Defining and Dating Bull and Bear Markets: Two Centuries of Evidence

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Despite widespread media interest in bull and bear markets, academic research that seeks to formally define bull markets is almost non-existent. This paper defines bull and bear markets in relation to a simple model of mean return regimes, and implements the definition using two formal turning point detection methods to demonstrate that two centuries of stock index returns can be separated into economically and statistically significant bull and bear market states. In-sample analysis of the turning points identified by the detection procedures is consistent with a two-state mean return model, a result that has important implications for capital asset pricing theory. The paper also examines the distinct return characteristics and the persistent duration of the bull and bear market states that are identified, and tests the superior out of sample performance of ex-ante trading rules developed from the turning point detection procedures (JEL: E32; G12; E44; C22).

Keywords: stock market, bulls and bears, turning point dating.

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I. Introduction

One of the most widely discussed topics in the financial media is the phenomenon of bull and bear markets, and the importance of bull versus bear markets to the investment community as well as the wider economy appears to be obvious. Despite this widespread agreement on the importance of bull and bear markets, it is unclear what financial commentators mean when they use these terms because there are no accepted definitions, a lack of a general consensus regarding many bull and bear market turning points, and almost no academic research on the subject. This contrasts sharply with the widely agreed-upon business cycle turning points provided by the National Bureau of Economic Research (NBER) that have achieved semi-official status for the United States economy and are the subject of considerable research.

The dearth of academic research on bull and bear market cycles can be explained by financial researchers' belief during the past thirty years that stock market prices follow a random walk with relatively constant drift, thus implying that bull and bear markets are simply the result of ex-post categorization of essentially random data. Recent research has questioned whether a random walk model with a constant drift term can explain observed asset pricing phenomenon, however, and instead suggests that the level of expected returns might change through time due to shifts in risk aversion or other underlying economic reasons (Cochrane [1997], [1999], [2001], Campbell and Cochrane [1999], Campbell [2000]). Recent empirical evidence of time-varying mean returns and considerable media interest in bull and bear markets imply that the development of a formal method to define and date bull and bear markets can be timely and important. This paper introduces a formal definition of bull and bear markets that is implemented using two objective turning point detection procedures, and examines whether the procedures identify statistically and economically distinct bull and bear market states that are consistent with a simple model of time-varying mean return parameter shifts.

The bull market definition introduced in the paper identifies bull markets according to their widely agreed-upon characteristic of "persistently" rising share prices, and the definition is implemented on two centuries of share index data using formal turning point procedures. The first bull and bear market turning point detection procedure seeks to find local peaks and troughs in stock index series, and defines bull markets as the periods between troughs and peaks, subject to the

requirement that the intervening time intervals contain sufficiently "persistent" gains. This approach borrows heavily from the algorithm developed by Bry and Boschan (1971) to determine turning points in the business cycle (see also Harding and Pagan [2002], Pagan and Sossounov [2003]).

A second approach identifies bull markets as ongoing periods of higher than usual returns, and bear markets as sustained periods containing lower than normal returns, with bull and bear market turning points being detected when the stock index return series switches from one state to the other. The relative return aspect of this second procedure is borrowed from the Initial Public Offering literature's definition of hot issue markets (Ibbotson and Jaffe [1975]), whereas the sustained ("persistent") aspect is imposed using an NBER-style minimum phase length requirement. Implementation of the procedure utilizes a modified counts cumulative sum (cusum) technique that counts the number of high return windows surrounding each particular month and detects whether this count has shifted in a sustained manner. Once bull and bear market turning points are identified and examined in sample, the consistency of the turning points as well as the duration of the bull and bear market phases identified by the two formal turning point detection procedures are tested and the characteristics of bull and bear markets are investigated. The analysis also examines whether the properties of bull markets can have a practical relevance to investors who are interested in market timing, including rolling out of sample tests of ex-ante trading rules that utilize bull and bear market turning points once they are detected.

The study's results provide a number of useful insights, in addition to the trading rule findings. The two methods used to implement the paper's formal definition of bull and bear markets identify fairly similar bull and bear market turning points and phase durations, even though the implementation procedures are quite different. Objective dating, testing, and characterization of bull and bear market cycles over two centuries also enhances our understanding of the persistent nature of stock market cycles, and can promote future research that attempts to economically explain stock market cyclical behavior. In-sample tests of the turning points identified by the turning point detection procedures are consistent with a simple model of time-varying mean return parameter shifts, and also indicate that the duration of bull and bear market phases are inconsistent with a random walk model with constant drift. These results have implications for the construction and testing of

capital asset pricing theory models with respect to the appropriate specification of the expected CAPM risk premium in each state (see Campbell and Cochrane [1999], Gordon and St. Amour [2000]). The paper's analysis also indicates that early warning signs of subsequent poor returns provided by share price index turning points can be important to investors with an interest in market timing.

The organization of the paper is as follows. Section II provides a review of the literature on bull and bear markets and their characteristics. Details of the bull and bear market definition and turning point detection procedures are provided in section III, while data sources and collection methods are described in section IV. Section V presents empirical results and the paper is concluded in section VI.

II. Stock Market Turning Point Literature

Bull and bear market turning points are talked about extensively in the financial media, but the turning point dates that are discussed do not appear to be determined by formal, consistent, and quantifiable rules. There is also an almost complete absence of academic research on the subject. Stock market turning point dating methods that do exist appear to implicitly use informal variants of the National Bureau of Economic Research (NBER) rules for dating the business cycle (see the discussion in Pagan and Sossounov [2003]).

Pagan and Sossounov (2003) formalize the application of NBER rules to the problem of dating stock market turning points by extensively modifying the algorithm Bry and Boschan (1971) develop to formally replicate NBER business cycle turning points. Pagan and Sossounov (2003) do not smooth the data, since large equity market prices changes are some of the most interesting data points. A local stock index peak (trough) is defined as a point that is higher (lower) than all points that are eight months either side. A cycle is required to last at least 16 months whereas a phase is required to last a minimum of four months, and the minimum phase length is ignored if the stock price index rises or falls by 20% in a single month.

Hardouvelis and Theodossiou (2002) study the effects of margin requirements on stock market volatility during bull and bear markets. Noting the lack of a widely accepted definition of bull markets, they implicitly adopt an NBER-style minimum phase length requirement and define bull (bear) markets as N consecutive months of positive

(negative) index returns (N = 3, 4, 5 or 6). They find that volatility and mean returns are lower when initial margin requirements are higher during bull markets.

An alternative method for identifying bull and bear market turning points is that of Hamilton regime switching (Hamilton [1989], Maheu and McCurdy [2000], see also Assoe [1998], Brailsford et al. [2000]). Maheu and McCurdy (2000) define bull and bear markets as high return, stable states and low return, volatile states, respectively. The stock market is estimated to spend 90% of its time in bull markets in their study. Assoe (1998) finds evidence of regime-switching in emerging markets that could be interpreted in relation to bull and bear markets.

Gordon and St. Amour (2000) introduce a consumption-based asset pricing model in which bull and bear markets are defined as alternating periods of low or high risk aversion using two-state Markov preference regimes. Turning points of preferences are not directly observable, so bull and bear market share index turning points are implied by the joint estimation of the model. The model is tested using stock index data from 1960 to the present, and at least two bear markets are indicated by the analysis.

Technical trading rule studies do not directly attempt to identify bull and bear markets, but the performance of trading rules that rely upon return continuance would be enhanced by the existence of statistically and economically significant bull and bear markets (see, e.g., Sullivan, Timmermann and White [1999], Fung et al. [1999]). One such technical trading rule is the filter rule whereby a stock index or an individual stock is purchased if it has already risen X percent from its recent low, and is sold if it has fallen X percent from its recent high (Alexander [1961], Fama and Blume [1966]). X percent filter rules require a definition of "recent high" and "recent low" before they can be implemented, so they share a common feature with NBER -style turning point identification techniques that have to define intermediate peaks and troughs when formally dating turning points. Brock, Lakonishok, and LeBaron (1993) find that filter rules perform well on the Dow Jones Industrial Average.

