A MODEL OF THE CYCLICAL BEHAVIOR OF THE PRICE EARNINGS MULTIPLE

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ABSTRACT

This paper presents a model of the cyclical behavior of the stock market price earnings multiple (PE), which explains the tendency of this multiple to fluctuate around its historical mean. Drawing upon the work of Kaldor, the paper derives nonlinear supply and demand curves for stocks, with three short-run equilibrium points. Two of these points, corresponding to extreme PE values, are stable, and the more central point is unstable. In the long run, the demand and supply curves shift, causing the PE to fluctuate between its extreme equilibrium values, thus modeling cyclicality in the behavior of the market PE.

INTRODUCTION

This paper presents an endogenous cyclical model of the stock market behavior that can explain the tendency of the market price earnings multiple (PE) to deviate significantly and for extended periods of time from its historical average value.[1] This tendency of the market PE to oscillate widely around its historical mean of about 15 times is well known and has been the subject of extensive theoretical and empirical discussion (see Shiller, 2000, for an excellent summary.) According to the efficient markets hypothesis, virtually unchallenged in the 1960s and 1970s, these deviations merely reflect shifts in the equilibrium value of the PE, brought about by changes in market fundamentals (Fama, 1970, 1991). Specifically, this school of thought believes that the stock market is dominated by rational investors, who seek maximum returns by using all available information, and who set the market PE at a level which reflects this information. While this school allows for the existence of irrational (noise) traders in the short run, it argues that in the long run such traders will be driven from the market through the arbitrage actions of rational investors. Under this interpretation, the sustained and huge deviations of the market PE from its historical arithmetic mean are explainable by fundamentals, such as extreme interest rates or earnings expectations, and simply represent shifts in the market equilibrium.

More recently, however, the efficient markets explanation of the PE behavior has been increasingly challenged by a number of researchers (DeBondt and Thaler, 1985, DeLong, Shleifer, Summers, and Waldemann, 1989, Shiller, 2000) who interpret fluctuations in the PE as temporary deviations from long run equilibrium. Such deviations are caused primarily by “noise trading," in which irrational investors buy or sell in pursuit of trends that they assume will eventually bring the market to a new higher or lower equilibrium position. Under these conditions, the market can be subject to excess volatility not warranted by changes in the underlying fundamentals.

Furthermore, unlike the advocates of market efficiency, these researchers argue that noise traders can influence the market significantly and on a continuing basis.

As the foregoing implies, the notion of a unique and stable equilibrium value for the market PE is central to the arguments advanced by both the efficient markets adherents and their critics. Furthermore, it is assumed by both camps that deviations from the long run equilibrium, whether permanent or temporary, are caused by exogenous shocks either to market fundamentals or to investment sentiments. Once the effects of these shocks dissipate, the market returns to its long run equilibrium. In other words, in the absence of new shocks, the market PE has no tendency to move, either upward or downward. This view of the market PE behavior, we believe, is at odds with its observed tendency to fluctuate regularly around its historical average value, remaining at levels well above or below this average for prolonged time periods. In other words, we believe there is a need for an endogenous model of PE behavior that can account for the cyclical movements of PE around its historical mean.

This paper proposes such a model. Our model, inspired by the celebrated nonlinear business cycle model of Kaldor (1940), recognizes the presence of both rational investors, who invest based upon market fundamentals, and noise traders, who invest based upon market trends. Following Kaldor, we hypothesize nonlinear supply and demand curves for stocks that reflect the behavior of both rational investors and irrational (noise) traders and arrive at a model with multiple equilibria. The short run stability conditions of these equilibria, together with the long run shifts in the supply and demand curves necessitated by market adjustments associated with extreme PE values, can explain the cyclical behavior of the market PE over time.

THE MODEL

The cyclical model of PE behavior developed in this paper utilizes nonlinear demand and supply curves for the aggregate stock market, both expressed in terms of the fundamental value of stocks as measured by the market PE.[2] While the model assumes short run constancy of expectations concerning future market fundamentals, such as earnings growth and interest rates, it does allow for revisions of these expectations over time, resulting in long run shifts in the aggregate demand and supply curves. In addition, the constancy of earnings expectations in the short run ensures that variations in the market PE also reflects movements in stock prices. The demand curve represents the demand of both rational and noise traders for stocks and is derived as the vertical sum of the demand curves for these two groups of investors.

