Turning points of Financial and Real Estate Market

Ranoua Bouchouicha
Université de Lyon, Université Lyon 2, F-69007, Lyon, France
CNRS, GATE Lyon-St Etienne, UMR 5824, F-69130 Ecully, France

E-mail : bouchouicha@gate.cnrs.fr

Abstract

In literature, we always associate banking crises to currency crises, but the latest crisis brought specific attention to the real estate market and its movements. This study looks at the real estate and financial market turning points in the UK and USA. To achieve this, we conducted a study on their commercial, residential and financial markets. We applied both a parametric and a non -parametric approach, deciding to use the Markov Switching Model and the Bry-Boschan algorithm. This study gives us conclusions showing which of the above approaches will present more accurate results when dating financial and real estate crises. The study also examines the effectiveness of the aforementioned methods when analysing residential and commercial real estate indices during a real estate crisis, and which of these indices presents a more precise prediction. Besides, the results of this study may give some indication involving the dependence between the real estate market and the financial market, which is an important factor to consider in reducing the portfolio management risk.

Keywords: *Turning points, Real Estate Market, Stock Market, Markov switching model, Bry-Boschan Algorithm*

1. Introduction

Cycle analysis is very important in the economy since they define the evolution of the economic activity. Determining the best way to date the business cycles has been the core of many studies (Pagan, 2002). In fact, the description of the economic cycle is usually done through the identification of its turning points: the peak and trough. Several statistical approaches have been developed to detect these turning points. Among which there is a non-parametric one, initiated by Bry-Boschan (1971), used by the NBER since the 1970's to date recessions. There are others which are parametric and based mainly on Markov regime change (Hamilton, 1989).

Since the housing is considered as a business cycle (Leamer, 2007), so we have resorted to sthe Bry Boschan algorithm and the Markov Switching Model to identify booms and busts episodes in the Real Estate Market.

In their article, Bunda and Ca'Zorzi (2009)[1] have applied the Bry-Boschan model and the Early Warning System to analyze the movements of the housing market and the financial market. In fact, they found out that the probability that a housing boom would be accompanied by financial market tensions is increased by a fall in price competitiveness, a large current account deficit and a strong real growth and high public debt-to-GDP ratio.

The housing price rise is also said to be an important measure for identifying periods of economic expansion, as the economic literature has increasingly recognised (Angello and Schuknecht, 2009, Detken and Alessi, 2009).

The question of whether movements of the Real Estate booms constitute a natural phenomenon associated with the financial market is essential for a portfolio manager to measure the risk of detaining the two assets.

Lizieri and Satchell(1997) found out some interesting results regarding the causality between the Property and Equity markets in UK.

The novelty of this paper is that it applies the parametric and the non-parametric approaches to analyse the starting dates of the recessions. Since in literature, the comparison is always in terms of cycles length but we never focus on the dates of the turning points themselves. So we analyse these two methods to conclude which one identifies better the crisis. In addition, we study the difference between the turning points in the commercial and residential markets.

What's going to be dealt with in the coming part is as presented below. Section 2 outlines the data and the econometric methodology. The empirical results are presented in section 3 and section 4 offers some concluding remarks.

2. Data and Methodology

2.1 Data

To analyse the Real Estate Market, we choose an indicator of activity on the securitised property market, the property and the housing Market. Monthly index values for the Real Estate Investment Trust (REIT) for UK and USA are extracted from Datastream for the period January 1987[2] to January 2010.

[1] They studied two economic indicators credit to the private sector to GDP and house prices' growth rate.

[2] We start from 1987, date of availability of IPD and SPCS10.

Concerning the Property market, we use the monthly Investment Property Index (IPD) for UK and S&P/Case Shiller 10 composite index (SPCS10) for USA. Finally for the Housing Market for UK we study the Halifax housing price index.
To analyse the stock market, S&P 500 and FTSE 500 are respectively chosen for the US and the UK market.

2.2 Methodology

We use the Bry-Boschan algorithm [3](1971) and the Markov switching model[4] Hamilton (1989) on the price indices of Real Estate and stock market. For the
The Bry and Boschan (1971) as mentioned above is a non-parametric technique for dating Business cycles, but it was already used in stock markets by Edwards et al. (2003), Pagan and Sossounov (2003), Gomez Biscarri and Perez de Gracia (2004) and Gonzalez et al. (2005) among others.
The stock returns has also been the subject of two-regime modeling using the Markov switching model such as Guidolin and Timmermann (2005) who studied the Bull and Bear of the UK stock market joining other research by Maheu and McCurdy (2000), Ang and Bekaert (2002).

2.3 Markov Switching Model and turning points

The MSM model was proposed by Hamilton (1980, 1990). It is useful when the series undergoes shifts from one type of behaviour to another. It assumes that there are k states of the nature which the universe of occurrence is $s_i\left(i=1,...,k\right)$ each with variance σ_i^2 and mean μ_i.
So if we consider $k=2$ for two states of the world and y_t a switching regime. Thus, if $s_t=1$, the regime is in the state 1 and if $s_t=2$, the regime is in the state 2. In our case state 1 is the expansion and state 2 is the recession. Movements of this unobserved state variable are assumed to evaluate according to a Markov process with the following transition probabilities:

$$p\left(s_t=1\middle|s_{t-1}=1\right)=p_{11}$$

$$p\left(s_t=2\middle|s_{t-1}=1\right)=1-p_{11}=p_{21}$$

$$p\left(s_t=2\middle|s_{t-1}=2\right)=p_{22}$$

$$p\left(s_t=1\middle|s_{t-1}=2\right)=1-p_{22}=p_{12}$$

Where p_{11} designate the probability of being in the regime one given that the system was in the regime one during the previous period while p_{12} denotes that y_t will switches from state 1 in t to state 2 in $t+1$.
Assuming for example that y_t represents the natural logarithm of the price index of stocks or Real estate investment trust, the returns can be modelled as:

$$\begin{cases}\Delta y_t=\mu_{s_t}+\varepsilon_t\\ \mu_{s_t}=\mu_0\left(1-S_t\right)+\mu_1 S_t\end{cases}, \text{ where } \varepsilon_t \sim iid\ \mathrm{N}\left(0,\sigma^2\right)$$

[3] BB algorithm,
[4] MSM

So the vector of parameter that should be estimated is $\nu = \left(\mu_1, \mu_2, \sigma_1^2, \sigma_2^2, p_{12}, p_{21}\right)$. This parameter vector is estimated by the maximisation of the log likelihood using the BFGS[5] method.