III. Bull and Bear Markets

A. Bull and Bear Markets as Mean Return Regimes

A statistical process with time-varying switches in the mean return parameter can be used to introduce a definition of bull and bear markets as potentially distinct and persistent mean return states (Pastor and Stambaugh [2000]). A time series process for capital returns R_t can be considered where the distribution of the change in the natural logarithm of the share price index R_t is normal with return standard deviation σ. The mean of the process is μ_k in each bull or bear market phase k (k = 1,…,K). The statistical process for R_t is assumed to be subject to alternating upwards and downwards bull and bear market mean return parameter shifts of potentially varying magnitudes and timing, so the mean parameter μ_k shifts by an amount Δ_{t+j} whenever a mean value regime switch occurs at a time $t+j$. The new mean parameter value μ_{k+1} in the new regime $k + 1$ therefore switches at mean value regime switch time $t + j$ to:

$$\mu_{k+1} = \mu_k + \Delta_{t+j} \qquad (1).$$

The time t value of $R_{t,k+1}$ during regime $k + 1$ is:

$$R_{t,k+1} = \mu_{k+1} + \varepsilon_t \qquad (2)$$

where:

$$\varepsilon_t - N\,(0, \sigma^2) \qquad (3)$$

and the mean of the distribution is given by equation (1). The conditional distribution is therefore a mixture of normals.

A bull or bear market turning point is formally defined as the point in time $t + j$ when the mean return parameter shifts to parameter value μ_{k+1} in the new regime $k + 1$, subject to a requirement that the change in state be sufficiently "sustained" before it is recognized so that the definition reflects the widely-agreed upon bull market characteristic of "persistently" rising share prices. The shift in the mean at time $t + j$, Δ_{t+j}, is itself not observable, so formal turning point detection procedures are utilized to implement this definition of bull and bear markets, and the terms "persistent" and "sustained" are also made precise in the implementation procedures, as outlined

B. The BB Turning Point Detection Method

The first formal detection procedure for defining and identifying bull and bear market turning points is referred to as the BB method since it closely follows the algorithm developed by Bry and Boschan (1971) to

replicate turning points in the business cycle published by the NBER. Points higher or lower than those on five months to either side are first identified. The highest of multiple peaks or the lowest of multiple troughs are then selected. A phase (peak to trough or trough to peak) must provide an absolute cumulative capital return of 10%, thus capturing the "persistent" aspect of bull or bear markets.[1] The data are also not smoothed.

The bull and bear market turning points detected by the BB method can be used in trading rules that utilize ex-ante information only, once account is taken of the lag with which the turning points are detected. Out of sample rolling tests of the trading rules provide an indication of the potential usefulness of the bull market turning point detection procedures to investors who are interested in market timing, and can also further characterize the bull and bear markets that are identified. The BB method requires that index values five months to either side of a particular month be examined before that month can be detected as a turning point, so ex-ante trading rules that use the BB method turning points are implemented with a six month lag.[2]

A simple trading rule based on the BB method (referred to as the "conservative" BB method trading rule) provides a stock market buy signal six months after a BB method bull market turning point, with all cash being invested in the stock market index at this time. It is a conservative trading rule because a complete sell signal is provided six months after a BB method bear market turning point, with all the money obtained from the stock index sale being reinvested in safe short-term treasury bills until the next buy signal is received. The conservative trading rule strategy therefore provides the index total return when invested in the stock market, and the risk-free Treasury bill return otherwise.

A "leveraged" BB method trading rule strategy is also examined. It is made slightly more risky than the "conservative" trading rule by

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1. The BB method therefore departs from the Bry and Boschan requirement that a phase last for at least five months. The results of the study are insensitive to this alternative phase length requirement (results not reported). The Bry and Boschan requirement that a complete cycle (peak to peak or trough to trough) must last at least 15 months is also discarded. The results are also insensitive to this requirement, especially since it would not have been imposed during the most recent 100 years of the sample.

2. It is also not always possible to eliminate all intermediate peaks or troughs when utilizing the BB method in ex-ante trading rules, so some intermediate peak or trough turning points are acted upon in the trading rule.

having investors borrow the equivalent of 100% of their cash holdings when a BB method trading rule buy signal is received, so the stock index position purchased is equal to two times the existing cash holding. The leveraged BB method trading rule strategy requires that all index holdings be sold (and converted to short term treasury bills) when a BB method trading rule sell signal is received. The leveraged strategy therefore provides two times the total index rate of return, minus the Treasury bill rate, when invested in the stock index, and the Treasury bill rate of return otherwise.[3]

C. The CC Turning Point Detection Method

A second turning point detection method formally defines bull and bear markets as sustained, "persistent" periods of above median or below median returns as the mean return parameter shifts into a persistently high or low return state (see equations (1) to (3)). This formal detection method utilizes a modification of a counts cusum (CC) procedure, so it is named the CC method. The CC method examines whether stock returns are either high or low relative to median returns, a consideration that was first used in the separation of new issue markets into "hot" and "cold" IPO return months in Ibbotson and Jaffe (1975). When combined with an NBER-style rule for the minimum length of cycle phases, the CC turning point detection method captures the idea that bull markets correspond to sustained ("persistent") periods of enhanced returns and financial well-being (see, for instance, Gitman and Joehnk [1996]).

The CC method is implemented using a modification of a counts cusum procedure (see Xiao, [1992]). Count cusum procedures detect shifts in a statistical process by qualitatively characterizing data points according to whether they have a certain feature (for instance, each data point might or might not be higher than the expected mean or median of the data set). The number of times that the data is counted as having this feature is then cumulated, and if the cumulation reaches a sufficiently high or low level then a significant shift in the process is detected.

To classify a specific month (say month *n*), an 11-month window consisting of month n as well as the five months on either side of month *n* is applied. In this window, six distinct periods lasting six months each

3. The "borrowing to invest" component of the leveraged trading rule is therefore implicitly implemented using index futures (or treasury bill short sales). An alternative would be to implement the strategy using margin purchases that would incur a slightly higher borrowing cost.

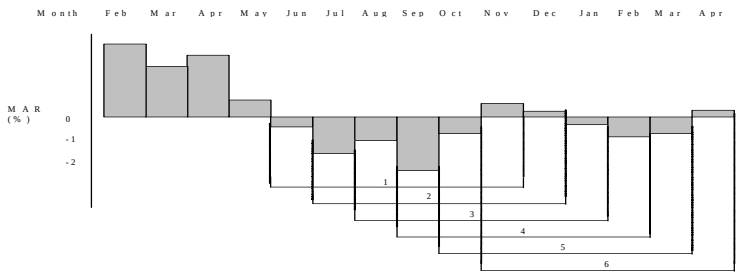

FIGURE 1.— Visual Demonstration of the CC Method.

Note: This figure displays the concept of an eleven-month window in which six distinct six-month periods are examined. These six-month periods are labeled 1 to 6 in the diagram, and the eleven-month window runs from June to April of the following year. The bars in the diagram represent the median-adjusted returns for each month. Prior to the beginning of the window, the median adjusted returns are above zero, and the months had been classified as bull market months. In the eleven–month window studied (June to April above) the majority of the median adjusted monthly returns are negative and thus the average median adjusted return in each six–month period in the window will be negative. This will result in month *n* (November) being assigned a count value (Y_n) of zero, as none of the surrounding six-month periods have positive median adjusted returns. The months prior to this eleven-month period had been identified as bull states (characterized by high assigned values of Y_n), so a switch of states is indicated, and the longest runs rule would identify June as the beginning of the bear market. A run of five months with negative returns begins in June and this is the longest run of negative returns closest to month *n*.

are examined. The first period consists of months $n - 5$ to n, the second contains months $n - 4$ to $n + 1$, and so on, up to the final period consisting of months n to $n + 5$ (see figure 1). Returns in each six-month period are compared to a median level of returns, so the procedure is closely related to stochastic trend decompositions (see e.g., Campbell et al. [1997]).[4] Month n is then assigned a value (Y_n) between zero and six based upon the number of six-month periods in the window with

4. A 25-year rolling median for monthly returns is used in the CC method. An alternative would be to use the median for the entire sample, but this would not allow for changes in the ongoing level of returns due to factors such as significant changes in risk premiums or inflation between decades or centuries. A 25-year rolling median was chosen (rather than a rolling median for a shorter time period) to avoid spurious fluctuations in the median. The median value was chosen for the benchmark instead of the mean value because it is less affected by extreme observations. A full 25-year period is not available at the start of the data set so the median for the first 25-year period is used in this situation.

positive median-adjusted returns. A value of six indicates that all periods in the surrounding window have above median returns and thus provides a strong indication of a high mean return state, while a value of zero indicates that all six periods have below median returns and thus provides evidence of a poor return state (see equations (1) to (3)). There is no requirement that CC bear market average returns be negative in order for a poor return state to be indicated, just that they be less than the median, but in practice completed low return phases always end up having negative capital returns (see the results section).