As shown in Figure 1, the demand curve for rational investors (D_1) is negatively sloped, reflecting the tendency for rational traders to hold fewer shares at higher PEs. The figure also shows that this curve is nonlinear, being relatively steep at very low and very high PEs, corresponding to depressed and booming markets. This demand curve is steep at the upper end of the curve, reflecting the assumption that at very low PEs, rational investors are eager to unload their excessive stock holdings as PE steadily rises from very low levels. Likewise, the demand curve is relatively steep at the lower end of the curve, showing that at very high PEs, the rational investors accelerate their exit from the market.

FIGURE 1
DERIVATION OF MARKET DEMAND FOR STOCKS

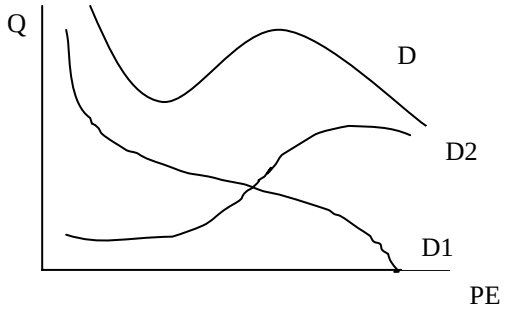


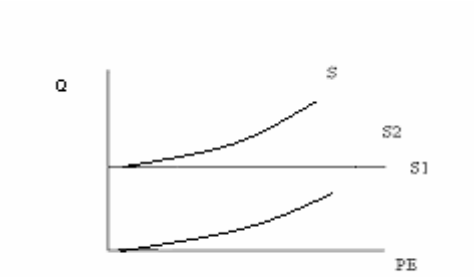
Figure 1 also shows the demand curve for noise traders (D_2). This demand curve is positively sloped, reflecting the assumption that these traders are trend chasers, who tend to increase their holdings in response to rising stock prices. The figure also shows that the demand curve for noise traders is relatively flat at both very low and very high PEs, again corresponding to depressed and booming markets, respectively. The demand curve is flat at the lower end of the curve, reflecting the fact that at very low PEs, noise traders only reluctantly increase their stock holdings as PEs rise from very low levels. Having possibly sustained losses in the previous downturn, noise traders wait for a more convincing and sustained increase in stock prices before aggressively returning to the market. Likewise, the demand curve is relatively flat at the upper end of the curve, showing that at very high PEs, noise traders become increasingly cautious and again become reluctant to increase their long positions, and may even lower them (that is, at very high PEs, D_2 may turn downward.)

Finally, Figure 1 shows that the total demand curve for stocks (D) is the vertical sum of the two underlying demand curves for rational investors (D_1) and noise traders (D_2). As the figure indicates, the total demand curve is S-shaped, depicting the tendency of total demand to fall at very low PEs, to rise as PEs increase further, and to fall again beyond the point of intersection of D_1 and D_2. As the PE begins to rise from low levels, in other words, the decreasing demand of rational investors for stocks initially dominates the increasing demand of noise traders to increase theirs, resulting in a falling total demand curve. This process reverses as the PE passes through its intermediate range, resulting in a rising total demand curve, followed by a range over which the demand curve becomes downward-sloping again. It is important to note that the total demand curve is based on the assumption that in the short-run the expectations are static expectations concerning the market fundamentals.

In a similar manner, the total supply curve represents the vertical sum of the supply curve of outstanding stocks and the supply curve of newly issued stocks. As shown in Figure 2, we assume that there is a fixed supply of outstanding stocks in the secondary market, shown by the flat line S_1. Likewise, it is assumed that the supply curve of newly issued stocks is positively sloped, shown by the curve S_2 in Figure 2. (S_2 can also be interpreted as the net supply curve of firms to account for the fact that many firms may buy back their own shares.) The rising supply curve of new issues indicates that firms tend to raise more equity capital at more favorable PEs, partly to finance new projects and partly to meet the demand of employees who wish to exercise their stock options (Baker and Wurgler, 2000). Figure 2 also shows that the

S_2 curve is nonlinear. The curve is relatively flat at very low PEs indicating the gradual increase in new issues as PE increases from very low levels. The S_2 curve is relatively steep at very high PEs, reflecting the fact that at these PE levels, firms significantly accelerate the pace of new share issuance to take advantage of low equity costs, as well as to finance the increased level of mergers and acquisitions. It can be seen from Figure 2 that the total supply curve (S), the sum of a flat and a rising curve, is also positively sloped.

