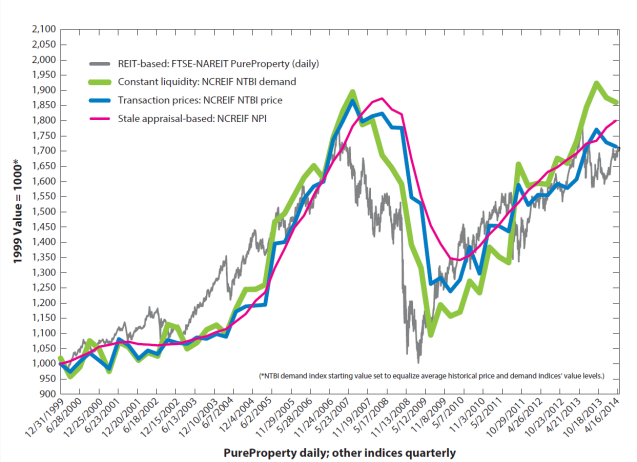
Revisiting lead-lag relationships in commercial real estate property price indices

Marc Francke (UvA and OF) and Willem Vlaming (MSCI and UvA)

February 20, 2026, International Conference on Real Estate Statistics 2026, Tokyo

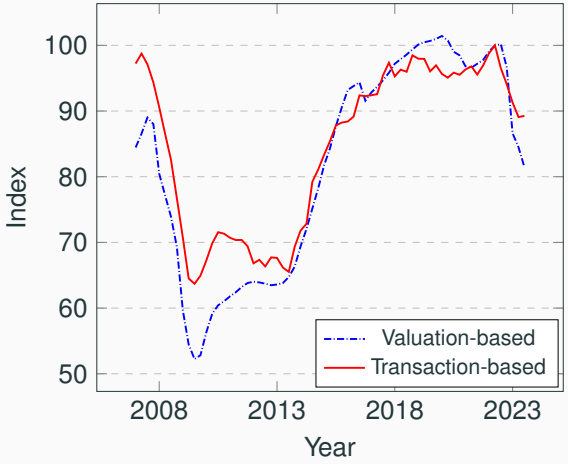
University of Amsterdam, Ortec Finance and MSCI

CPPI US 2000–2014 (Source: Geltner, 2015)



Consensus that appraisers use dated transactions and lag & smooth the market

CPPI UK (MSCI and own calculations; valuation-based: capital gain only)



What happens at the end of the sample (2023Q2)?

Appraisal smoothing

- Appraisal rule:

$$A_{i,t} = \omega MV_{i,t} + (1 - \omega)A_{i,t-1}$$

  where A is the appraisal and MV the market value of property i (Geltner, 1991; Geltner, 1993; Fisher et al., 1994; Quan and Quigley, 1991; Edelstein and Quan, 2006)
  - ✓ if $\omega = 1$, then appraisal is fully based on the current sale prices
  - ✓ if $0 < \omega < 1$, then appraisal is also partly based on past appraisal value
- Appraisal rule is rational on a property level as only a noisy estimate of the current market value is available,
- However, the appraisal rule on an index level leads to smoothing and lag bias (lower index return volatility and higher autocorrelation, later in detection turning points)

Transaction-based indices

- 'Ideal' method
  - Estimate a model to predict prices based on sales in period t only
  - Estimate a model to predict prices based on sales in period $t+1$ only
  - Calculate a price index return based on these model outcomes (Laspeyres/Paasche/Fisher/Tornquist): $r_{t+1|\mathcal{S}\{t,t+1\}}$
    - return in period $t+1$ conditional on sales in period t and $t+1$ only
- CRE is very heterogeneous and the number of sales is small

  $\rightarrow$ makes the ideal method unfeasible, too much noise due to
  - wrong input
  - missing variables
  - wrong functional form
  - in combination with low number of observations

Transaction-based indices: Which information set was used?