A switch in the return state is detected when the count value Y_n passes from one side of three to the other side. For example, if the market is in a bear market state characterized by low values of Y_n, a break to a bull market state is indicated when Y_n rises to four. Similarly, a break to a new bear market phase is indicated when the value of Y_n falls from above three to two. In order to ensure that switches are only identified when a decisive break has occurred, the value of Y_n must hit one or five (after passing through three) in order for a break to be accepted. An NBER-style five-month minimum phase length requirement is also imposed. The eleven-month window used in the CC method (and the BB method) tends to enforce this minimum phase length requirement, thus emphasizing the definition of bull markets as states with "persistently" high returns. The NBER-style five-month minimum phase length requirement is ignored, however, if a particular month has a return of positive or negative 20% (see, also, Pagan and Sossounov [2003]). The starting point for a switch in states is identified as the start of the longest run of above median monthly returns closest to the point where Y_n rises above three in a new bull market state or the start of the longest run of below median monthly returns closest to the point where Y_n falls through three in a new bear market.

The CC method is an ex-ante detection method, so "conservative" and "leveraged" CC method ex-ante trading rules that follow the pattern of the BB method trading rules can be implemented and tested using six-month lagged CC method trading rule buy or sell signals when the count value Y_n takes on a value of either five or one. A trading rule that pays attention to both BB and CC method trading signals is also possible, and is therefore tested as well. It is highly unlikely that the CC method could identify a relatively high return state when the BB method has already indicated that the index is falling, but it is possible that the CC method could sometimes identify a switch to a low return state more quickly than the BB method. The combined BB/CC trading rule

therefore relies upon the CC method to provide a trading rule sell signal, with the BB method being relied upon to provide a trading rule buy signal.

IV. Data Sources

Bull and bear markets are considered to be broad market movements that can be illustrated using low frequency data and the longest possible time series of stock index data. By combining several indices, a monthly stock price index that runs from January 1800 through December 2001 is created for this study.

Schwert (1990) creates an index of stock prices that runs from 1802 to 1925 by splicing together and combining the best available stock market indices for the period.[5] The Schwert (1990) stock index is mainly composed of railroad, insurance and banking stocks for the period prior to 1885. Over the period 1885 to 1925, Schwert uses the Dow Jones index of industrial and transportation stocks. The Schwert stock index data is used for the period up until 1925, with data from the Global Financial Data index for 1800 and 1801 added to the beginning of the series. For the period 1926 to 1956, a stock index based on 90 U.S. stocks constructed by Standard and Poor's (S&P) is used, with the S&P 500 stock index being used from 1956 onwards.[6]

Nominal capital returns are used to identify bull and bear markets. There are many factors that support this procedure, in addition to precedent. Dividends for the early nineteenth century are generally unavailable or unreliable. Schwert (1990) estimates the unknown dividend yield from 1802 to 1870 using percentage changes in stock prices, as it has been found that dividend yields are related to capital gains (Fama and French [1988]). Schwert reports that periods for which dividend data is available reveal that the variation in dividend yields is small relative to the variation in stock prices, and capital returns are highly correlated with total returns. Bull and bear market turning points are therefore identified using capital returns, but all regression results

5. Schwert (1990) provides full information on the Schwert index and the statistical behavior of the spliced index series.

6. Schwert (1990) recommends that the Dow Jones capital index be used for the time period 1885 to 1925 (rather than the Cowles index that is used in the S&P Composite Index), so the Schwert (1990) recommendation is followed for this time period.

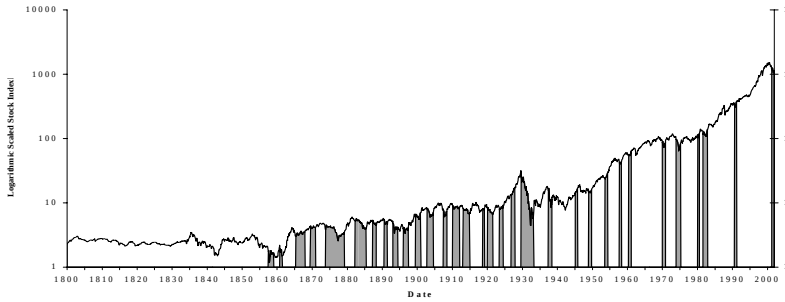

FIGURE 2.— The Stock Index Level for the entire sample (January 1800 – December 2001).

Note: Business cycle peaks and troughs reported by the NBER during the period for which they are available (December 1854 – December 2001) are also graphically presented. Note that shaded areas underneath the stock market index represent US business cycle recessions. Index scale is noted on the vertical axis of the graph.

are also estimated using total returns as well as capital returns. The total return results are virtually identical to capital return results, and are therefore not always reported. Nominal returns rather than real returns are used, again due to precedent, but also because of the limitations of nineteenth century inflation measures; the study also emphasizes differences in returns between bull and bear market phases, a magnitude that is very unlikely to be affected by deflating both.

The level of the stock index is presented in figure 2. The series shows a strong overall upward trend over time, but some large market movements such as the crash of 1929 and the effects of the Great Depression during the 1930s are also evident. The shaded areas of figure 2 represent NBER recessions for the time period beyond 1854, since recessions are a significant stock market risk factor. It is apparent that most recessions (26 of 31) overlap with market downturns, but it is also interesting to note that the sharpest stock market falls during the last half century (such as the 1987 crash and the 1962 stock market fall) were unaccompanied by recessions.[7]

7. We thank an anonymous referee for pointing this out.

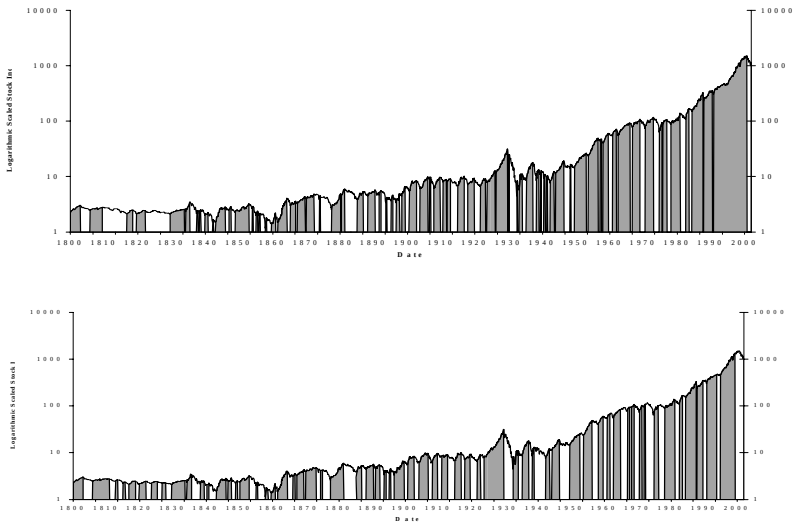

FIGURE 3.— Bull and Bear Markets.

Note: This figure graphically presents bull and bear market phases detected by the BB and CC Methods for the period January 1800 – December 2001. Note that shaded areas underneath the stock market index represent bull markets. Index scale is noted on the vertical axis of the graph.

