Capture the abrupt changes in Asian residential property markets

Eddie C.M. Hui [a], Cong Liang [a, *], Jiawei Zhong [a], Wai-Cheung Ip [b]

[a] Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong
[b] Department of Applied Mathematics, The Hong Kong Polytechnic University, Hong Kong

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ABSTRACT

In this paper, studies on the real estate markets mainly focused on the relationship between abrupt change points and corresponding political issues and economic collapse. Within the past statistical framework, change-point detection technique was widely considered based on large and long data sets. Few studies considered the situation where a limited size of time-series data sets is available in the real estate markets. To fill in this gap, the wavelet analysis with minimax threshold is introduced in this paper. By comparing Daubechies LA(8), wavelet analysis with minimax threshold is a versatile and powerful approach to the analysis of residential data as they are flexible in their function form and provide a robust computational method even with a small sample size. The detected change points reflect some significant political issues and economic collapses. It can be shown from the empirical result that a "diffusion relationship" happened from one location to another.

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1. Introduction

Real estate has been long regarded as one of the safest investment products in financial markets. As such, investors are able to build a secure foundation for their wealth (Haight & Singer, 2005). Over the past ten years, as the outbreak of cataclysmic events (such as human swine flu, Severe Acute Respiratory Syndrome [SARS], credit risk arisen from the bankruptcy of Lehmann Brothers, and Asian financial crisis) occurred more frequently, security markets have been fluctuating. Meanwhile, real estate markets have been relative stable, and thus become more popular among investors. Due to its durable nature (Malpezzi & Wachter, 2005), it is believed that real estate serves as a hedging tool against inflation when its return exceeds, or at least equals to, the rate of inflation (Worzala & Sirmans, 2003). Therefore, the benefits received over time create a compounding effect on real estate returns, which, unlike those of some other instruments in the equity market, are more than simply compensations by means of a predictable income stream (Haight & Singer, 2005). Recently, many researchers have attempted to find a strategic investment in the real estate market (Falkenbach, 2009; Hui & Yu, 2012; Hui, Lau, & Lo, 2009, 2014; Nguyen, van der Krabben, & Samsura, 2014), with their major concern being the risk-change point relationship (Ling & Hui, 2013).

Though real estate is a comparatively safe investment option, its return is still inevitably affected by external factors. Various demand shocks, such as political events, economic crises, and epidemic diseases, may give rise to changes. To some extent, nearly all those changes are regarded as sudden drops (or rebound), which cause a series of short- and long-term effects. Pessimistically, some investors consider that a change may ultimately lead to capital losses. Such awareness is the reason why investors are unwilling to pay a premium for the security of the rights when facing uncertainty (Tu & Bao, 2009). Hence, identifying those sudden changes could reveal important findings that provide crucial information for policy-making and investment decisions, as these changes contain some hidden information that might not be easily observable. A change of that nature is usually termed as a jump point, which refers to a long-term widespread change of the fundamental structure, rather than a micro scale or short-term output (Hansen, 2001).

This paper intends to detect the change points and the corresponding events' level of influence on residential price indices (calculated from transaction prices) of four different cities (i.e. Singapore, Hong Kong, Shanghai, and Taipei). In the past few decades, numerous researchers have introduced a variety of methodologies to detect jump point(s). However, these approaches mostly require large datasets (Andrew & Meen, 2003; Vuorenmaa,

* Corresponding author.
E-mail addresses: bscmhui@polyu.edu.hk (E.C.M. Hui), liang.cong@hotmail.com (C. Liang), jaredzhong@gmail.com (J. Zhong), mathipwc@a.polyu.edu.hk (W.-C. Ip).

2005). Since the pricing data for real estate market of most developing countries is not large enough to meet the requirement of these methods, it renders comparisons of the impact of international events between developing countries, or between developed and developing countries, difficult.

By contrast, the wavelet analysis, which only requires smaller datasets, could address this issue. Specially, the techniques introduced by Ip, Wong, Xie, and Luan (2004) and Donoho and Johnstone (1994) for the wavelet analysis and change point detection, would be applied to study residential property prices of the four renowned Asian cities. More importantly, in order to examine the location effect among these cities, a comparison between the spreading out effect relationship is to be conducted as well.

This paper is structured as follows. Section 2 presents the literature review as to change point and the methods previously used in its detection. Section 3 introduces the wavelet analysis for jump point detection. Section 4 presents the results of the empirical studies and discusses the rationale that lies behind the detected change points. Finally, Section 5 draws a conclusion.

