TRANSACTION-BASED PRICE INDICES

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CPPI HANDBOOK 2ND DRAFT CHAPTER **5**

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INTRODUCTION

- 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

THRESHOLD CONSIDERATIONS (1)

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

THRESHOLD CONSIDERATIONS (2)

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

THRESHOLD CONSIDERATIONS (3)

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)

TRANSACTION-BASED PRICE INDICES
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

STEP 3: INDEX CONSTRUCTION (2)

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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