1. Introduction

An interesting topic in time series analysis is the detection of trends and the measurement of change points. Lots of literatures have been proposed in finding change points. For example, Chow [1960], Nyblom [1989], Ploberger, Kramerus, and Kontrus [1989], Bleaney [1990], Lin and Terasvirta [1994] etc. have proposed various methods in detecting the change points. Broemeling and Tsurumi [1987] used a Bayesian procedure to solve inferential problems of structural shift. They provided a simple way to analyze data and did not rely heavily on asymptotic distribution theory in making statistical inference. Tsay [1988] proposed a procedure in detecting outliers, level shifts and variance changes in a univariate time series. Balke [1993] pointed out that Tsay's procedures do not always perform satisfactorily when level shifts are present. Barry and Hartigan [1993] also put forward the Bayesian analysis for change points problems.

Before we perform the change points detecting process, some fundamental questions arise: 1. What does a change point mean? Can we give a clear definition about a change point? 2. How do we decide the change points if the economic structure for a time series changes gradually? 3. How do we smooth or get rid of a unstable and uncertain intervention in a time series? 4. How do we deal with some economic keywords which are not clearly defined? These problems involved with the semantic interpretation and fuzzy statistical analysis have long time bothered many researchers. For this, Zadeh [1965] proposed fuzzy set theory, a new tool to generalize the classical notation of a set and accommodate semantic and conceptual fuzziness in statements. Fuzzy theory has the intrinsic property of linguistic variables. This property can help us to reduce the difficulties of uncertain problems. Besides, fuzzy theory is widely used in various areas. For example, Clymer, Corey, and Gardner [1992] proposed a method of fuzzy control in airport, Gupta, Martin-Clouaire and Nikiforuk [1984], Adlassing [1986] use fuzzy signal analysis on clinical diagnose. Cao and Chen [1983] propose the fuzzy meteorological analysis.

In this paper we are going to make use of the concept of fuzzy logic in dealing with the change period and trend problems in time series analysis. These interesting problems have been investigated a lot by many researchers. Cutsem and Gath [1993] suggested a useful approach based on fuzzy clustering for the detection of outliers and for the robust estimation of the underlying parameters. Hartha way and Bezek [1993] established FCRM as a promising technique for switching regression parameter estimation and clustering. Yoshinari, Pedrycz, and Hirota [1993] developed a new method to build fuzzy models through clustering methods based on linear varieties.

Wu [1994] suggested an algorithm about fuzzy time series classification. Inclan and Tiao [1994] proposed an iterative procedure to detect variance changes based on a centred version of the cumulative sums of squares presented by Brown *et al*. [1975].

Modified Page [1955] (MPAGE) method and the cumulative sum (CUSUM) method proposed by Hinkley [1971]. Hsu [1979, 1982] investigated the detection of a variance shift at an unknown point in a sequence of independent observations, focusing on the detection of points of change one at a time because of the heavy computational burden. Worsly [1986] used maximum likelihood methods to test a change in mean for a sequence of independent exponential family random variables. Sastri *et al*. [1989] presented a study of performance comparison for six time series change detection procedures.

However, those detecting techniques are based on the assumption that the underlying time series conducts a significant change point characteristic Wu and Chen [1999]. Using the concept of fuzzy set theory, Wu and Chen [1999] proposed a procedure about change period detection for nonlinear time series. Nevertheless, we must indicate that, in dealing with time series with switching regimes, we should consider not only the change point detection but also the properties of change periods. Because many patterns of change structure in time series occur over a time interval, those phenomena should not be treated as a mere sudden turning at a certain time.

Another problem is that a change period of a time series in a certain observation time interval may be seemed like a noise in a larger observation time interval. In our research, we propose a procedure based on fuzzy logic to detect change periods. Our approach enables us to filter the noise and find a suitable change period that meet your need by controlling the parameters. Moreover, we don't require any initial knowledge about the structure in the data to apply this method.

This paper is organized as follows: in section 2, we introduce the basic concept of fuzzy logic and introduce our approach with some examples. In section 3, some simulations are illustrated. Empirical examples of three foreign exchange rates are studied in section 4. Section 5 is the conclusion and suggestions.