2. Literature review

2.1. A brief review on change points

The detection of change points is an important topic in macro-economic studies, and it requires the development of mathematical tools. The most usual methods are Fourier transforms and related statistical methods. When studying the price changes in French real estate market, Rachev and SenGupta (1993) found and discussed the "stability" properties of Laplace model and a mixture model of Laplace and Weibull. Lombard (1988) utilized the Fourier analysis to detect the cusps. In the empirical studies, Fourier transform can only convert the time-series data into a signal process, without retaining the other information, e.g. the location and the frequency of the change points. It indicates that it is really hard to see the location impact within the time horizon domain. To overcome the weakness arising from Fourier analysis, Muller (1992) developed a nonparametric regression method to examine the location and the scale of a cusp in a time-series, which is based on the boundary kernels framework. Nevertheless, no sophisticated standard for the jump point detection is fully accepted. To improved Muller's model (1992), Eubank and Speckman (1995) introduced another semi-parametric method and a least-square estimator to detect the discontinuities in one of the derivatives of regression functions. The major contribution in this approach is that smooth higher derivatives for the function are no longer a requirement. However, both of the above two approaches demand a large data set. Andrew and Meen (2003) investigated the aggregate time-series transaction data in Britain real estate by employing the dummy variables in the regression model. A significant relationship was found between the house prices and transactions, with a detected change point during the 1990s (decreasing transactions). Lavielle and Teyssière (2006) discovered some major changes which matched with important social and economic events when they studied the bivariate series of returns on FTSE 100 and S&P 500 index. They also analyzed multivariate series of returns on real and artificial financial markets and achieved similar results. Another study by Strikholm (2006) found a sequential method and applied it on the US ex-post real interest rate series. In piecewise linear structural break models, this method can estimate the number of breaks. Hillebrand and Schnabl (2006) segmented the Yen/Dollar exchange rate with a change point detector, to examine whether Japanese foreign exchange interventions had an obvious impact on the volatility of the exchange rate. Furthermore, Bourassa, Haurin,

Haurin, Hoesli, and Sun (2009) discussed the influence of the housing characteristics on the market appreciation rate, by constructing a repeated sale model of residential single-family properties. They concluded that the market-wide bubbles, the changes of local and national macroeconomic variables contributed to the average change in real estate prices. But their method only works on hypothesizing the house will appreciate at different rates depending on the characteristics of the property and change in the strength of the housing market.

Since wavelet analysis contains some expected properties, it is a good tool to handle the transaction information from the real estate market, without any hypothesis on the objective market (e.g. market equilibrium). Donoho and Johnstone (1994) generalized the traditional wavelet detection methods. They only considered small samples and developed selective wavelet reconstruction technique. Wang (1995) employed a technique to pick up the jumps and sharp cusps by detecting the significantly large absolute values over a determined threshold from the wavelet-transformed data. The assumption of uncorrelated white noise for the time series is the major limitation of this technique. Johansen et al. (2000) suggested a cointegration model with piecewise linear trend and a predetermined number of known break points. Inoue (1999) also applied the cointegrating rank and developed the test for trend breaks. However, the method of Johansen et al. (2000) and Inoue (1999) only rely on the parametric models. Ip et al. (2004) suggested a wavelet detection analysis for jumps or cusps, which can be applied on discontinuous functions with noise. By proposing this approach on the daily exchange rate of USD/DEM between 1 August 1989 and 31 July 1991, they found evidence to support that all the points detected can be explained by important economic and political events. They also compared their method with three traditional approaches (Wang, 1995; Xie, 1993; Yin, 1988), and emphasized that their new method is more flexible with less benchmark selection bias. Later, Lai and Huang (2007) introduced wavelet transform technique on the Chinese real estate stock market. However, they limited themselves to the qualitative analysis while being lack of the data supporting.

Previous studies proved that wavelet analysis is a versatile and powerful technique for the change point detection. Two of the above methods, Ip et al. (2004) and Donoho and Johnstone (1994) would be employed in the following change point analysis. The method suggested by Ip et al. (2004) has also been applied in two related researches (Hui, Liang, Ip & Ho, 2013; Hui, Liang, Zhong & Ip, 2015).

2.2. Major events from 1999 to 2009

It is supposed that several global and Asian events would show significant impacts on the targeted real estate market.

2.2.1. Global events

① A series of organized terrorist attacks occurred on September 11, 2001 in the United States. At that morning, four commercial passenger flights were hijacked by 19 Al-Qaeda terrorists. The hijackers then crashed down the Twin Towers of the World Trade Center, one of the famous landmarks in New York City, causing more than 3000 deaths. A great economic shock was reflected in the US and global markets. The New York Stock Exchange (NYSE), the American Stock Exchange (AMEX), and NASDAQ were forced to be closed until September 17. The Dow Jones Industrial Average (DJIA) stock market index dropped by 684 points, or 7.1%, to 8,921, which is one of the most daily declines, on the reopen day. It is believed that 9/11 would cause some side effects on global real estate markets. From the