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TRANSITIONS IN THE RELATION BETWEEN EARNINGS AND EARNINGS VALUATIONS MULTIPLES

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I. Introduction

An ideal scenario for stock market investors is one where earnings are growing and the price to earnings valuation multiple of the aggregate market is also expanding in anticipation of even stronger earnings growth in the future, as happened during the powerful bull market of the latter half of the nineties. The opposing scenario of declining earnings and valuations is the greatest concern to investors, but a situation of growing earnings yet a declining stock market would be an obvious frustration to investors. This paper is motivated by recent claims of stock market commentators that investors need not be too concerned about bear markets developing in the United States market since earnings forecasts are still favourable.[1] This paper explores whether there is a relationship between earnings growth cycles and price to earnings ratio regimes using Hamilton regime-switching analysis, and demonstrates that misalignment between earnings growth rates and the trend in earnings valuation multiples is relatively rare and short-lived. The paper therefore documents the existence of a multi-dimensional earnings growth and earnings valuation cycle in the aggregate stock market.

Real business cycles are a well-known feature of the macro-economy, and the existence of cyclical behaviour in financial markets has also been documented, including time-varying stock market risk premia as well as hot and cold Initial Public Offering cycles that switch between states of heightened versus low activity (see, e.g., Cochrane, 1997, 1999, 2001; Campbell and Cochrane, 1999; Campbell, 2000; Ibbotson and

[1] See e.g., Charles L. Norton, RealMoney.com, Don't despair over decelerating earnings growth, July 20, 2004, TheStreet.com.

Jaffe, 1975; Ritter, 1984; Ibbotson et al., 1994; Ritter 1998; Loughran et al. 1994). It is equally well-known that earnings are closely related to (and somewhat lag behind) the business cycle turning points provided by the National Bureau of Economic Research, but the documentation of an earnings cycle using regime-switching analysis has not previously been provided. Establishing a connection between earnings growth cycles and price to earnings valuation trends ties in with the view that stock market values are linked to future earnings. The theoretical basis for this view is well-established, and includes the Marsh and Merton (1987) argument that, in an efficient market, the current share price index level is equal to the present value of all future permanent earnings, so trends in earnings valuation multiples would reflect ongoing anticipated future earnings accelerations or decelerations.

Not all market participants share this view of a close relationship between current earnings valuation multiple trends and future earnings growth. This paper therefore examines the link between Price to Earnings (PE) ratios and earnings trends. We are particularly interested in periods, such as recently, where the two series appear to be misaligned, that is, when PEs are falling (rising) but earnings are rising (falling). In order to detect such transition periods, the paper utilizes Hamilton (1994) regime switching analysis to identify transitions in the PE ratio to earnings growth relationship. The nature and characteristics of these transition periods are then analyzed, since these sub-periods within the stock market are interesting curiosities that can have important implications for the understanding of investors' expectations.

The paper is organised as follows. Section 2 outlines the paper's research method. A third section outlines and discusses the paper's results, and a final section provides a brief conclusion.

2. RESEARCH METHOD

The research method consists of two phases. First, a regime switching technology is employed to identify the timing of a PE/earnings cycle and transitions therein. Then, an analysis of the transition periods is made.

2.1 Identifying a PE/earnings cycle

To identify a PE/earnings cycle we first identify the two underlying cycles, a PE cycle and an earnings cycle. From these cycles we develop the PE/earnings cycle from the joint probabilities of the underlying cycles. The PE/earnings cycle is then used to date periods of transition, or misalignment periods, where relative PEs are rising but relative earnings are falling, or vice versa.