V. Empirical Results

A. Turning Points and Characteristics of Bull and Bear Markets

Bull and bear market phases detected by the BB and CC methods are presented in tables 1A and 1B and are graphically illustrated in figure 3. Both turning point detection methods indicate the same starting points for well-known bear markets such as the 1929 and 1987 stock market crashes, and also identify the prolonged upturns leading up to these crashes as well as other significant bull market periods, including the powerful bull market that lasted through most of the nineties.

The consistency with which the BB and CC methods identify bull and bear markets is illustrated in figure 4, where BB and CC method bull and bear market phases and mean phase returns are graphed for the most recent time period. Most bull market turning points provided by the BB and CC methods during the last half century are identical (nine), whereas four bull market switches are first identified by the BB method.

TABLE 1A. BB Method Peaks and Troughs: January 1800 – December 2001

Peak to Trough Dates	Mean Phase Capital Return	Trough to Peak Dates	Mean Phase Capital Return
		Jan 1800 – Dec 1801	0.0083
Dec 1802 – Oct 1805	–0.0062	Oct 1805 – Jun 1809	0.0029
Jun 1809 – Sep 1816	–0.0030	Sep 1816 – Jun 1818	0.0078
Jun 1818 – Jul 1819	–0.0122	Jul 1819 – Mar 1822	0.0048
Mar 1822 – Jul 1829	–0.0018	Jul 1829 – Oct 1833	0.0042
Oct 1833 – Feb 1834	–0.0298	Feb 1834 – May 1835	0.0292
May 1835 – Jun 1837	–0.0183	Jun 1837 – Nov 1837	0.0292
Nov 1837 – Apr 1838	–0.0284	Apr 1838 – Sep 1838	0.0357
Sep 1838 – Nov 1839	–0.0163	Nov 1839 – Oct 1840	0.0112
Oct 1840 – Mar 1842	–0.0224	Mar 1842 – Jun 1842	0.0406
Jun 1842 – Jan 1843	–0.0183	Jan 1843 – Dec 1845	0.0195
Dec 1845 – Jan 1847	–0.0111	Jan 1847 – Aug 1847	0.0246
Aug 1847 – Nov 1848	–0.0168	Nov 1848 – Dec 1852	0.0082
Dec 1852 – Nov 1853	–0.0188	Nov 1853 – Mar 1854	0.0251
Mar 1854 – Jan 1855	–0.0365	Jan 1855 – Jul 1855	0.0306
Jul 1855 – Nov 1855	–0.0459	Nov 1855 – Apr 1856	0.0206
Apr 1856 – Oct 1857	–0.0315	Oct 1857 – Mar 1858	0.0956
Mar 1858 – Jul 1859	–0.0153	Jul 1859 – Oct 1860	0.0316
Oct 1860 – Jul 1861	–0.0387	Jul 1861 – Mar 1864	0.0335
Mar 1860 – Mar 1865	–0.0237	Mar 1865 – Oct 1866	0.0100

(*Continued*)

TABLE 1A. (Continued)

Peak to Trough Dates	Mean Phase Capital Return	Trough to Peak Dates	Mean Phase Capital Return
Oct 1866 – Apr 1867	–0.0203	Apr 1867 – Aug 1869	0.0113
Aug 1869 – Dec 1869	–0.0252	Dec 1869 – Apr 1872	0.0080
Apr 1872 – Nov 1873	–0.0127	Nov 1873 – Feb 1874	0.0608
Feb 1874 – Jun 1877	–0.0138	Jun 1877 – Mar 1880	0.0206
Mar 1880 – May 1880	–0.0608	May 1880 – May 1881	0.0282
May 1881 – Jan 1885	–0.0093	Jan 1885 – Nov 1886	0.0158
Nov 1886 – Mar 1888	–0.0118	Mar 1888 – May 1890	0.0106
May 1890 – Jul 1891	–0.0153	Jul 1891 – Feb 1892	0.0288
Feb 1892 – Jul 1893	–0.0279	Jul 1893 – Nov 1893	0.0592
Nov 1893 – Feb 1895	–0.0092	Feb 1895 – Aug 1895	0.0431
Aug 1895 – Aug 1896	–0.0266	Aug 1896 – Aug 1897	0.0346
Aug 1897 – Apr 1898	0.0137	Apr 1898 – Apr 1899	0.0367
Apr 1899 – Jun 1900	–0.0130	Jun 1900 – Aug 1902	0.0180
Aug 1902 – Sep 1903	–0.0262	Sep 1903 – Jan 1906	0.0189
Jan 1906 – Jun 1906	–0.0207	Jun 1906 – Nov 1906	0.0197
Nov 1906 – Oct 1907	–0.0417	Oct 1907 – Sep 1909	0.0217
Sep 1909 – Jul 1910	–0.0207	Jul 1910 – Jul 1911	0.0101
Jul 1911 – Sep 1911	–0.0511	Sep 1911 – Sep 1912	0.0118
Sep 1912 – Nov 1914	–0.0113	Nov 1914 – Oct 1916	0.0190
Oct 1916 – Nov 1917	–0.0273	Nov 1917 – Oct 1919	0.0134

(*Continued*)

TABLE 1A. (Continued)

Peak to Trough Dates	Mean Phase Capital Return	Trough to Peak Dates	Mean Phase Capital Return
Oct 1919 – Aug 1921	–0.0153	Aug 1921 – Feb 1923	0.0189
Feb 1923 – Jul 1923	–0.0320	Jul 1923 – Dec 1925	0.0178
Dec 1925 – Mar 1926	–0.0349	Mar 1926 – Aug 1929	0.0259
Aug 1929 – Nov 1929	–0.1273	Nov 1929 – Mar 1930	0.0473
Mar 1930 – Jun 1932	–0.0564	Jun 1932 – Aug 1932	0.3755
Aug 1932 – Feb 1933	–0.0600	Feb 1933 – Jan 1934	0.0730
Jan 1934 – Mar 1935	–0.0184	Mar 1935 – Feb 1937	0.0343
Feb 1937 – Mar 1938	–0.0523	Mar 1938 – Dec 1938	0.0538
Dec 1938 – Jun 1939	–0.0299	Jun 1939 – Sep 1939	0.0674
Sep 1939 – May 1940	–0.0379	May 1940 – Oct 1940	0.0366
Oct 1940 – Apr 1941	–0.0281	Apr 1941 – Jul 1941	0.0372
Jul 1941 – Apr 1942	–0.0330	Apr 1942 – Jun 1943	0.0350
Jun 1943 – Nov 1943	–0.0218	Nov 1943 – May 1946	0.0192
May 1946 – Feb 1948	–0.0141	Feb 1948 – Jun 1948	0.0463
Jun 1948 – Jun 1949	–0.0129	Jun 1949 – Dec 1952	0.0156
Dec 1952 – Aug 1953	–0.0159	Aug 1953 – Jul 1956	0.0223
Jul 1956 – Feb 1957	–0.0184	Feb 1957 – Jul 1957	0.0207
Jul 1957 – Dec 1957	–0.0351	Dec 1957 – Jul 1959	0.0222
Jul 1959 – Oct 1960	–0.0078	Oct 1960 – Dec 1961	0.0214
Dec 1961 – Jun 1962	–0.0429	Jun 1962 – Jan 1966	0.0127

(*Continued*)

TABLE 1A. (Continued)

Peak to Trough Dates	Mean Phase Capital Return	Trough to Peak Dates	Mean Phase Capital Return
Jan 1966 – Sep 1966	–0.0235	Sep 1966 – Nov 1968	0.0140
Nov 1968 – Jun 1970	–0.0199	Jun 1970 – Dec 1972	0.0168
Dec 1972 – Sep 1974	–0.0281	Sep 1974 – Jun 1975	0.0478
Jun 1975 – Sep 1975	–0.0411	Sep 1975 – Dec 1976	0.0173
Dec 1976 – Feb 1978	–0.0146	Feb 1978 – Nov 1980	0.0156
Nov 1980 – Jul 1982	–0.0130	Jul 1982 – Jun 1983	0.0426
Jun 1983 – May 1984	–0.0097	May 1984 – Aug 1987	0.0212
Aug 1987 – Nov 1987	–0.1091	Nov 1987 – May 1990	0.0158
May 1990 – Oct 1990	–0.0333	Oct 1990 – Aug 2000	0.0144
Aug 2000 – Dec 2001	–0.0159		

Note: A bear (bull) phase starts at the beginning of the month following the peak (trough) date. Mean phase capital returns represent the average capital return in each phase. The last phase is incomplete, so the mean phase return is computed using data up to December 2001.