- Ideal method (not feasible)

$$\text{Index}_t^{\text{Ideal}} = 100 \times (1 + r_{2|\mathcal{S}\{1,2\}}) \times (1 + r_{3|\mathcal{S}\{2,3\}}) \times \ldots \times (1 + r_{t|\mathcal{S}\{t-1,t\}})$$

- Frozen: index return for period t estimated using only sales up to period t

$$\text{Index}_t^{\text{F}} = 100 \times (1 + r_{2|\mathcal{S}\{1,2\}}) \times (1 + r_{3|\mathcal{S}\{1,\ldots,3\}}) \times \ldots \times (1 + r_{t|\mathcal{S}\{1,\ldots,t\}})$$

- Unfrozen: index return for period t estimated using all sales (up to $T > t$)

$$\text{Index}_t^{\text{uf}} = 100 \times (1 + r_{2|\mathcal{S}\{1,\ldots,T\}}) \times (1 + r_{3|\mathcal{S}\{1,\ldots,T\}}) \times \ldots \times (1 + r_{t|\mathcal{S}\{1,\ldots,T\}})$$

- In general: $r_{t|\mathcal{S}\{t-1,t\}}$, $r_{t|\mathcal{S}\{1,\ldots,t\}}$ and $r_{t|\mathcal{S}\{1,\ldots,T\}}$ differ from each other (revision)

Transaction-based indices: methods

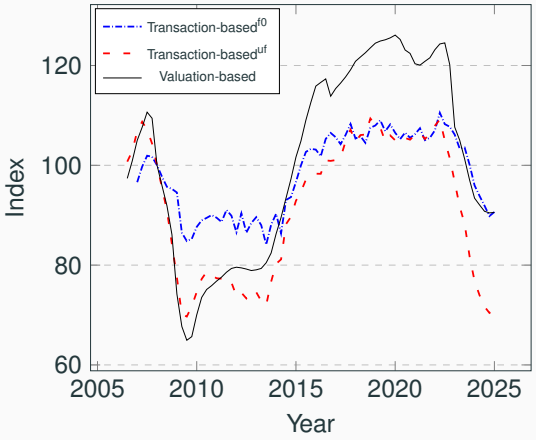
- Previous studies used unfrozen transaction-based index returns to analyze lead-lag relations with valuation-based index returns $\rightarrow$ unfair comparison
- We use frozen transaction-based index returns from various versions of repeat sales and hedonic pricing models by recursive estimation
- Analzye lead-lag relations by Granger-causality tests

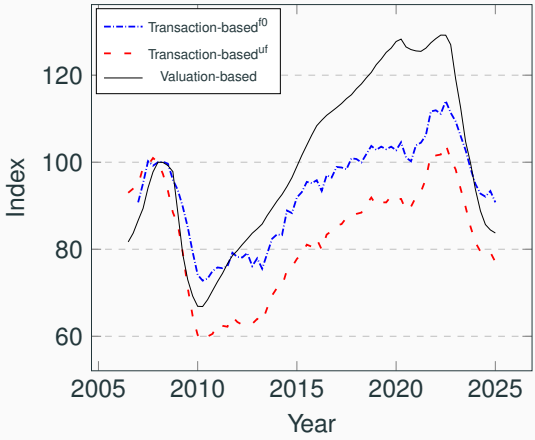
Office market data in US, UK, and NL (left: sales; right: valuations)

