return/risk premium
  - weight of money impact
- Long-term fundamentals
  - risk premium
  - risk free rate
  - rental growth
- Relative importance?

Relative importance of short & long term in determining value

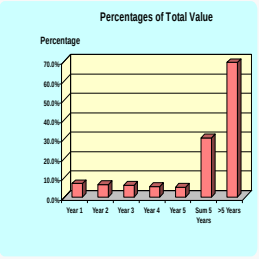
Scenario 1: equal annual discount and growth rates



- All discount rates 9%
  - risk free 5%
  - risk premium 4%
  - rental growth 2%
- In excess of 5 years represents 70% of value

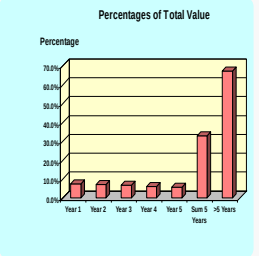
Relative importance of short & long term in determining value

Scenario 2: First five years risk premium increased by 1%



- LT discount rate 9%
  - risk free 5%
  - risk premium 4%
  - rental growth 2%
- Short-term discount rate 10%
  - risk free 5%
  - risk premium 5%
  - rental growth 2%
- In excess of 5 years represents 69.4% of value
- Change in value = -3.6%

Scenario 3: LT risk premium increased by 1%



- LT discount rate 10%
  - risk free 5%
  - risk premium 5%
  - rental growth 2%
- Short-term discount rate 9%
  - risk free 5%
  - risk premium 4%
  - rental growth 2%
- In excess of 5 years represents 67.1% of value
- Change in value = -8.8%

Short run & long run methodology

Error-Correction Models (ECM)

- If two variables are cointegrated, we can represent the relationship as a so-called *error-correction model (ECM)*:

$$\Delta y_t = \sim \left(y_{t-1} - \quad x_{t-1} \right) + \Delta x_t + £_t$$

- This has a nice economic interpretation:
  - y can wander away from its long-run (equilibrium) path in the short run, but will be pulled back to it by the ECM over the long term
- If there are other *stationary* variables that affect the short-run behavior of y, they can be included in the above relationship

Error Correction Term

- The error correction term tells us the speed with which our model returns to equilibrium following an exogenous shock.
- It should be negatively signed, indicating a move back towards equilibrium, a positive sign indicates movement away from equilibrium
- The coefficient should lie between 0 and 1, 0 suggesting no adjustment one time period later, 1 indicates full adjustment
- The error correction term can be either the difference between the dependent and explanatory variable (lagged once) or the error term (lagged once), they are in effect the same thing.

Broadly, the steps in testing for Cointegration

1) Test all the variables to determine if they are I(0), I(1) or I(2) using the ADF test.
2) If both variables are I(1), then carry out the test for cointegration
3) If there is evidence of cointegration, use the residual to form the error correction term in the corresponding ECM
4) Add in a number of lags of both explanatory and dependent variables to the ECM
5) Omit those lags that are insignificant to form a parsimonious model
6) Use the ECM for dynamic forecasting of the dependent variable and assess the accuracy of the forecasts

Application to a rental modelling approach

- Modelling methodology may distinguish between *long run* rental levels and *short run* dynamic (rental growth) changes . (Analogy with house price levels and growth in house prices)
- Link rental *levels* with 'fundamental' driver variables
  - e.g. retail rental levels may depend on retail turnover/sales
- Capture short-term *movements* in rental levels
- In *long term* reversion towards underlying 'fundamental' rental values
- Technically known as an *error correction mechanism*
- We'll make use of this in modelling rental growth – Case Studies section

Synopsis

- The economic interpretation of co-integration is that if two, or more, series are linked to form an equilibrium relationship then, although the series may temporarily depart they will, over time, co-vary closely.
- If rental levels are linked to demand and supply variables over the long-term, a co-integrating relationship can be estimated. For example, in the office sector a potential demand proxy variable is office employment or, in the case of industrials, output in distribution industries.
- We would expect that the demand for space as measured by employment or sector output variables would have an impact on rental values.
- The long-term relationships attempt to capture the impact of these variables.

Synopsis

- There will be occasions when rental levels may reflect an imbalance between demand and supply. For example, tenants may be prepared to pay above market prices in order to obtain space. On such occasions the rental levels may be out of line with the fundamentals determining their underlying value, as depicted by the long-term relationship.
- Asa consequence, in the short-term it is of interest to look at the evolution, the dynamics, of rental growth. The dynamic equations capture the adjustment back to the underlying long-term relationship.
- It should be noted that we have has assumed a single

Synopsis

- In essence, the main advantage in employing the methodology is that it captures both the short-run rental adjustment dynamics and a long- term rental levels relationship.
- Whenever there is a divergence between the rental level and its underlying long-term determinants, the ECM formulation ensures that this gap is closed.
- There may be differences in the speed at which the different locational rents respond to changes in property and economic variables. The speed of these adjustments is captured by the ECM formulation.

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