TABLE 1B. CC Method Turning Points: January 1800 – December 2001

Switch Dates (Low Return Phase)	Mean Phase Capital Return	Switch Dates (High Return Phase)	Mean Phase Capital Return
Jan 1800 – Dec 1802	0.0083		
Dec 1802 – Oct 1805	–0.0062	Oct 1805 – Nov 1810	0.0019
Nov 1810 – Aug 1812	–0.0058	Aug 1812 – May 1813	0.0091
May 1813 – Dec 1814	–0.0094	Dec 1814 – Aug 1815	0.0092
Aug 1815 – Sep 1816	–0.0082	Sep 1816 – Sep 1818	0.0067
Sep 1818 – Oct 1819	–0.0113	Oct 1819 – Nov 1821	0.0059
Nov 1821 – Jul 1823	–0.0049	Jul 1823 – Apr 1825	0.0043
Apr 1825 – Sep 1826	–0.0058	Sep 1826 – Oct 1827	0.0032
Oct 1827 – Jul 1829	–0.0045	Jul 1829 – Aug 1833	0.0042
Aug 1833 – Feb 1834	–0.0183	Feb 1834 – Aug 1835	0.0242
Aug 1835 – Apr 1838	–0.0141	Apr 1838 – May 1839	0.0127
May 1839 – Mar 1840	–0.0192	Mar 1840 – Oct 1840	0.0143
Oct 1840 – Jan 1843	–0.0144	Jan 1843 – Dec 1845	0.0195
Dec 1845 – Jul 1846	–0.0138	Jul 1846 – Aug 1847	0.0097
Aug 1847 – Nov 1848	–0.0168	Nov 1848 – Jun 1849	0.0184
Jun 1849 – Feb 1850	–0.0090	Feb 1850 – Dec 1852	0.0101
Dec 1852 – Jan 1855	–0.0188	Jan 1855 – Jul 1855	0.0306
Jul 1855 – Oct 1857	–0.0240	Oct 1857 – Aug 1858	0.0403
Aug 1858 – Jul 1859	–0.0154	Jul 1859 – Oct 1860	0.0316
Oct 1860 – Jul 1861	–0.0387	Jul 1861 – Jun 1864	0.0302
Jun 1864 – Feb 1866	–0.0116	Feb 1866 – Oct 1866	0.0190

(*Continued*)

TABLE 1B. (Continued)

Switch Dates (Low Return Phase)	Mean Phase Capital Return	Switch Dates (High Return Phase)	Mean Phase Capital Return
Oct 1866 – Apr 1867	–0.0203	Apr 1867 – May 1869	0.0122
May 1869 – Dec 1869	–0.0125	Dec 1869 – Feb 1873	0.0057
Feb 1873 – Jun 1874	–0.0079	Jun 1874 – Jan 1875	0.0028
Jan 1875 – Jun 1877	–0.0171	Jun 1877 – May 1881	0.0191
May 1881 – May 1885	–0.0083	May 1885 – Nov 1886	0.0188
Nov 1886 – Mar 1888	–0.0118	Mar 1888 – May 1890	0.0106
May 1890 – Dec 1890	–0.0309	Dec 1890 – Apr 1892	0.0114
Apr 1892 – Jul 1893	–0.0302	Jul 1893 – Mar 1894	0.0304
Mar 1894 – Feb 1895	–0.0132	Feb 1895 – Aug 1895	0.0431
Aug 1895 – Aug 1896	–0.0266	Aug 1896 – Aug 1899	0.0208
Aug 1899 – Sep 1900	–0.0137	Sep 1900 – Aug 1902	0.0201
Aug 1902 – Feb 1904	–0.0171	Feb 1904 – Nov 1906	0.0149
Nov 1906 – Feb 1908	–0.0280	Feb 1908 – Sep 1909	0.0243
Sep 1909 – Nov 1910	–0.0113	Nov 1910 – Sep 1912	0.0051
Sep 1912 – Nov 1914	–0.0113	Nov 1914 – Oct 1916	0.0190
Oct 1916 – Nov 1917	–0.0273	Nov 1917 – Jul 1919	0.0139
Jul 1919 – Aug 1921	–0.0122	Aug 1921 – Aug 1922	0.0279
Aug 1922 – Sep 1923	–0.0108	Sep 1923 – Aug 1929	0.0205
Aug 1929 – Jun 1932	–0.0505	Jun 1932 – Jan 1934	0.0629
Jan 1934 – Mar 1935	–0.0184	Mar 1935 – Feb 1937	0.0343
Feb 1937 – Mar 1938	–0.0523	Mar 1938 – Oct 1938	0.0684

(*Continued*)

TABLE 1B. (Continued)

Switch Dates (Low Return Phase)	Mean Phase Capital Return	Switch Dates (High Return Phase)	Mean Phase Capital Return
Oct 1938 – Apr 1942	–0.0106	Apr 1942 – Jun 1943	0.0350
Jun 1943 – Feb 1944	–0.0046	Feb 1944 – May 1946	0.0187
May 1946 – Jun 1949	–0.0072	Jun 1949 – Jul 1952	0.0164
Jul 1952 – Aug 1953	–0.0062	Aug 1953 – Mar 1956	0.0245
Mar 1956 – Feb 1958	–0.0068	Feb 1958 – Jul 1959	0.0235
Jul 1959 – Oct 1960	–0.0078	Oct 1960 – Aug 1961	0.0249
Aug 1961 – Sep 1962	–0.0135	Sep 1962 – Oct 1964	0.0169
Oct 1964 – Dec 1966	–0.0017	Dec 1966 – Jul 1967	0.0246
Jul 1967 – Feb 1968	–0.0080	Feb 1968 – Nov 1968	0.0220
Nov 1968 – Jun 1970	–0.0199	Jun 1970 – Apr 1971	0.0366
Apr 1971 – Nov 1971	–0.0139	Nov 1971 – May 1972	0.0262
May 1972 – Dec 1974	–0.0137	Dec 1974 – Mar 1976	0.0286
Mar 1976 – Feb 1978	–0.0068	Feb 1978 – Mar 1981	0.0131
Mar 1981 – Jul 1982	–0.0143	Jul 1982 – Jun 1983	0.0426
Jun 1983 – May 1984	–0.0097	May 1984 – Aug 1987	0.0212
Aug 1987 – Nov 1987	–0.1090	Nov 1987 – Aug 1989	0.0209
Aug 1989 – Oct 1990	–0.0094	Oct 1990 – Oct 1993	0.0125
Oct 1993 – Nov 1994	–0.0020	Nov 1994 – Apr 1999	0.0214
Apr 1999 – Dec 2001	–0.0035		

Note: A low return (high return) phase starts at the beginning of the month following the negative (positive) switch date. Mean phase capital returns represent the average capital return in each phase. The last phase is incomplete, so the mean return for the phase is computed using data up to December 2001.

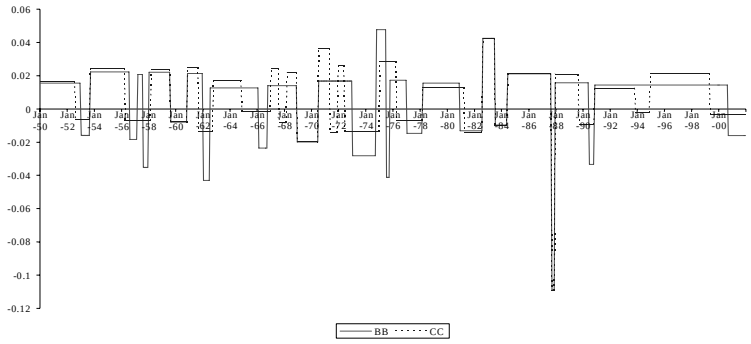

FIGURE 4.—Mean Returns for Phases Identified by the BB and CC Methods.