Thus, considering our observed data y_t, $t = 1...N$[6], the conditional likelihood function assuming that $y_t | s_t \sim N\left(\mu_{s_t}, \sigma_{s_t}^2\right)$, is given by

$$f\left(y_t | s_t\right) = \frac{1}{\sqrt{2\pi\sigma_{s_t}}} \exp\left(\frac{-\left(y_t - \mu_{s_t}\right)^2}{2\sigma_{s_t}^2}\right)$$

We expect higher average of returns in the state 1 which is expansion period and a high volatility during recessions which is the state 2.

For the Markov Switching Model, we use the Rats program[7] which gives the same results as the code written by Hamilton (1994). We use the first log difference of the price index for the Real Estate data and the stock data. The results are presented in the table 1. The means and the variances of each of the two regimes are given in the first column with standard error of each parameter in parentheses. It's clear that the regime switching model has divided the data into two distinct regimes one with high mean μ_1 and the other with low mean μ_2 .The high probabilities of $p_{11} = 1 - p_{21}$ and p_{22}, respectively of remaining in expansion and remaining in recession highlight that each regime is highly persistent. So the two regimes are likely to persist for about an average of $\left(1/p_{21}\right)$ months for the regime 1 and $\left(1/p_{21}\right)$ months for the regime 2.

Table 1. Estimates of the Markov Switching Model for returns

	UK				USA		
	Halifax	REIT	IPD	FTSE 500	REIT	SP/CS 10	S&P500
p_{12}	0.0458 (0.0432)	0.0128 (0.0095)	0.0253 (0.0177)	0.0464 (0.0317)	0.0302 (0.0361)	0.0228 (0.0080)	0.0369 (0.0162)
p_{21}	0.0558 (0.0708)	0.0531 (0.0325)	0.0430 (0.0161)	0.0240 (0.0219)	0.1015 (0.0547)	0.0176 (0.0123)	0.1023 (0.0512)
μ_1	1.1243 (0.0680)	0.7120 (0.4243)	0.9757 (0.0759)	1.1168 (0.1969)	1.0515 (0.5822)	0.9509 (0.0524)	1.2287 (0.1925)
μ_2	-0.2711 (0.1212)	-1.4333 (2.0668)	0.1002 (0.3850)	-0.0001 (0.4203)	-1.8654 (1.3938)	-0.3415 (0.0682)	-1.4158 (1.2053)
σ_1	0.2340 (1.6046)	0.6717 (0.2252)	0.4505 (0.0667)	0.0766 (0.2169)	0.9514 (0.8428)	0.4808 (0.0271)	0.3301 (0.1685)
σ_2	1.0261 (3.4432)	1.3977 (0.2848)	1.8343 (0.1595)	1.5997 (0.5404)	1.6582 (3.0275)	1.7540 (0.0639)	1.8968 (0.7478)

[5] Broyden,Fletcher,Goldfarb,Shanno is a method for solving nonlinear optimization problems.
[6] The number of observations.
[7] Chris Brooks,(2008) p153.

2.4 Bry-Boschan Algorithm and turning points

The BB algorithm (1971) is standard in the business cycle literature from the early paper of Burns and Mitchel (1946). It was proposed to in order to replicate in an automatic way The US business cycle turning points as established by the NBER. The turning points identified in the series of level of prices, marks the shifts from phases of boom and bust. Thus a peak identifies a start of recession and this methodology imposes a strict succession alternating peaks and troughs by removing irrelevant local extreme points. It operates directly on raw data by selecting the local extremes under the constraints on the length and amplitude of expansions and recessions. Thus, this algorithm performs a selection of peaks and troughs that could be the cycle's turning points and then applies successive operations to remove those that don't correspond to the criteria characterizing the cycles.

A local peak (trough) is detected at time t whenever $\{y_t < (>)\, y_{t\pm k}\}, k = 1,...,K$ where $K = 5$ for monthly data. The phase resulting from this algorithm is at least equal to 6 months and a cycle should have a minimum duration of 15 months.[8]

To identify the turning points, we used the Matlab code of the algorithm which is an adoption of the original Gauss code.

To identify the turning points, the Bry-Boschan Algorithm (1971)[9] follow six steps of successive applications of filter procedures and selection of extreme values:

Step 1: Determination of extreme values and their replacement.

Step 2: Determination of cycles through a moving average filter. For this step and the subsequent steps, consider the alternation of turns by selecting highest of multiple peaks and lowest of multiple troughs.

Step 3: Application of Spencer curve on the series resulting from the step 2,"update" the turning points and elimination of the too short cycles.

Step 4: Detection of turning points on the resulted series of step 3 with a new moving average filter and elimination of short cycles.

Step 5: determination of turning points in the original series taking into account information obtained through the step 4 and elimination of the too short cycles.

Step 6: Statement of final turning points.

3. Results

3.1 Comparison of turning points of the two approaches

The Graphs of the Turning points by the parametric and the non- parametric approaches are given in the Appendix 2, 3, 4 and 5. While the dates of turning points are summarised in Appendix 6.

Concerning the Halifax index, both of the two approaches detect three recessions. Two in the early 90's and one in 2007. In fact, prices tumbled in the 1990's but the market normally thrived between 1999 and 2004. The MSM detects the start of the crisis before the BB algorithm in the two cases while the end date of the crisis is the same in the two approaches.

BB algorithm detects more turning points than the MSM model for UK REIT. It detects five periods of recessions while the MSM identifies three. The first period detected by the - parametric approach begins two years earlier before that identified by the non-parametric.

[8] See Harding and Pagan (2002) for further information about the application of the algorithm on quarterly data algorithm

[9] See the Appendix 1 for the original detailed procedure with the information about the length of cycles.

Concerning the last crises, it was first detected by the BB algorithm 9 months earlier before the MSM model.
The non parametric approach points out just two periods of downturn on the IPD while the MSM is able to date three major periods. One beginning in the middle of 88 might have been driven by the movement of the stock market of 1987. Then the MSM detects a period of slow in IPD returns that lasts 4 years which is not taken into account in the BB approach.
Finally the last crisis is detected by the two methods but earlier by the MSM approach. However, the end date is the same for the two methods. Although, the Real Estate Market may still suffer from the crisis, this end date may just be a near sign of the beginning of the market recovery.