2.1.1 Regime Switching

Regime switching analysis examines the regimes and the regime parameters that underlie the frequency distribution of a random variable X_t, such as the rate of change of earnings or the market price to earnings multiple for each quarter *t*. Once the regimes are identified and regime parameters are initially estimated, for instance the analysis might identify a high earnings growth state ($S = 0$) and a second low earning growth state with sluggish but still positive earnings growth ($S = 1$), then Hamilton regime-switching analysis estimates the probability that each earnings observation corresponds to a particular state. Autoregressive Hamilton regime switching (e.g., Hamilton, 1990) then iteratively smoothes regime conditional probability estimates for each observation by taking account of the likelihood that each preceding observation corresponds to the same regime, once initial starting point estimates for regime parameters and the probability of transitions between states are

made. The smoothed conditional probabilities are then used to re-estimate the parameters that best characterize each earnings growth or PE ratio trend regime, and regime conditional probability estimates are subsequently updated using the re-estimated regime parameters in an iterative procedure. Market cycles are considered to possess strong temporal information content if statistical inferences regarding cyclical regime presence are sharply clarified by, and are therefore heavily dependent upon, the ordering through time of earnings or PE observations.

The autoregressive component of the regime switching analysis is introduced by having the variable of interest (e.g., the PE ratio trend or the earnings changes series) follow separate within state autoregressive processes. The autoregressive procedure can be illustrated for the two regime case for a variable X_t using the following equations:

$$X_t = c_0(1-S_t) + c_1 S_t + [\phi_0(1-S_t) + \phi_1 S_t]X_{t-1} + [\sigma_0(1-S_t) + \sigma_1 S_t]\varepsilon_t \qquad (1)$$

where c_0 and c_1 are state contingent constants, ϕ_0 and ϕ_1 are state contingent serial correlation parameters, σ_0 and σ_1 are state contingent volatility parameters, S_t is a binary state variable that follows a first-order Markov Chain such that the state transition probabilities are

$$\Pr(S_t = 0 \mid S_{t-1} = 0) = q$$

$$\Pr(S_t = 1 \mid S_{t-1} = 0) = 1 - q$$

$$\Pr(S_t = 1 \mid S_{t-1} = 1) = p$$

$$\Pr(S_t = 0 \mid S_{t-1} = 1) = 1 - p$$

and

$$\varepsilon_t \sim N(0,1).$$

High transition probability estimates of remaining in a state (high smoothed estimates of q and p) imply that high and low states are strongly persistent.

The presence of an autoregressive component within each state can increase temporal smoothing and reduce switching between states because the analysis is less likely to interpret the natural oscillations of an autoregressive process as switches to a new state. In the extreme, however, it could actually eliminate switching between states altogether if a single within state autoregressive component can describe the cyclical oscillations of all the observations since in this situation spurious cyclical regimes are due to autocorrelation only.

The final component of the regime switching analysis combines conditional probability estimates for the PE changes and the earnings changes series to take account of the stylized fact that misalignment states are defined in terms of the twin dimensions of PE states and earnings states. The misalignment periods conditional probability estimates for each observation quarter t are multiplied together to create an overall, multi-characteristic conditional probability estimate of the misalignment regimes. A quarter therefore has to possess the twin characteristics of a positive (negative) PE trend and falling (growing) earnings changes, as defined by high conditional probability estimates for each characteristic, before it is classified as belonging to a misaligned overall regime.

2.2 Transition Period Analysis

Having determined a method for defining transition periods we then turn to an analysis of these sub-periods. The transition periods can be of two types: ‘up’ PE changes and ‘down’ earnings changes; or, ‘down’ PE changes and ‘up’ earnings changes. Each is identified separately.

2.3 Data

We collect quarterly data over the period 1979-2004: 25 years and 101 quarters of data. (from Shiller's website: http://aida.econ.yale.edu/~shiller/data.htm)

3. RESULTS

An AR1 autoregressive Hamilton regime switching analysis is run on the two underlying series, the PE series and the earnings series, to identify the cycles and regime switches in the series.[2] Results are reported in Figure 1 and Table 1.[3] The regime transition probability estimates are also reported in Table 1. The diagonal elements of the estimated transition probability matrix measure the likelihood that a state, once entered into, will re-occur in the following time period. When this estimate is close to one the state is persistent since regime phases tend to last for a number of quarters or even years. The transition probability estimates are all very high, thus implying that earnings growth and PE trend states are very persistent.[4]

It is seen for both series that two highly distinct and persistent up and down market states exist. An interesting feature of the Table 1 results is the clear distinction between a sharply positive PE ratio trend state and a second PE ratio trend state where the PE ratio is falling. The distinction between earnings growth states is not as sharp,

[2] We find clear regime switching using AR1 quarterly data. The other run tried was the AR0 run, but this did not converge as nicely. This is likely due to persistence in the PE earnings data.