Note: This figure reports BB and CC method bull and bear market phases and their corresponding mean phase returns for the period January 1950 – December 2001.

Bear market switches reveal a different story, with CC method bear market switches leading BB switches in eight situations, versus four negative switches that are identically identified by both methods. A CC method switch to a low return state that begins in April 1999 was a precursor of serious market losses starting in late 2000, thus illustrating the CC method's early detection of poor return states, a feature that is most likely due to the CC method's comparison of returns with a rolling median.

Table 2 provides summary statistics for the bull and bear markets identified by the BB and CC methods.[8] Both methods identify the average duration of a bull market as being close to 22 months, whereas the BB (CC) method average bear market duration is 15 (18) months.[9] Two sample Kolmogorov-Smirnov tests reported in panel A of table 3 test the null hypothesis that there is no difference in the distribution of duration amongst BB and CC method bull and bear market Results dictate that BB method bull and bear markets are significantly different,

8. Table 3 has also been reproduced for the British stock market for the same time period and the overall results are very similar, with differences between bull market and bear market returns being slightly smaller and average bull and bear market phase durations being slightly longer (results not reported but available upon request). Analysis of international markets is beyond the scope of this paper.

9. As with the business cycle, the duration of upturns versus downturns has become much less symmetric since World War II.

TABLE 2. CC Method Turning Points: January 1800 – December 2001

Switch Dates (Low Return Phase)	Mean Phase Capital Return	Switch Dates (High Return Phase)	Mean Phase Capital Return
Jan 1800 – Dec 1802	0.0083		
Dec 1802 – Oct 1805	–0.0062	Oct 1805 – Nov 1810	0.0019
Nov 1810 – Aug 1812	–0.0058	Aug 1812 – May 1813	0.0091
May 1813 – Dec 1814	–0.0094	Dec 1814 – Aug 1815	0.0092
Aug 1815 – Sep 1816	–0.0082	Sep 1816 – Sep 1818	0.0067
Sep 1818 – Oct 1819	–0.0113	Oct 1819 – Nov 1821	0.0059
Nov 1821 – Jul 1823	–0.0049	Jul 1823 – Apr 1825	0.0043
Apr 1825 – Sep 1826	–0.0058	Sep 1826 – Oct 1827	0.0032
Oct 1827 – Jul 1829	–0.0045	Jul 1829 – Aug 1833	0.0042
Aug 1833 – Feb 1834	–0.0183	Feb 1834 – Aug 1835	0.0242
Aug 1835 – Apr 1838	–0.0141	Apr 1838 – May 1839	0.0127
May 1839 – Mar 1840	–0.0192	Mar 1840 – Oct 1840	0.0143
Oct 1840 – Jan 1843	–0.0144	Jan 1843 – Dec 1845	0.0195
Dec 1845 – Jul 1846	–0.0138	Jul 1846 – Aug 1847	0.0097
Aug 1847 – Nov 1848	–0.0168	Nov 1848 – Jun 1849	0.0184
Jun 1849 – Feb 1850	–0.0090	Feb 1850 – Dec 1852	0.0101
Dec 1852 – Jan 1855	–0.0188	Jan 1855 – Jul 1855	0.0306
Jul 1855 – Oct 1857	–0.0240	Oct 1857 – Aug 1858	0.0403
Aug 1858 – Jul 1859	–0.0154	Jul 1859 – Oct 1860	0.0316
Oct 1860 – Jul 1861	–0.0387	Jul 1861 – Jun 1864	0.0302
Jun 1864 – Feb 1866	–0.0116	Feb 1866 – Oct 1866	0.0190

(*Continued*)

TABLE 2. (Continued)

Switch Dates (Low Return Phase)	Mean Phase Capital Return	Switch Dates (High Return Phase)	Mean Phase Capital Return
Oct 1866 – Apr 1867	–0.0203	Apr 1867 – May 1869	0.0122
May 1869 – Dec 1869	–0.0125	Dec 1869 – Feb 1873	0.0057
Feb 1873 – Jun 1874	–0.0079	Jun 1874 – Jan 1875	0.0028
Jan 1875 – Jun 1877	–0.0171	Jun 1877 – May 1881	0.0191
May 1881 – May 1885	–0.0083	May 1885 – Nov 1886	0.0188
Nov 1886 – Mar 1888	–0.0118	Mar 1888 – May 1890	0.0106
May 1890 – Dec 1890	–0.0309	Dec 1890 – Apr 1892	0.0114
Apr 1892 – Jul 1893	–0.0302	Jul 1893 – Mar 1894	0.0304
Mar 1894 – Feb 1895	–0.0132	Feb 1895 – Aug 1895	0.0431
Aug 1895 – Aug 1896	–0.0266	Aug 1896 – Aug 1899	0.0208
Aug 1899 – Sep 1900	–0.0137	Sep 1900 – Aug 1902	0.0201
Aug 1902 – Feb 1904	–0.0171	Feb 1904 – Nov 1906	0.0149
Nov 1906 – Feb 1908	–0.0280	Feb 1908 – Sep 1909	0.0243
Sep 1909 – Nov 1910	–0.0113	Nov 1910 – Sep 1912	0.0051
Sep 1912 – Nov 1914	–0.0113	Nov 1914 – Oct 1916	0.0190
Oct 1916 – Nov 1917	–0.0273	Nov 1917 – Jul 1919	0.0139
Jul 1919 – Aug 1921	–0.0122	Aug 1921 – Aug 1922	0.0279
Aug 1922 – Sep 1923	–0.0108	Sep 1923 – Aug 1929	0.0205
Aug 1929 – Jun 1932	–0.0505	Jun 1932 – Jan 1934	0.0629
Jan 1934 – Mar 1935	–0.0184	Mar 1935 – Feb 1937	0.0343
Feb 1937 – Mar 1938	–0.0523	Mar 1938 – Oct 1938	0.0684

(*Continued*)

TABLE 2. (Continued)

Switch Dates (Low Return Phase)	Mean Phase Capital Return	Switch Dates (High Return Phase)	Mean Phase Capital Return
Oct 1938 – Apr 1942	–0.0106	Apr 1942 – Jun 1943	0.0350
Jun 1943 – Feb 1944	–0.0046	Feb 1944 – May 1946	0.0187
May 1946 – Jun 1949	–0.0072	Jun 1949 – Jul 1952	0.0164
Jul 1952 – Aug 1953	–0.0062	Aug 1953 – Mar 1956	0.0245
Mar 1956 – Feb 1958	–0.0068	Feb 1958 – Jul 1959	0.0235
Jul 1959 – Oct 1960	–0.0078	Oct 1960 – Aug 1961	0.0249
Aug 1961 – Sep 1962	–0.0135	Sep 1962 – Oct 1964	0.0169
Oct 1964 – Dec 1966	–0.0017	Dec 1966 – Jul 1967	0.0246
Jul 1967 – Feb 1968	–0.0080	Feb 1968 – Nov 1968	0.0220
Nov 1968 – Jun 1970	–0.0199	Jun 1970 – Apr 1971	0.0366
Apr 1971 – Nov 1971	–0.0139	Nov 1971 – May 1972	0.0262
May 1972 – Dec 1974	–0.0137	Dec 1974 – Mar 1976	0.0286
Mar 1976 – Feb 1978	–0.0068	Feb 1978 – Mar 1981	0.0131
Mar 1981 – Jul 1982	–0.0143	Jul 1982 – Jun 1983	0.0426
Jun 1983 – May 1984	–0.0097	May 1984 – Aug 1987	0.0212
Aug 1987 – Nov 1987	–0.1090	Nov 1987 – Aug 1989	0.0209
Aug 1989 – Oct 1990	–0.0094	Oct 1990 – Oct 1993	0.0125
Oct 1993 – Nov 1994	–0.0020	Nov 1994 – Apr 1999	0.0214
Apr 1999 – Dec 2001	–0.0035		

Note: A low return (high return) phase starts at the beginning of the month following the negative (positive) switch date. Mean phase capital returns represent the average capital return in each phase. The last phase is incomplete, so the mean return for the phase is computed using data up to December 2001.

but CC method bull and bear market durations are not. The hypothesis that there is no difference in the distribution of duration between BB versus CC method bull markets cannot be rejected, whereas the same hypothesis for BB versus CC method bear markets is rejected.