FIGURE 2
DERIVATION OF MARKET SUPPLY OF STOCKS



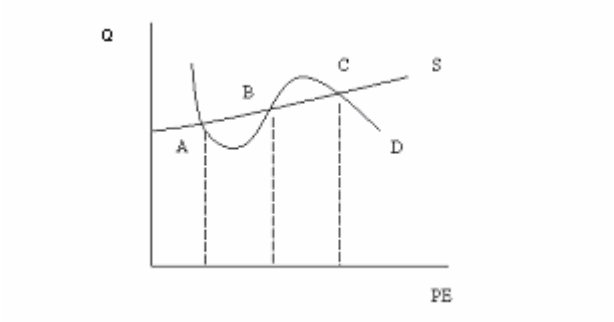
The above total demand and supply curves express the relationship between the quantities of stocks demanded and supplied and the value of PE under the short run conditions that all related factors other than PE remain constant. In the long run, changes in these other factors can shift the curves. One such pivotal factor is the interest rate, changes in which can shift both of the curves. For example, consider the case of rising interest rates in a booming economy, due to heightened inflationary expectations, rising demand for loans, or anti-inflationary monetary policy. Rising interest rates will motivate corporations to replace increasingly costly debt with relatively cheaper equity by selling additional stocks, thereby shifting the supply curve for stocks upward. At the same time, the rising rates will reduce demand by negatively impacting corporate earnings prospects, thereby reducing the attractiveness of stocks. The downward demand shift is reinforced by investors' portfolio realignment from stocks to bonds in response to the higher bond yields. Finally, the downward shift in the demand curve gains impetus as higher interest rates discourage margin buying of stocks. Thus, the tendency of interest rates to rise in a booming economy will have the effect of shifting the total supply curve upward and the total demand curve downward.

The effects of a fall in interest rates on the supply and demand curves for stocks can be similarly analyzed. Interest rates decline in a weakening economy due to moderated inflationary expectations, decreasing demand for loans, or expansionary monetary policy. Falling interest rates will in turn motivate corporations to replace equity with increasingly cheaper debt, thereby shifting the supply curve for stocks downward. At the same time, the falling rates will increase demand for stocks by positively impacting corporate earnings prospects, thereby improving the attractiveness of stocks. The upward demand shift is reinforced by investors' portfolio realignment from bonds to stocks in response to the lower bond yields. Finally, the upward shift in the demand curve is further bolstered as lower interest rates encourage margin buying of stocks. Thus, the tendency of interest rates to fall

in a declining economy will have the effect of shifting the total demand curve upward and the total supply curve downward.

To demonstrate how the above short and long run factors interact to determine the equilibrium PE, we bring the total demand and supply curves for stocks together, as in Figure 3.

FIGURE 3
SHORT-RUN MULTIPLE QUILIBRIUM POINTS



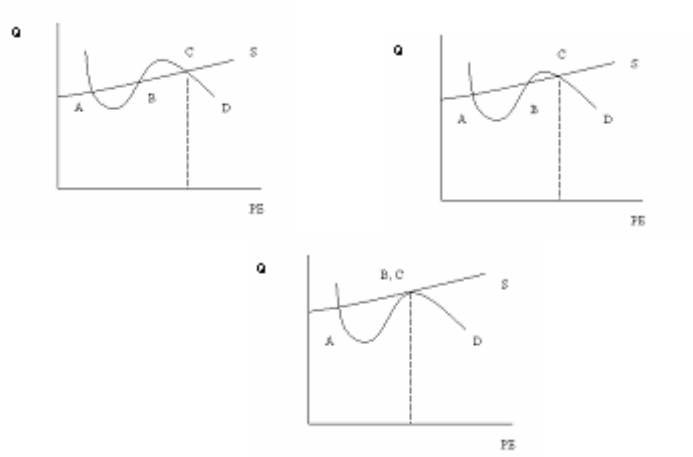
As Figure 3 indicates, the demand and supply curves intersect at 3 points, A, B, and C, resulting in three short run equilibrium values for PE. Clearly, the equilibrium at the center, point B, is unstable. To see this, assume the actual PE lies to the right of B. At this point, the quantity of shares demanded exceeds the quantity supplied, which would drive the PE upward and away from B, towards C. In contrast, the points A and C are stable. To illustrate, assume the prevailing PE ratio lies to the left of, say, the uppermost intersection point, C. At this point, excess demand would drive the PE higher until it settles at equilibrium point C. Under these conditions, the market PE will tend to move away from the center equilibrium point B and settle at the extremes A and C for extended periods of time. Thus, to reiterate, there are three short run equilibrium points, A, B, and C, characterized by different stability properties. Point A is distinguished by the fact that it is a stable equilibrium at a low PE, C by the fact that it is a stable equilibrium at a high PE, and B by the fact that it is an unstable equilibrium.