Concerning the Stock market, The MSM is able to detect the three major crises on FTSE 500 stock returns, the one that occurred in 1987, which is well detected by this approach since we remark that the stock returns had already register a probability of recession even before October 1987. This is similar to the S&P 500 for the US market.
Comparing the resulting turning points from all the data, we conclude that the Markov switching model is clearer and closer to the historical events than the BB algorithm and this applies to both UK and US.

3.2 Comparing the turning points of Real Estate market vs Stock market

Regarding the first period, Halifax price index, the REIT index detect a fall in the market before the FTSE100, however the movements in the IPD occur just one month after those of the FTSE 100.
The third recession period for the financial market corresponds to the second for the REIT and Halifax index prices. It happens before the two later ones.
Concerning the crisis of 2007, the results are divided between two cases: the first one is when the Real Estate market turning points happed before those of the Stock market and the second one is when they hit after.

The Halifax and the IPD both of them indicate turning points, respectively after three and two months of the FTSE 100. Whereas, the REIT index indicates a turning point in the Real Estate market three months beforethat of the stock market. In fact, we identify through the REIT five pressures in the market, the three of them are followed by a pressure in the financial market. Bunda et ca'zorzi et al.(2009) found two episodes of housing booms followed by tension in the banking sector and downward pressures in the Sound Sterling in 1991 and 2006.
The first slump period in the Real Estate data identified by the non-parametric approach covers the two first recession periods resulting from the movements of the FTSE 500 price index.
Among the three recessions in 2007 detected by the BB algorithm in the Real Estate data, two of them register a movement after that of the stock market, which doesn't coincide with the historical facts. However, the according to the MSM, the turning points in the real estate market happen before those in the financial market and the crash of 1987 happened before the recessions in the Real Estate market.
Concerning the Securitised market property and the property market in US, the non parametric approach identifies six periods of downturn, one in the early 90's, two in the middle of the 90's and one in 2006 and 2007.
The returns of housing prices indicate the beginning of the crash in Juin 2006 and this is for the two approaches. This is close to the historical fact that the subprime crisis was caused by the housing market whereas; the turning point for the REIT market is identified in 2007.

We remark that the REIT price index and the S&P 500 have the same behavior when we apply the Markov switching model. The two markets have similar turning points dates.

4. Conclusion

Since the BB algorithm detects local minima and maxima, this is the main reason behind the many turning points resulting from this approach. In fact, the algorithm detects even two periods of recessions that are separated by five months while the MSM identifies the occurrence of a recession or an expansion through the probability of being in the two cases.

The empirical results above give us some conclusions about the quality of dating the crisis periods. Actually, the Markov switching model gives better results than the Bry Boschan model. For the latter, assuming that the expansions and contractions of minimum duration can conduct to misleading interpretations (Hamilton 2001).
The Markov switching model approach is much clearer regarding the justification of mathematical calculations used in the identification of the turning points. In addition, it is based on estimated econometric specifications. It not only allows the statistical inference but also forecasts turning points (Bodart et al 2003).
It's interesting to study some interactions between the Real estate market and the stock market although the practical implications remain difficult to adopt because of the low levels of liquidity in the Real estate market. The housing markets are different from the stock markets since houses take time to build so when demand rises, supply just respond with a considerable lag. In addition the price of Real Estate pays an implicit income which is for example the amount of the rent that the owner saves by owning the building. So the value has to take into account expectations of the future rents.

To improve the work, we will try to detect linear and non-linear causality between the assets during the contraction periods resulting from the Markov switching Model since the question of whether international markets are related or not is important from the perspective of the investment portfolio manager.

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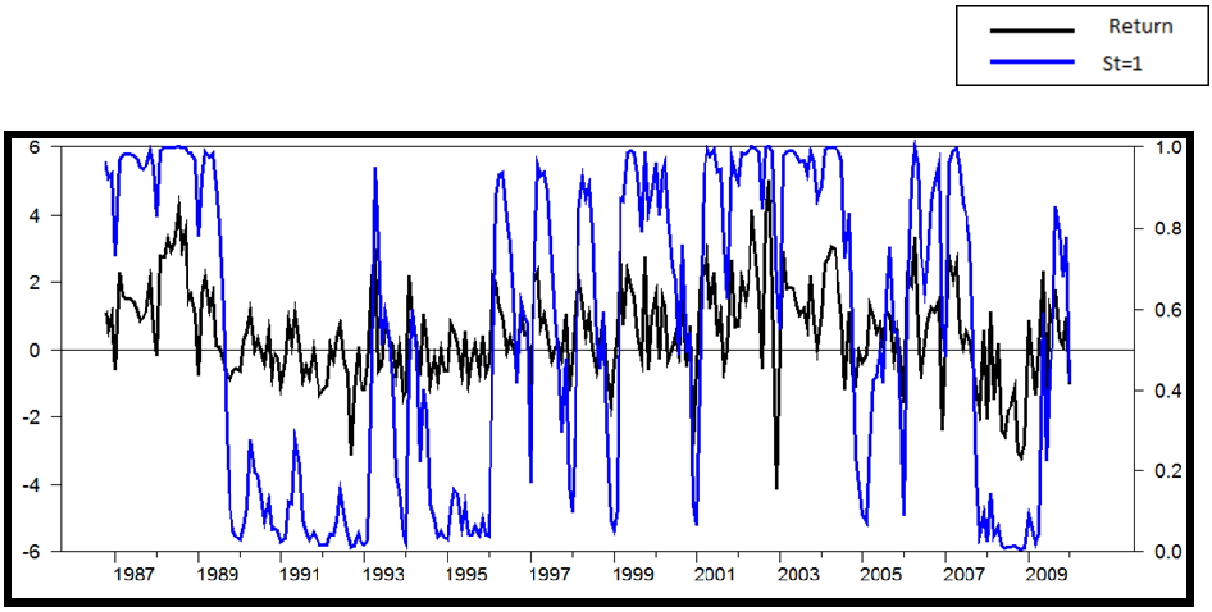
Appendix 1
Procedure for programmed determination of turning points*

1. Determination of extremes and substitution of values.
2. Determination of cycles in 12-month moving average (extremes replaced).
(a) Identification of points higher (or lower) than 5 months on either side.
(b) Enforcement of alternation of turns by selecting highest of multiple peaks (or lowest of multiple troughs).
3. Determination of corresponding turns in Spencer curve (extremes replaced).
(a) Identification of the highest (or lowest) value within ±5 months of selected turns in the 12-term moving average.
(b) Enforcement of minimum cycle duration of 15 months by eliminating lower peaks and higher troughs of shorter cycles.
4. Determination of corresponding turns in a short-term moving average of 3 to 6 months, depending on MCD (months of cyclical dominance).
(a) Identification of highest (or lowest) value within ±5 months of the selected turn in the Spencer curve.
5. Determination of turning points in the original series.
(a) Identification of the highest (lowest) value within ±4 months, or MCD term, whichever is larger, of the selected turn in the short-term moving average.
(b) Elimination of turning points within six months of beginning and end of series.
(c) Elimination of peaks (or troughs) at both ends of series which are lower (or higher) than values closer to the end;
(d) Elimination of cycles whose duration is less than 15 months.
(e) Elimination of phases whose duration is less than 5 months.
6. Statement of final turning points.