[3] A Matlab program is used to implement the autoregressive regime-switching analysis using a matrix algebra reformulation of the Hamilton (1990) Appendix summation notation. Advantages of Matlab for implementing the analysis include simplicity and transparency, and the Matlab program has excellent convergence properties. The Matlab programming details are provided in Cahan, Cahan and Powell (2004).

[4] An estimate of the average duration of a state is the inverse of the probability of leaving the state (e.g., 1/(1-q) and 1/(1-p) in the two state model).

but the AR1 parameter estimate indicates that within state earnings growth is highly persistent.

The joint interaction of these two series is then used to form the PE/Earnings misalignment cycle. These are periods, as mentioned above, where PE growth rates and Earnings growth rates are misaligned, that is, one series is in an upstate and the other series is in a downstate. The outcome is a clearly defined cyclical switching between aligned PE/Earnings states and misaligned PE/Earnings states. These regimes are apparent in Figure 1. It is seen that periods of PE/Earnings misalignment occur fairly infrequently in the data, just 22 quarters out of 96 quarters, or 23%.

[Table 1 and 2 and Figure 1 about here]

Three transition periods occur in the data, as summarised below.

- Dec-79-Sep-82: hi PE growth, low earnings growth
- March-87-Sep-88: low PE growth , high earnings growth period
- Sep-02-Jun-03: low PE growth , high earnings growth period

These results line up with our intuition that PEs climbed during 1979-83 and dropped during the 1987 and 2002 “Crashes”. In total, there were 22 quarters of misalignment. On the other hand, the remaining 77% of the periods were aligned.

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Table 1

Results for autoregressive Hamilton regime switching analysis

This table presents results for autoregressive Hamilton regime switching analysis applied to the mean level of PE and earnings for each quarter *t*. The third to fifth column report estimated regime parameters: μ is the mean in each regime, σ is the standard deviation in each regime, and ϕ is the state contingent serial correlation parameter. The final three columns report the transition probability matrix (P matrix) that gives the probability p_{ij} of switching from regime *i* at time *t* to regime *j* at time *t+1*. The data set used in the study consists of the average quarterly data from Shiller's website over the period 1979-2004: 25 years and 101 quarters of data. Website: http://aida.econ.yale.edu/~shiller/data.htm

Panel A: PE series

Model	Regime	Mean μ	St. Dev. σ	AR1 Par. ϕ	P matrix	
					1	2
2 state model	1	0.00638	0.023409	0.05197	0.96178	0.038223
	2	-0.00323	0.058488	-0.04524	0.12542	0.87458

Panel B: Earnings series

Model	Regime	Mean μ	St. Dev. σ	AR1 Par. ϕ	P matrix	
					1	2
2 state model	1	0.006988	0.03238	0.68136	0.96668	0.033323
	2	0.004185	0.09112	0.60634	0.084558	0.91544

Table 2

Aligned and misaligned market periods for PE/Earnings

This table presents results for two state autoregressive Hamilton regime switching analysis applied to the PE trend and earnings growth series. The first column (Date) reports the beginning and end points of each overall phase, and the second column reports the length in months of the phase.

Aligned PE / earnings growth markets	
Date	Quarters
Jun-79 - Dec-79	1
Dec-82 - Dec-86	17
Dec-88 - Sep-02	56
Hi PE growth / low earnings growth markets	
Date	Quarters
Dec-79-Sep-82	12
Low PE growth / High earnings growth markets	
March-87-Sep-88	7
Sep-02-Jun-03	3

Figure 1

2 State Model Conditional Probability Estimates for State Regimes