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Matching indices for thinly-traded commercial real estate in Singapore[☆]

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ABSTRACT

We use a matching procedure to construct three commercial real estate indices (office, shop and multiple-user factory) in Singapore using transaction sales from 1995Q1 to 2010Q4. The matching approach is less restrictive than the repeat sales estimator, which is restricted to properties sold at least twice during the sample period. The matching approach helps to overcome problems associated with thin markets and non-random sampling by pairing sales of similar but not necessarily identical properties across the control and treatment periods. We use the matched samples to estimate not just the mean changes in prices, but the full distribution of quality-adjusted sales prices over different target quantiles. The matched indices show three distinct cycles in commercial real estate markets in Singapore, including two booms in 1995–1996 and 2006–2011, and deep and prolonged recessions with declines in prices around the time from 1999 to 2005. We also use kernel density functions to illustrate the shift in the distribution of house prices across the two post-crisis periods in 1998 and 2008.

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1. Introduction

Unlike residential real estate markets where transactions are abundant, commercial real estate transactions are thin and lumpy. Many institutional owners hold commercial real estate for long-term investment purposes. The dearth of transaction data has led to the widespread use of appraisal based indices, such as the National Council of Real Estate Investment Fiduciaries (NCREIF) index, as an alternative to transaction-based indices in the U.S. However, appraisal-based indices are vulnerable to smoothing problems. Appraisers appear to systematically under-estimate the variance and correlation in real estate returns and other asset returns (Webb et al., 1992). Despite various attempts to correct appraisal bias, it remains an *Achilles' heel* of appraisal-based indices. Corgel and deRoss (1999) found that recovering the true variance and correlation of appraisal-based returns reduces the weights of real estate in multi-asset portfolios.

Transaction-based price indices avoid appraisal smoothing problems. However, the number of private real estate transactions varies greatly over time. Investors hold onto their properties in "down" markets and sell them if they are priced above appraisal values in "up" markets. The volatility of transaction based indices is highly correlated with the liquidity (volume) in commercial real estate markets. Innovative methodologies have been proposed to correct for illiquidity in real estate transactions, including liquidity constant transaction based indices (Fisher et al., 2007), repeat sales regressions (RSRs) adjusted for non-randomness in transactions (Gatzlaff and Haurin, 1997; Munneke and Slade, 2000, 2001), among others.

This paper uses a propensity score matching technology to construct commercial real estate indices. The proposed matching indices are estimated based on comparable sales that occur in two different periods, one in a treatment period and another in a base (control) period. The matching approach has previously been used by McMillen (2012) and Deng et al. (2012) to estimate private residential real estate price indices in the U.S. and Singapore, respectively. Guo et al. (2012) propose a within-complex matching methodology, which pairs two different sales in the same building when constructing a pseudo repeat sale indices. Our matching indices differ from standard repeat sale price indices in three ways. First, matching indices are not restricted to a small number of non-random repeat transactions when markets are illiquid. Second, the matching approach is less sensitive to changes in sample composition across transaction periods. Third, the matching indices have an advantage over the mean-based RSR estimator in explicitly accounting for variations across different price quantiles over time.[3]

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[3] McMillen (2012) finds that the upper end of housing price distribution in Chicago shifts further to the right than the lower end of distribution between 1995 and 2005.

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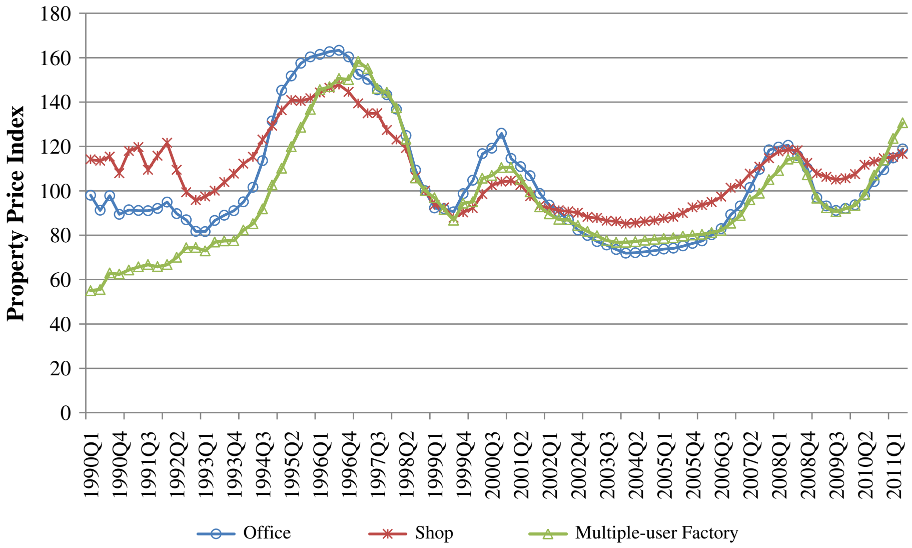

Source: URA

Fig. 1. Commercial real estate price indices.