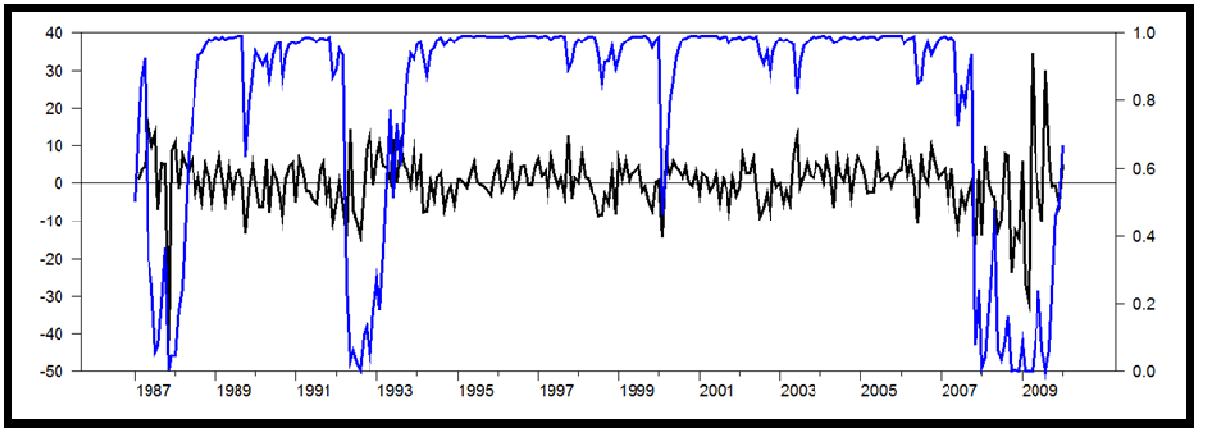
*Bry, G., Boschan, C., 1971. Cyclical Analysis of Time Series: Selected Procedures and Computer Programs. NBER, New York, P21.

Appendix 2

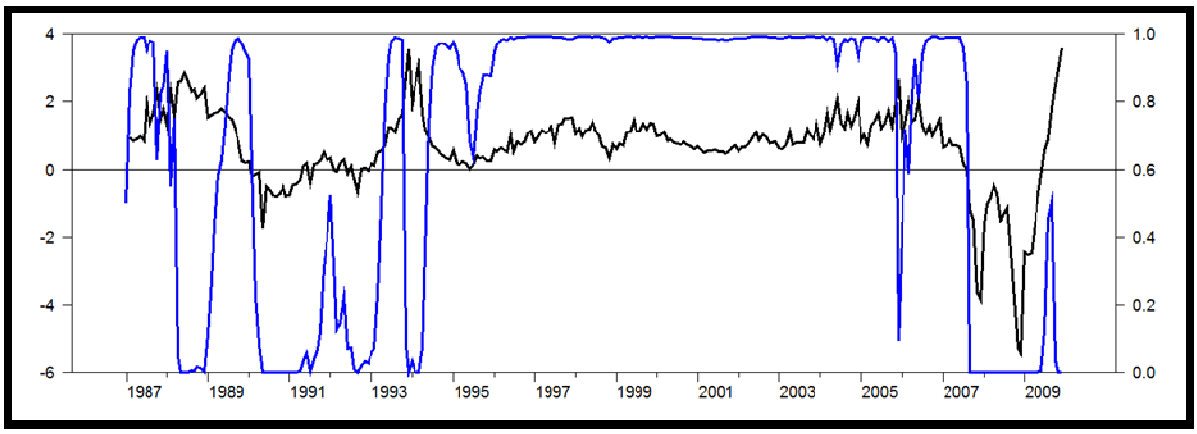
Dating recessions in UK using the MSM (UK data)



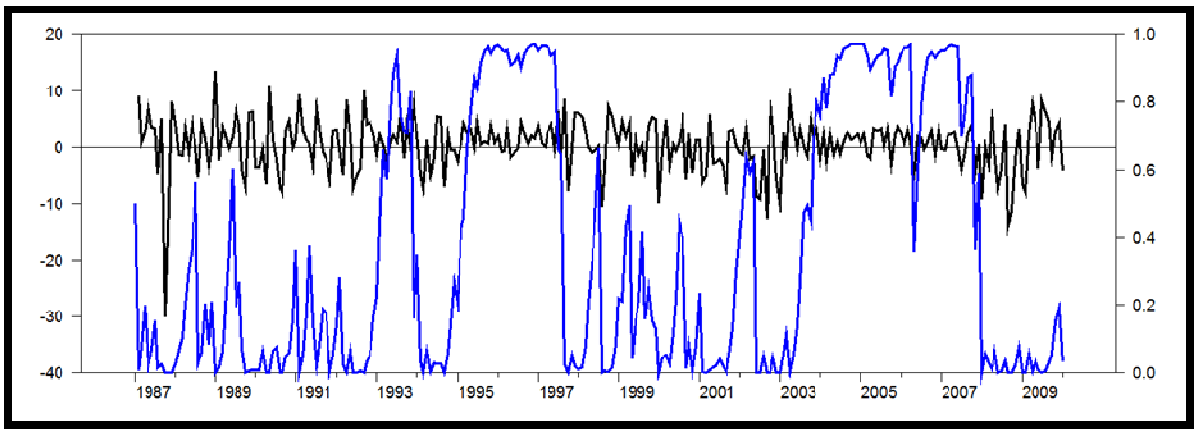
Graph 1. Halifax return and probability of being in expansion



