TRANSACTION-BASED PRICE INDICES

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- Data collection & manipulation
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  - Hedonic
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Transaction price based indices preferred method for constructing CPPIs
• both stocks and flows are to be recorded “at current value on the market (that is the amount agreed upon by two parties) or at its closest equivalent.”

Steps of CPPI production
1. Data collection & manipulation prior to index computation
2. Computation or estimation of a basic price or value model on which the index will be based
3. Construction of final reported index product based on the model

Threshold considerations relating steps 1 and 2

Choices on specific methodologies in all steps
1. Coverage of index
   - Included commercial property
   - Geographical area
   - Depends on data source at hand

2. Stratification / segmentation
   - Non-overlapping market segments (strata) spanning total population
   - Goal: individual property pricing dynamics within strata are more homogeneous than between strata
   - Property prices are partly determined by demand and supply on space market
   - Demand an supply and so stratification depends on
     - Location / Use / Physical quality & size class

3. Frequency
   - Depend on data
   - Setting number of strata and frequency is a joint decision
4. Equal and value weighted indices at elementary level
   - For lowest level (stratum/market segment) price returns
   - Value weighted price returns
     - Arithmetic repeat sales model
   - Equal weighted log price returns
     - Hedonic price model where log price is dependent variable
     - ‘Standard’ repeat sales model
   - Choice between value/equal weights depends on perspective user
     - Value: compare performance of a particular portfolio
     - Equal: each property in index is an equally valid representative
5. Constant and varying liquidity indices
   - How informative are transaction prices alone?
   - For real estate asset market: transaction prices are not a sufficient statistic for the state of the market
   - Changes in liquidity tend to be highly correlated with changes in transaction prices and strongly pro-cyclical
   - Volume of sales provides important additional information
     - Additional statistic: volume of sale
     - Liquidity adjusted price indices
       Price movements that would have the same liquidity (ease of selling)
       (Fisher et al, 2003; Goetzmann and Peng, 2006)
STEP 1: DATA COLLECTION & MANIPULATION

- Transaction prices/date (legal transfer / sales contract)

- Filtering
  - ‘Arms-length’ (open market) transactions (violated by transaction between related parties)
  - Repeat sales: identification of **identical properties** (violated by partial sales and construction projects)
    - Required information missing: filter on annualized returns and time between sales
  - Hedonic: minimum set of **characteristics** at time of sale
    - Set depends on property type (industrial, hotel, retail, office, etc.)
    - Absolute and relative number of transactions is small
    - Characteristics can be replaced by an **appraisal value**
STEP 2: COMPUTATION OR ESTIMATION (1)

- Methods are identical to ones for computation of RPPI
- Main differences between CRE and RRE
  - More heterogeneous: extensive set of characteristics
  - Less transactions
- Consequences
  - Hedonic price model based on property characteristics difficult to apply in practice
  - Alternatives
    - SPAR
    - Hedonic price model with appraisal value as regressor
  - Smoothing of ‘noisy’ price indices
STEP 2: COMPUTATION OR ESTIMATION (2)

- Simple averaging & Mix-adjustment
  - Only applicable for homogeneous properties and large number of transactions

- Regression based
  - Hedonic price model
    - Chained (imputed) and pooled (time dummy)
  - Repeat sales model

- SPAR method
STEP 2: HEDONIC METHODS (1)

- Models price change of the average transacted property in the market
- Price changes result from changes in:
  - Property characteristics
  - Property characteristics parameters (only for imputed model)
  - Time varying constants (otherwise not captured in model)
    - General market conditions
    - Omitted variables
- Imputed hedonic model is unlikely to be applied in practice due to insufficient number of transactions
- Hedonic models can produce ‘constant age’ price indices
STEP 2: HEDONIC METHODS (2)

- **Advantages**
  - Sound basis in economic and index theory
  - Use all transactions for which characteristics are available
  - Enables sorting of data into specialized indices

- **Issues**
  - Data intensive
  - Dependence on functional form and model specification
  - Omitted variable bias; insufficient quality adjustment
  - Pooled model:
    - Assumption of time invariant coefficients is unrealistic
    - Revision of index
  - Chained model:
    - Coefficients may become very volatile over time due to lack of sufficient data
  - In between methods are much more complex to estimate
STEP 2: REPEAT SALES METHODS (1)

- Models average price change

**Assumption**
- Property characteristics (coefficients) are constant over time
- Aging violates this assumption

**Matching methods**
- Generalize exact matching of repeat sales
  - However, requires property characteristics
  - Less prone to misspecification and to effects of extreme observations
  - Hedonic approach may lead to better estimates in case of poor matching

**Advantages**
- No need property characteristics which are hard to obtain
- No omitted variable bias
- Simple estimation method
- Tracking price changes experienced by investors
STEP 2: REPEAT SALES METHODS (2)

Issues

- Single sales are omitted
  - Difficult to estimate for smaller market segments
- Potential sample selection bias
  - Overrepresentation of short-held properties
  - Loss aversion: propensity to sell ‘winners’
  - Heckman procedure requires property characteristics for total population
- Price index includes aging effect: downward bias
- Price index includes renovations: upward bias
- Not always easy to define ‘identical’ property
- Revision effects
STEP 3: INDEX CONSTRUCTION (1)

- **Definition of representative property** (imputed method)
  - Standardized property with fixed characteristics
  - Rolling window average
  - Laspeyres / Paasche / Fisher

- **Geometric/arithmetic bias correction**
  - Geometric means of log price returns have a natural interpretation in time series as growth rates
  - In cross-sections geometric means do not have a natural interpretation
  - Approximations of arithmetic means can be calculated from geometric means
Frequency conversion and noise reduction

- In standard models estimates of price levels do not depend on information in preceding and subsequent periods
- Estimates sensitive to noise / outliers, in specific when number of observations per period is low
- Result: saw-toothed price index (high vol., neg. 1st order AC)
- Solutions (both in hedonic and repeat sales model):
  - Post-estimation smoothing: introducing temporal lag bias
  - Replace time dummy variables by a stochastic time series model (random walk with varying drift): less easy to estimate
  - Combine several lower frequency indices to compute a high frequency index (for example 4 Yearly to create a Quarterly index): easy to compute from standard output from regression
    - Yearly indices starting from 1st, 2nd, 3rd and 4th quarter
STEP 3: INDEX CONSTRUCTION (3)

- Computation of composite indices
- Composite return is a weighted average of the market segment returns
- Weights: value weighted
  - Stock
  - Transactions
- Weights may be adjusted periodically (yearly), however at a lower frequency than the index (monthly)
INDEX EVALUATION

- **Standard errors of estimated returns and levels**
  - Index with lowest average standard error of the estimated returns is to be preferred
    - Number of observations
    - Misspecification and omitting variable problem

- **Volatility and first order autocorrelation**
  - Noise introduces excess volatility and decreases first order autocorrelation

- **Revision effects**
  - Revision effects in repeat sales and pooled hedonic models can be evaluated
  - Noise reduction techniques tend to lower revision effects

- **Temporal bias: lead and lag relations**
  - Stock market indices tend to lead transaction based indices
  - Transaction based indices tend to lead investment return indices
Thank you!

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