Year	US			UK			NL		
	# RS	#	($m)	# RS	#	(£m)	# RS	#	(€m)
2001	120	670	23.4	39	279	23.1	4	32	14
2002	157	764	30.2	72	276	22.3	3	32	17.9
2003	230	880	28.4	78	246	26	4	19	33.1
2004	481	1415	29.2	143	355	24.4	4	29	27.7
2005	758	2143	27.9	186	389	32.8	11	53	20.6
2006	810	2140	32.8	243	504	34.6	15	66	26.1
2007	927	2271	38.4	182	369	43.2	21	120	20.8
2008	510	1093	30.8	114	196	29.6	20	61	19.7
2009	276	460	20.9	119	204	31.4	5	20	15.4
2010	462	755	29	196	302	28.4	4	19	33.1
2011	697	1072	31.7	185	254	36.9	6	20	16.2
2012	881	1359	29	209	265	43.2	13	22	32.9
2013	1043	1576	31	281	393	38.3	9	23	15.5
2014	1243	1858	31.9	317	460	36.3	23	43	21.9
2015	1371	2063	29.2	297	418	37.3	40	62	19.2
2016	1319	1810	31.1	248	308	31.9	75	113	14.5
2017	1251	1737	31.2	259	302	36.3	79	127	17.6
2018	1292	1679	31.6	265	300	45.9	69	123	16.7
2019	1275	1615	31	211	224	40.5	78	102	17.6
2020	850	998	24.7	130	133	36.3	74	82	16.4
2021	1335	1464	27.1	179	185	41.5	57	69	28.2
2022	1241	1299	24.7	141	141	46.8	81	84	17.3
2023	883	900	16.4	114	114	29.1	46	46	17.1
2024	941	941	18	136	136	24	30	30	18.3

Year	US		UK		NL	
	#	($m)	#	(£m)	#	(€m)
2001	197	49.3	2353	11.6		
2002	203	47.8	2317	11.9		
2003	286	44.5	2193	11.9		
2004	339	49.4	2219	13.1		
2005	404	70.4	2388	15.4		
2006	459	85.1	2556	18.2		
2007	561	101.4	2664	17.9		
2008	600	86.6	2385	13.5	240	19.8
2009	577	67.1	2158	11.9	395	15.1
2010	550	73.1	2373	13.7	430	14.0
2011	558	88.4	2327	14.2	409	13.5
2012	625	94.3	2144	13.5	395	12.8
2013	616	113.1	1990	15.4	310	12.7
2014	677	124.8	1972	19.5	223	14.1
2015	752	144.5	1876	22.7	200	15.7
2016	776	148.5	1664	23.6	124	21.0
2017	764	159.1	1548	24.9	109	24.0
2018	678	176.5	1520	27.4	97	31.6
2019	678	184.2	1387	28.9	94	37.8
2020	795	157.2	1338	29.6	94	40.9
2021	842	147.2	1197	32.5	87	46.1
2022	826	130.1	1091	29.7	88	43.6
2023	805	102.4	945	27.0	86	41.3
2024	731	92.6	790	29.7	82	42

Indices for the UK (left) and US (right)





Lead-lag relations

Results from Granger-causality tests

- unfrozen transaction-based index return lead valuation-based index returns in the US and NL
- valuation-based index return lead frozen transaction-based index returns in all markets
- results are similar using different (repeat sales and hedonic pricing) models
- (we have additional results for REIT-based and constant liquidity index returns)

Conclusion

- Make fair comparisons by conditioning on the appropriate information set
- Traditional view that appraisers lag market value because they use past transactions for their valuations seems dated
- Other forms of information are being used to update valuations, like yield movement or the lack of demand
- Still notoriously lagged appraisals out there (Germany, Japan)

References

Edelstein, R. H. and D. C. Quan (2006). “How Does Appraisal Smoothing Bias Real Estate Returns Measurement”. In: *The Journal of Real Estate Finance and Economics* 32, pp. 41–60.

Fisher, J. D., D. Geltner, and B. Webb (1994). “Value Indices of Commercial Real Estate: A Comparison of Index Construction Methods”. In: *The Journal of Real Estate Finance and Economics* 9, pp. 137–164.

Geltner, D. (1991). “Smoothing in Appraisal-Based Returns”. In: *The Journal of Real Estate Finance and Economics* 4, pp. 327–345.

— (1993). “Estimating Market Values from Appraised Values without Assuming an Efficient Market”. In: *The Journal of Real Estate Research* 8.3, pp. 325–345.

— (2015). “Real Estate Price Indices and Price Dynamics: An Overview from an Investments Perspective”. In: *The Annual Review of Financial Economics* 7, pp. 615–633.

Quan, D. C. and J. M. Quigley (1991). “Price Formation and the Appraisal Function in Real Estate Markets”. In: *The Journal of Real Estate Finance and Economics* 4, pp. 127–146.