Graph 2. REIT return and probability of being in expansion



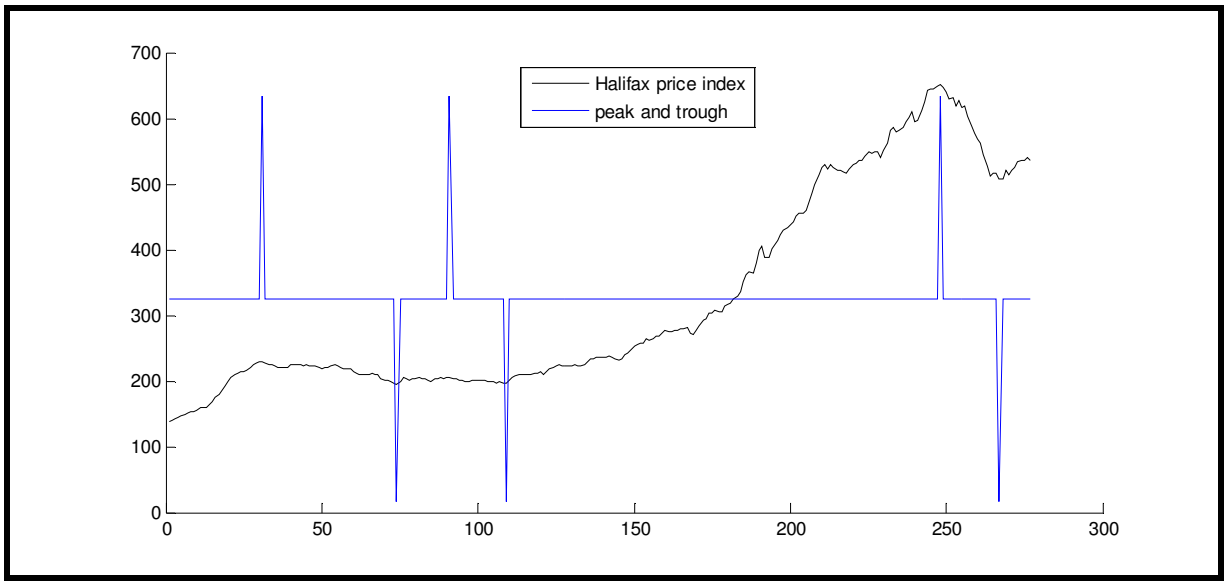
Graph 3. IPD return and probability of being in expansion



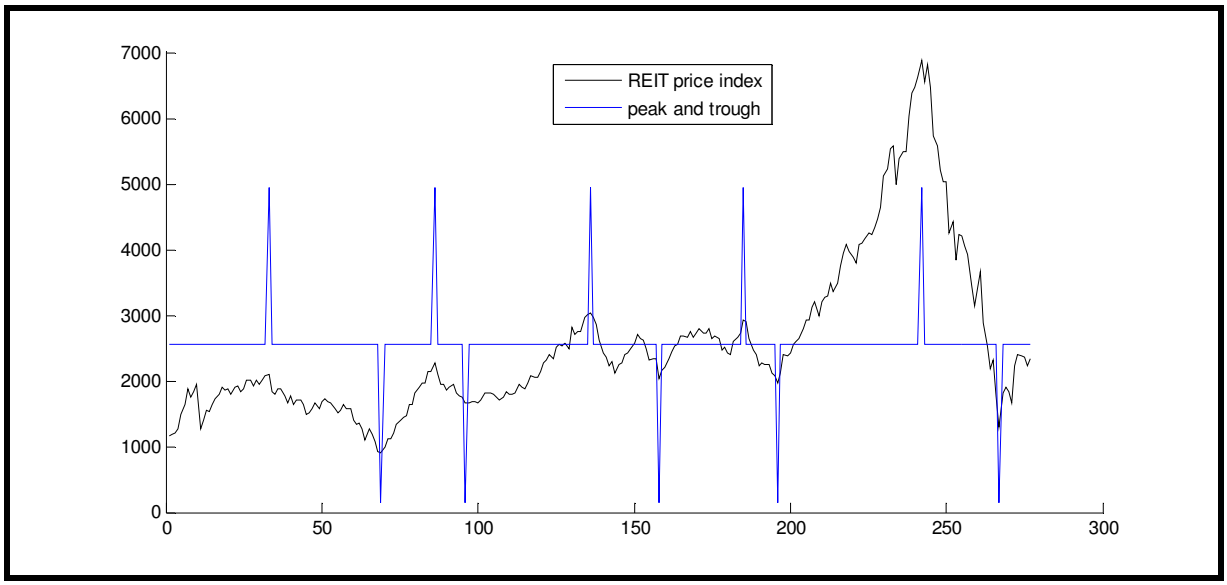
Graph 4. FTSE 500 return and probability of being in expansion

Appendix 3

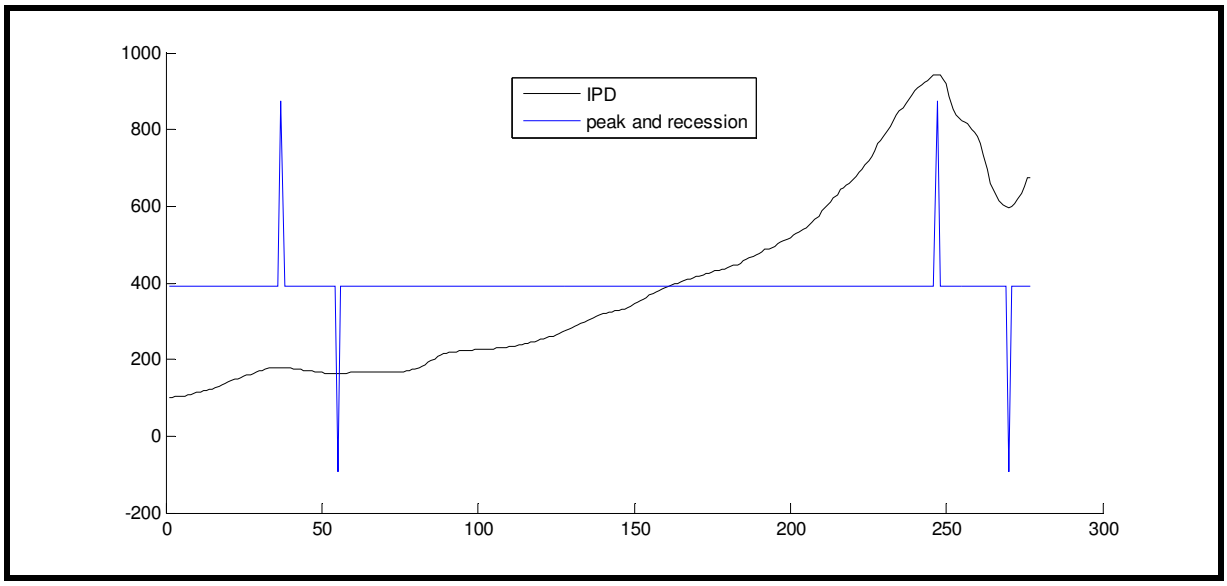
Graphs of dating recessions using the BB algorithm (UK data)