Commercial real estate plays a key role in supporting various economic activities in Singapore, which is a global financial hub centered in Asia. Currently, the commercial real estate indices published by the Urban Redevelopment Authority (URA), a government agency overseeing urban development and planning, are the only publicly available indices for commercial real estate transactions in Singapore. The URA publishes quarterly indices for four commercial submarkets, including office, shop, multiple-user factory, and multiple-user warehouse. Despite the importance of commercial real estate markets, Tu et al. (2004) is currently the only study devoted to developing robust commercial real estate indicators in Singapore. Tu et al. (2004) use a spatiotemporal approach to model office price changes adjusted for different transaction activities in strata office space between the central and the suburban markets.

This paper develops matched-sample indices for three major commercial real estate submarkets in Singapore — office, shop, and factory — for the period 1995Q1–2010Q4. The matched price indices identify three distinct cyclical phases in commercial real estate prices in Singapore. Based on kernel density estimates of the price distributions, we observe significant differences in price trends over the two post-crisis periods in 1998 and 2008. The distributions of matched samples prices shifted to the right in the 2008 period. The quantile estimates reveal different price dynamics across the three submarkets. In the office market, the 90% percentile price index is more volatile than the index for the 10% percentile, which implies that the variation in sales prices in the top-tiered office market is highly sensitive to market shocks. The quantile distributions for factory prices shows a different picture, with both 10% and 90% percentiles price indices trending downward over the sample periods.

The remainder of the paper is organized as follows. Section 2 reviews the literature on commercial real estate index methodologies and their limitations. Section 3 provides an overview of Singapore's commercial real estate market and the URA indices. Sections 4 and 5 compare the standard RSR methodology with the matching approach. Section 6 summarizes the data used for our empirical estimation of commercial real estate indices in Singapore. Section 7 analyzes and compares the matching-based commercial real estate indices with other transaction-based indices. Section 8 concludes.

2. Commercial real estate indices

The appraisal-based NCREIF property index and its predecessor, the Russell-NCREIF index, have been recognized as the *de facto* benchmarks of commercial real estate performance by institutional investors in the US (Fisher et al., 1994; Geltner and Goetzmann, 2000; Pagliari et al., 2001). The indices are estimated using appraised values of unleveraged commercial properties in the portfolios of NCREIF members. Appraisers' reliance on past information is a source of lagged errors that are embedded into current appraised values (Quan and Quigley, 1991; Cho and Megbolugbe, 1996; Chinloy et al., 1997; Clayton et al., 2001; Diaz and Wolverton, 1998; Lai and Wang, 1998; Hansz and Diaz, 2001; Bokhari and Geltner, 2011). Various de-lagging and de-smoothing procedures have been proposed to uncover the true volatility of appraisal-based indices (Geltner, 1989, 1991, 1993; Fisher et al., 1994; Cho et al., 2003; Fu, 2003; An et al., 2012; Bond et al., 2012).

While repeat sales regression (RSR) indices have been viewed as the gold standard for constructing house price indices for residential property markets, applications of RSR to illiquid commercial real estate indices are subject to serious disadvantages. First, the RSR sampling process restricts the data set to properties that sell twice within a sample period. This restriction reduces the size of the already thin commercial real estate sales sample.[4] Second, potential sample selection bias occurs when more frequently transacted properties have higher price changes than the population of sample properties (Haurin and Hendershott, 1991; Munneke and Slade, 2000, 2001). Third, asymmetry in the number of transaction activities (liquidity) during up and down markets is another potential source of non-randomness in the sample that distorts temporal changes in indices (Fisher et al., 2004).[5] The first NCREIF transaction based index (NCREIF-TBI) was developed by the MIT Center for Real Estate in 2006 (Fisher et al., 2007). Derivations of monthly frequency commercial real estate indices were subsequently made possible by a frequency-conversion methodology proposed Bokhari and Geltner (2012), which can handle sparse and non-random commercial real estate transactions. Commercial real estate RSR indices constructed using the Bokhari–Geltner approach include Moody's/Real Capital Analytics (RCA) commercial property price index (CPPI) and the CoStar commercial repeat-sales index (CCRSI) in the US.

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[4] Wu et al. (forthcoming) point out that a similar sampling limitation is faced in many booming nascent housing markets in emerging economies, where housing markets are dominated by new sales with single transactions only.

[5] Sales of starter or luxury homes (Englund et al., 1999), and macro-economic shocks (Gatzlaff and Haurin, 1997) can cause variations in liquidity in the housing markets that can affect RSR price indices.

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