Panel B of table 3 provides simulated confidence intervals indicating that a random walk with constant drift provides phase durations that are too short relative to the historically observed durations, thus supporting the characterization of bull and bear markets as persistent mean return regimes (see equations (1) to (3)).[10] A random walk with constant drift therefore could not have accounted for the observed bull and bear market BB method phase durations, with the reason being evident from figure 5 which plots the historical duration distributions as well as the median distributions from the simulations. The simulated random walk duration distributions have higher frequencies (probabilities) at lower duration intervals that are more tightly distributed (have lower standard deviation) than the historically observed distribution under the BB method.[11] The CC method historical durations are also short relative to CC method confidence intervals for a random walk with constant drift, but they do not lie outside the confidence intervals.

Table 2 indicates that the stock market spends just under 60% of its time in bull markets.[12] The BB and CC methods provide identical classifications of months 84% of the time, with the largest categorization difference occurring during months that the CC method identifies as bear markets but the BB method identifies as bull markets (almost 10% of months). Over 70% of the months in bull states exhibit positive stock returns, while less than 40% of the months in bear states have positive capital returns. Differences in returns between bull and bear market states are therefore unlikely to be generated by large positive versus large negative outliers in otherwise similarly distributed

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10. Simulated confidence interval bounds are estimated by sorting the simulation results for each duration measure in ascending order, and then selecting the 50th and 950th result for the duration measure from a total simulation sample of 1000.

11. Kolmogorov-Smirnov tests indicate that the gamma distribution fits the historical and the simulated distributions better than the normal distribution. Maximum likelihood estimation also indicates that the gamma distribution fits well relative to the Weibull, exponential and logistic distributions. [Results not reported but available upon request.]

12. This result is consistent with Pagan and Sossounov (2003), but contrasts sharply with Maheu and McCurdy (2000) where bear markets are defined as low mean, high volatility states.

TABLE 3. Analysis of BB and CC Bull and Bear Duration

Panel A: K–S Tests for BB and CC duration distribution hypotheses	*p*–value for K–S test	Decision at 5% significance level
H_0 : No Difference Between BB Bull and Bear Duration	0.002	Reject
H_0 : No Difference Between CC Bull and Bear Duration	0.345	Do not reject
H_0 : No Difference Between BB Bull and CC Bull Duration	0.053	Do not reject
H_0 : No Difference Between BB Bear and CC Bear Duration	0.025	Reject

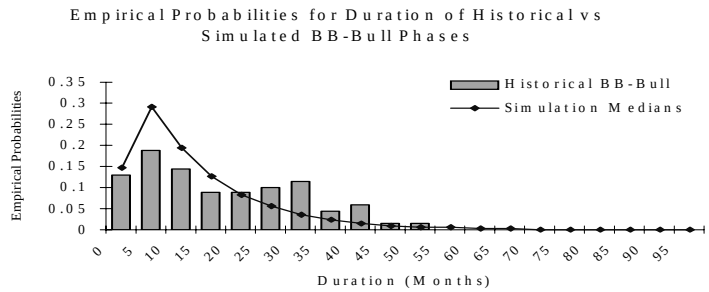
(*Continued*)

TABLE 3. (Continued)

Panel B: Mean and Standard Deviation for Historical Phase Duration vs Simulated Confidence Intervals for the BB and CC methods.

	Mean Phase Duration (months)	Standard Deviation of Phase Duration (months)
BB Method		
Historical Bull Markets	20.42*	17.76*
Simulation Derived Confidence Interval for Bull Markets	12.22 – 17.40	9.03 – 15.94
Historical Bear Markets	14.70*	15.21*
Simulation Derived Confidence Interval for Bear Markets	9.52 – 12.82	6.33 – 10.73
CC Method		
Historical Bull Markets	22.52	14.52
Simulation Derived Confidence Interval for Bull Markets	16.31 – 23.07	10.88 – 20.46
Historical Bear Markets	17.88	9.62
Simulation Derived Confidence Interval for Bear Markets	14.29 – 19.60	9.00 – 17.01

Note: *denotes actual historical duration statistics are outside the 95% simulation derived upper bound. Phase duration is the number of continuous months in each phase. Simulations assume a random walk process $-\Delta 1nP_t = \mu + \sigma\varepsilon_t$ where $\varepsilon_t \sim N(0,1)$. The number of simulations is 1000.



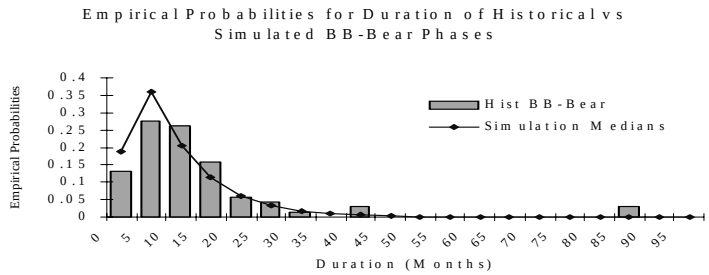


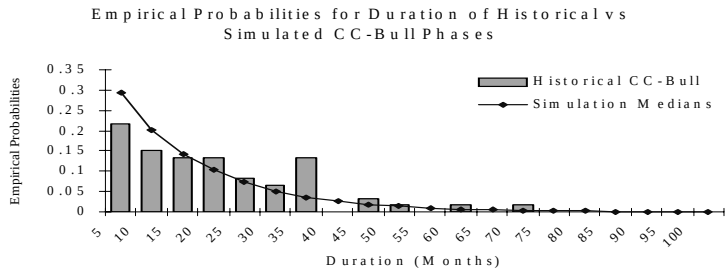
FIGURE 5

(*Continued*)

data. Return volatility during bear market months slightly exceeds bull market volatility (by less than 10%).

B. In Sample Statistical Significance of Bull and Bear Market Mean Regime Shifts

An indication of whether the BB and CC methods detect turning points that identify statistically significant mean return states can be provided by examining the extent to which the BB and CC method bull and bear markets explain return differences (see panel 1 of table 4). Months identified by both methods as being bull market months (about 50% of the months) provide mean capital returns of 2.10% whereas months that the BB and CC method both identify as bear market months (35% of the months) have mean capital return losses of –2.1%, thus resulting in a net



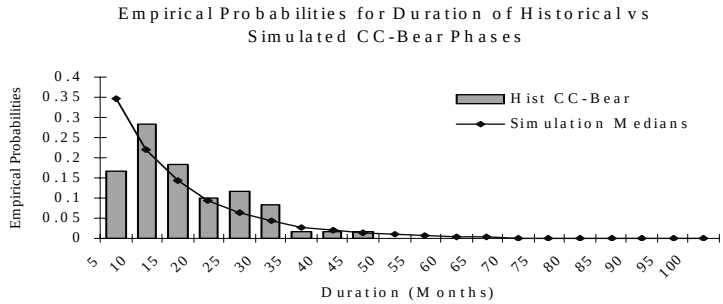


FIGURE 5.— Empirical Probabilities for Duration of Historical versus Simulated BB and CC Method Bull and Bear Phases.

difference in mean returns that is surprisingly large (over 4% per month). Table 4 also shows that mean returns for months identified by both the BB and CC method as being bull markets are highly significantly different from all other months' mean returns, as are the returns for months identified by both methods as being bear market months.