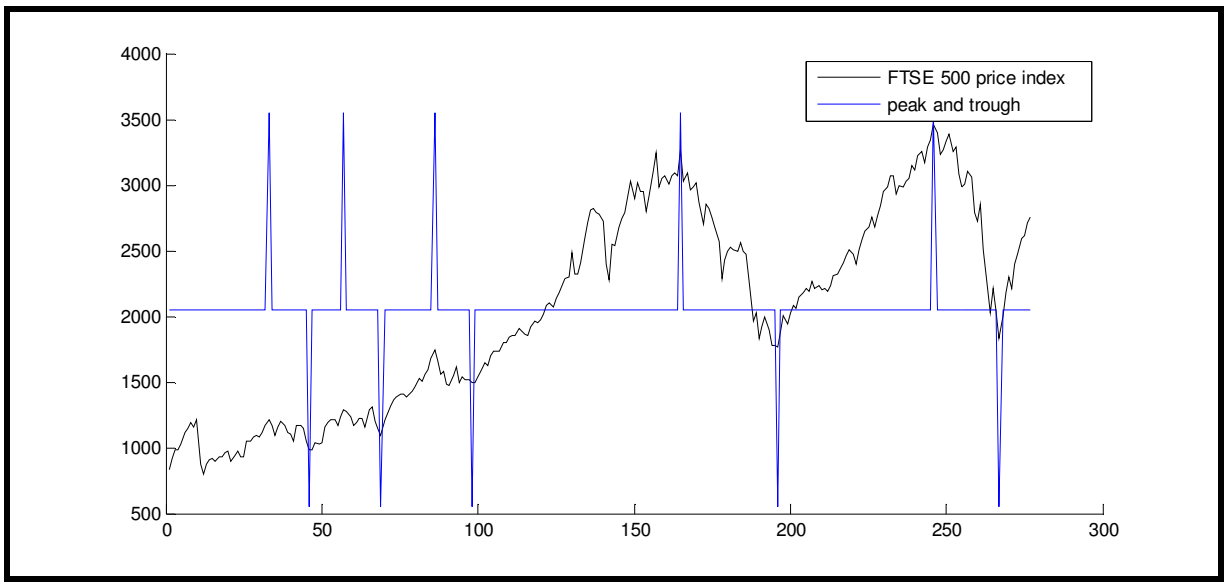
Graph 5. BB algorithm on the Halifax price index



Graph 6. BB algorithm on the REIT UK price index



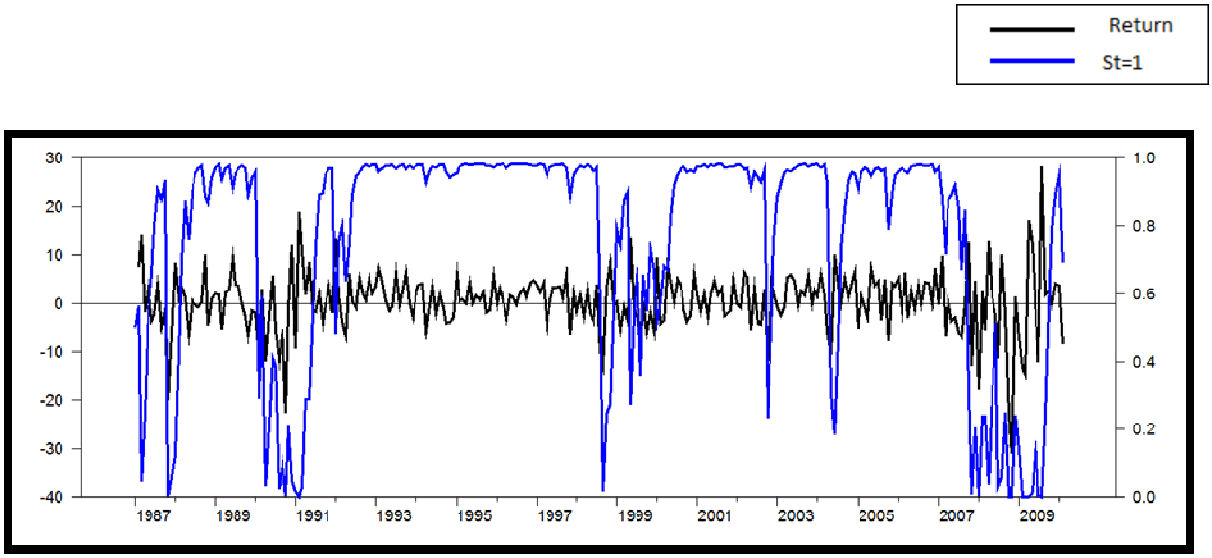
Graph 7. BB algorithm on the IPD



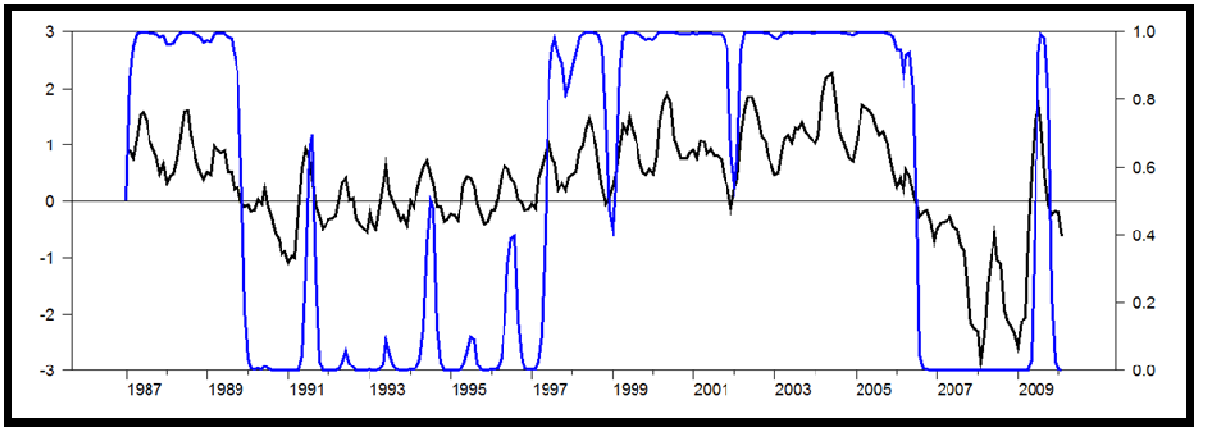
Graph 8. BB algorithm on FTSE 500 price index