In sample performance of the simple model of mean return regimes (model (1) to (3)) is further examined by testing the extent to which dummy variables representing each BB method (CC method) bull and bear market phase explain monthly return differences. Panel 2B of table 4 indicates that dummy variables representing each individual BB (CC) method bull or bear market phase are significant when explaining returns, even after taking account of the explanatory power of overall bull and bear market state dummies, thus providing support for model (1) to (3). Panel 2B also indicates that each bull market state dummy

TABLE 4. Results for Bull/Bear Market Combinations Identified by the BB and CC Methods and Tests for Mean Regime Switches.

PANEL 1: Regression Results for Bull/Bear Market Combinations Identified by the BB and CC Methods

Dummy	Coefficient(Mean Return)	*t*–stat	# of Obs	Std. Dev.
BB bull and CC bull	0.021	17.5773*	1187	0.0412
BB bull and CC bear	0.011	4.2532*	222	0.0386
BB bear and CC bull	–0.0057	–2.0712*	163	0.0353
BB bear and CC bear	–0.021	–13.6294*	851	0.0444
F–value	132.12*			
R–square	0.1793			

Tests of Differences in Mean Returns between the Combinations	Diff in Mean Returns	*t*–stat
BB Bull & CC Bull vs. Other Combinations	0.034	19.67*
BB Bear & CC Bear vs. Other Combinations	–0.0376	–20.39*

(*Continued*)

TABLE 4. (Continued)

Panel 2A: Test for Significance of Phase Effects	SS Model	*R*–square	*F*–value
BB Method	1.5445	0.3022	7.22*
CC method			
	0.9231	0.1806	4.27*
Panel 2B: Tests for Significance of Phase Effects and Bull/ Bear Effects			
BB Method			
Bull/Bear	0.8405	0.1645	538.54*
Phases	0.704	0.1377	3.32*
CC Method			
Bull/Bear	0.6106	0.1195	335.81*
Phases	0.3125	0.0611	1.46*

Note: For panel 1, since there is no intercept in the regression model, the coefficient for each dummy represents the mean return under each combination. *t*–stats have been adjusted for heteroskedasticity using White's correction and * denotes significance at 5% level. The dummy for BB bull and CC bull is equal to 1 when both methods identify a bull market; otherwise it is zero. The dummy for BB bear and CC bull is equal to 1 when the BB method identifies a bear market and CC method identifies a bull market; otherwise it is zero. The dummy for BB bull and CC bear is equal to 1 when the BB method identifies a bull market and CC method identifies a bear market; otherwise it is zero. The dummy for BB bear and CC bear is equal to 1 when both methods identify a bear market; otherwise it is zero. Panel 2A examines phase effects and a significant result implies there are significant phase effects. Panel 2B reports the results for a two-way analysis of variance (with no interactions) test for phase effects once bull and bear state effects have been accounted for. A significant result for bull/bear implies there are significant bull/bear state effects once phase effects have been accounted for, and a significant result for phases implies there are significant phase effects once bull/bear effects have been accounted for. There are 138 BB method phases and 120 CC method phases.

TABLE 5. Summary Statistics for the Performance of Different Trading Rules over two sub–periods (January 1934 – December 1967 versus January 1968 – December 2001)

	Jan 1934 – Dec 1967			Jan 1968 – Dec 2001		
	Passive (Buy and Hold)	"Conservative" (Buy and Sell)	"Leveraged"	Passive (Buy and Hold)	"Conservative" (Buy and Sell)	"Leveraged"
Trading Rules Based on BB Method						
Average Monthly Trading Rule Return	0.0105	0.0078	0.0169	0.0101	0.0111	0.0155
Stdev of Monthly Trading Rule Return	0.0473	0.0252	0.0505	0.0446	0.0303	0.0607
Sharpe Ratio	0.1930	0.2548	0.3081	0.1001	0.1783	0.1627
Trading Rules Based on CC Method						
Average Monthly Trading Rule Return	0.0105	0.0058	0.0149	0.0101	0.0093	0.0138
Stdev of Monthly Trading Rule Return	0.0473	0.0235	0.0469	0.0446	0.0241	0.0483
Sharpe Ratio	0.1930	0.1885	0.2889	0.1001	0.1508	0.1677
Trading Rules Based on Combined BB and CC Methods						
Average Monthly Trading Rule Return	0.0105	0.0071	0.0162	0.0101	0.0101	0.0145
Stdev of Monthly Trading Rule Return	0.0473	0.0282	0.0564	0.0446	0.0256	0.0514
Sharpe Ratio	0.1930	0.2038	0.2639	0.1001	0.1725	0.1728

Note: The Sharpe ratio is equal to the average monthly trading rule return minus the risk–free rate divided by the standard deviation of the trading rule returns

variable is highly significant on its own, with BB (CC) method *F*-values in excess of 500 (300). A surprisingly high proportion of the variation in returns is explained by the bull and bear market phase dummy variables (close to a third for the BB method, as indicated in panel 2A of table 4). The sensitivity of these results to the assumed distribution of returns in each state (see model (1) to (3)) is examined using randomization of observations and randomization of residuals (Manly [1997]). The conclusions drawn from parametric and computer intensive methods are the same (results not reported but available upon request), thus providing further support to the model.

The in-sample tests of the turning points identified by the detection procedures have implications for the construction and testing of capital asset pricing theory models. The results imply that an appropriate specification of the expected CAPM risk premium in each state is required (see Campbell and Cochrane [1999], Gordon and St. Amour [2000]), and further indicate that covariance with the market index in the low return state is the important component of asset return risk.[13]

C. BB and CC Method Rolling Out of Sample Trading Rule Results

A test of the empirical and economic importance of the bull market trading rule dummy variables for market timing investors is obtained by testing the rolling out of sample performance of the returns that investors would have obtained using the different trading rules. Table 5 reports the trading rule returns that would have been generated during the past two thirds of a century, and compares them to the returns generated by a passive index buy and hold investment strategy that is 100% invested at all times.[14] Two time-period sub samples are utilized, as suggested by Sullivan, Timmermann, and White (1999), in order to check whether the trading rule results are consistent through time.

The "conservative" trading rule strategy that invests in the stock market only when a bull market is detected (with a lag) tends to generate a very small reduction in total returns relative to a passive buy and hold strategy (by 0.1% or 0.2% per month), but the standard

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13. A rising required risk premium in the low return state can help to explain ongoing capital losses in the state. The negative returns that are associated with volatility clustering are another potential explanation of losses in bear market regimes (Black, 1976). We thank an anonymous referee for pointing this out.

14. Due to unavailability of interest rate data prior to 1934, the analysis only covers the period January 1934 to December 2001.

deviation of returns is reduced by close to a half, thus providing considerably reduced risk for only a small return sacrifice and therefore a much stronger Sharpe ratio.[15] The "leveraged" trading rule strategy that invests more heavily in the stock market when bull markets are detected provides returns that are 50% higher than a passive buy and hold strategy with a similar level of risk, thereby providing a much better Sharpe ratio than a passive strategy.[16] The rolling out of sample trading rule tests therefore provide an indication that bull and bear market trading rule strategies developed from the BB and CC methods can be useful for investors with an interest in market timing.

VI. Conclusion

The results of this study suggest that bull and bear markets that are identified using two formal turning point detection procedures can be described by a simple two state mean return switching process. Bull and bear market turning points also appear to be exploitable using simple trading rules developed from the bull and bear market turning point detection procedures. In-sample tests of the turning points identified by the detection procedures support a simple two-state mean return regime model, a result that has implications for the construction and testing of capital asset pricing theory models in the presence of ongoing, persistent regime shifts in mean returns.

Several avenues for future research can be suggested. The possibility that leads or lags may exist between the turning points identified could be further explored, as could the relationship between bull and bear markets and monthly effects. Trading rules that utilize a shorter peak and trough detection window, and therefore a shorter detection lag, can also be tested. Finally, the dates that have been detected as turning points could be incorporated into research that attempts to economically explain bull and bear market cycles.

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15. The Sharpe ratio is equal to the mean trading rule return minus the risk-free rate divided by the standard deviation of the trading rule returns.

16. Trading rule return benefits are not likely to be eliminated by transaction costs, since very few trades would have occurred during the 68-year sample. The costs of index trading also fell sharply by the latter half of the sample.

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