Appendix 4

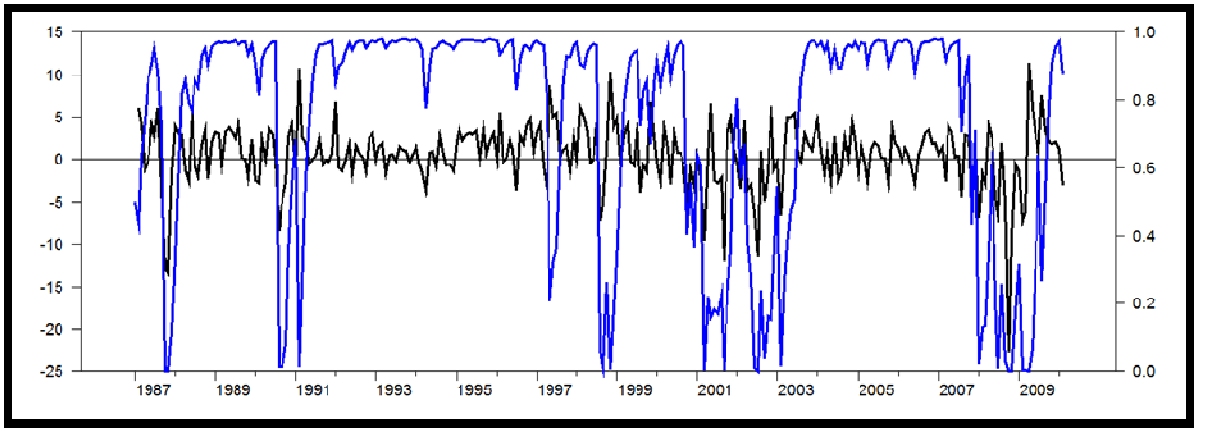
Dating recessions in US using the MSM (US data)



Graph 9. REIT return and probability of being in expansion



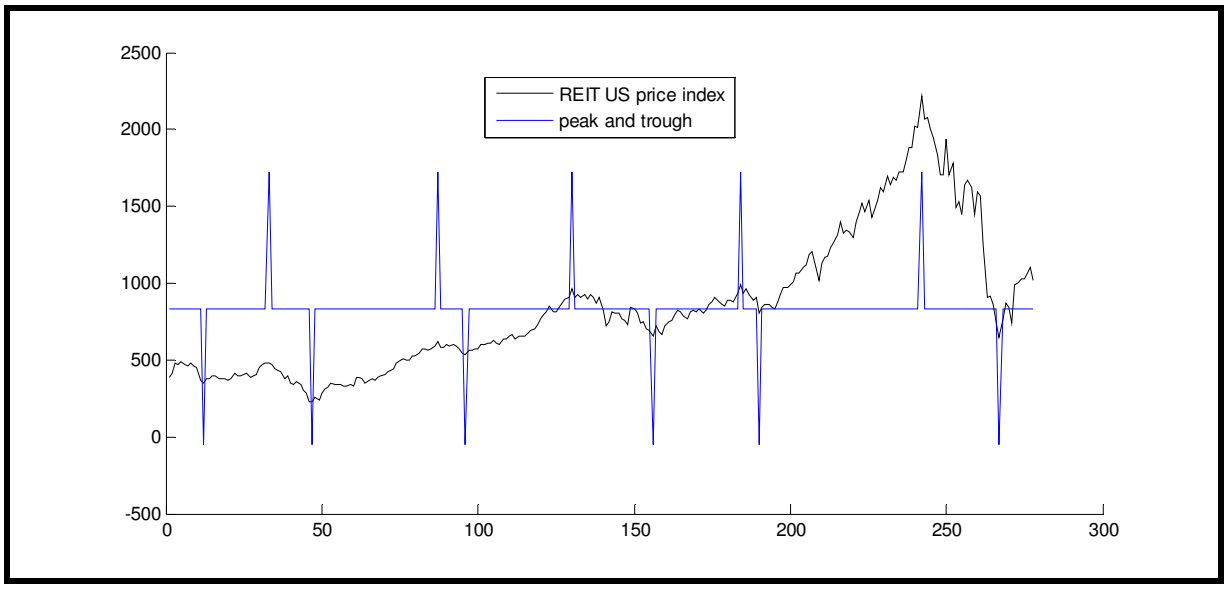
Graph 9. SP/CS 10 composite return and probability of being in expansion



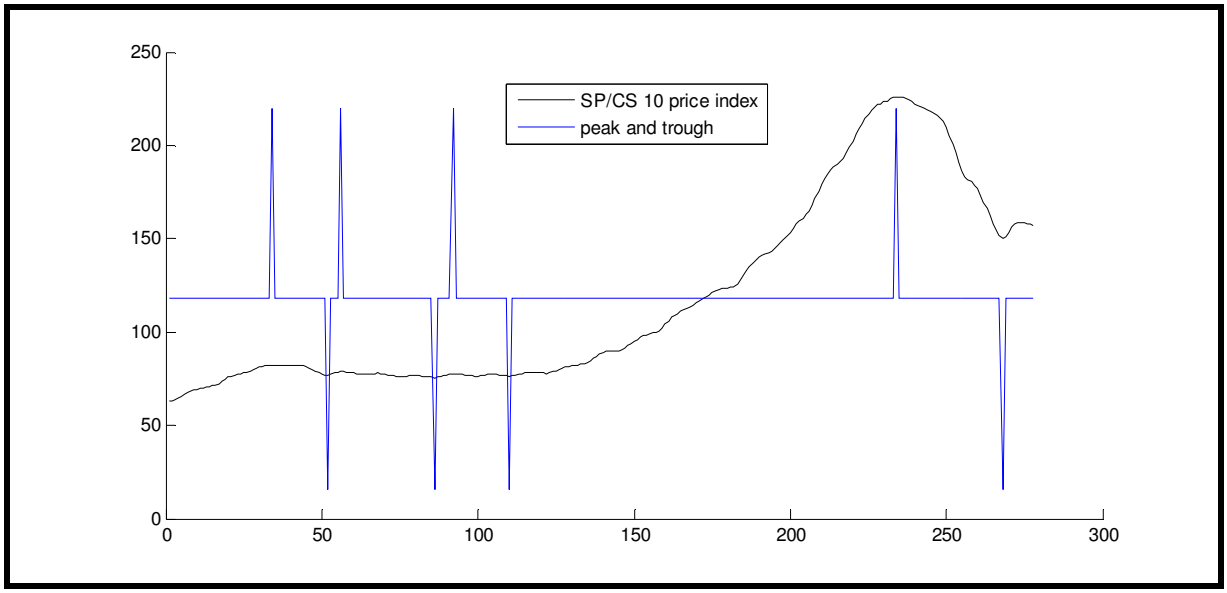
Graph 9. S&P 500 return and probability of being in expansion

Appendix 5

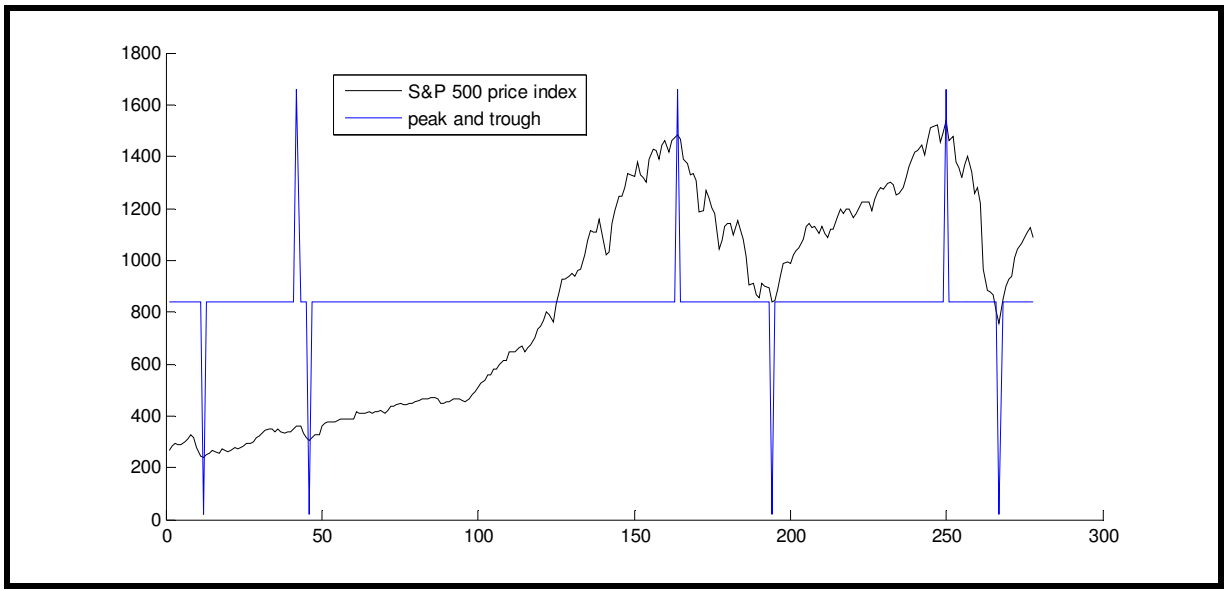
Graphs of dating recessions using the BB algorithm (US data)



Graph 10. BB algorithm on the REIT US price index



Graph 11. BB algorithm on the SP/CS 10 composite price index



Graph 12. BB algorithm on the S&P 500 price index

Appendix 6

Table 2. Dating recessions using the BB algorithm (UK data)

Halifax		REIT		IPD		FTSE 500	
Start**	**End*****	**Start****	**End*****	**Start****	**End*****	**Start****	**End*****
07/1989	02 /1993	09/1989	09/1992	01/1990	07/1991	12/1989	09/1990
						08/1991	08/1992
07/1994	01/1996	02/1994	12/1994			01//1994	06/1994
		04/1998	02/2000			12/1999	01/2003
		05/2002	04/2003				
08/2007	03/2009	02/2007	03/2009	07/2007	06/2009	05/2007	02/2009

** Identify a peak in the graphs of the BB algorithm
***Identify a trough in the graphs of the BB algorithm

Table 3. Dating recessions using the MSM (UK data)

Halifax		REIT		IPD		FTSE 500	
Start	**End**	**Start**	**End**	**Start**	**End**	**Start**	**End**
10/1989	02/1993	07/1987	03/1988	05/1988	01/1989	01/1987	12/1992
11/1993	01 /1996	05/1992	12/1992	05/1990	04/1994	03/1994	10/1994
						09/1997	05/2003
05/2007	04/2009	11/2007	09/2009	01/2007	06/2009	02/2008	08/2009'

Table 3. Dating recessions using the BB algorithm (US data)

REIT		SP/CS10		S&P 500	
Start**	**End*****	**Start****	**End*****	**Start****	**End*****
XXXX	12/1987			XXXX	12/1987
09/1989	11/1990	10/1989	04/1991	06/1990	10/1990
		08/1991	02/1994		
03/1994	12/1994	08/1994	02/1996		
10/1997	12/1999				
04/2002	10/2002			08/2000	02/2003
02/2007	03/2009	06/2006	04/2009	10/2007	03/2009

XXXX : means that the start date is out of the sample (before January 1987).
** Identify a peak in the graphs of the BB algorithm
***Identify a trough in the graphs of the BB algorithm

Table 4. Dating recessions using the MSM (US data)

REIT		SP/CS10		S&P 500	
Start	**End**	**Start**	**End**	**Start**	**End**
02/1987	01/1988			07/1987	03/1988
04/1990	04/1991	01/1990	03/1997	08/1990	06/1991
09/1998	03/2000			08/1998	02/2003
11/2007	08/2009	08/2006	05/2009	01/2008	05/2009