Clearly, these tendencies comport with the historical behavior of the market, in which PE deviates substantially from its historical mean for sustained periods. The task of our model, then, is to explain why PE, having settled at one of its stable short run equilibrium points A or C, will depart from these points in the long run. In other words, our model implies that A and C are stable equilibrium points in the short run but not in the long run. More specifically, our model implies that if PE is initially at point A, long run forces will move it toward C, and once PE reaches that point, long run forces will drive it back toward A. In other words, in the long run, PE will repeatedly cycle between its two short run equilibrium positions A and C.

The mechanism that triggers the departure of PE from a short run equilibrium position is the process of long run demand and supply shifts. These shifts are assumed to occur in response to long run changes in such fundamentals as interest rates and expectations concerning the future prospects for the economy, as described earlier. To illustrate more formally, suppose that the economy is strong and the market in a buying mode so that PE has risen to the short-term equilibrium level

given by point C in Stage 1 of Figure 4. At this elevated equilibrium level of PE, both the stock market and the economy enjoy mutually reinforcing strength. As a result, interest rates and the other factors which shift demand downward and supply upward will come into play as discussed earlier and shown in Stage 2 of Figure 4.

FIGURE 4
LONG RUN SHIFTS IN EQUILIBRIUM FROM HIGH PE



Stage 1 Stage 2 Stage 3

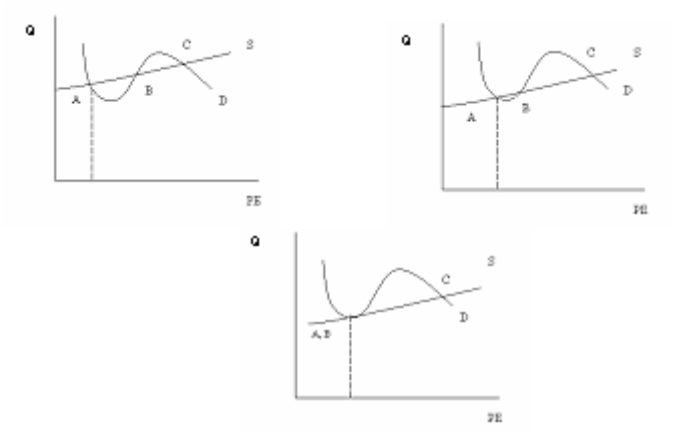
It can be seen from Stage 3 of Figure 4 that the opposite shifts in the supply and demand curves will cause the equilibrium point C to move downward and approach the equilibrium point B. Eventually, the continuing shifts in the supply and demand curves will bring the curves to a condition of tangency, as shown in Stage 3 of Figure 4, where the points formerly labeled C and B coincide, producing a new type of equilibrium unlike the conditions originally prevailing at either C or B. The point of tangency is characterized by stability on its right hand side, where an excess supply of stocks will lower PE towards equilibrium, and instability on its left hand side, where an excess supply of stocks will again lower PE, but this time away from equilibrium. This downward movement of PE from the point of tangency will continue until it finds a new stable short run equilibrium at point A, where it will remain for an extended period of time.

As was the case with the equilibrium at point C, however, eventually long run adjustments, triggered this time by falling interest rates in a weak economy, reverse the movement in PE, with the market now cycling back upward from short run equilibrium point A toward point B. Thus, the model predicts a process of continuous fluctuations between two short run equilibria characterized by high and low PE values.

As shown in Stages 1 and 2 of Figure 5, demand will rise as interest rates fall, accompanied by the adjustments in expectations as described earlier. Eventually,

the equilibrium point A coincides with B, represented graphically by the tangency of the supply and demand curves in Stage 3 of Figure 5. As before, the point of tangency represents a new type of equilibrium situation, characterized this time by stability on its left hand side, where an excess demand for stocks will raise the PE towards the equilibrium, and instability on its right hand side, where an excess demand for stocks will again raise the PE, but this time away from the equilibrium. At any rate, on either side of this tangency point, there will be an excess demand for stocks, resulting in a continued upward movement of the PE multiple. Consequently, once the opposite long run shifts of the demand and supply curves have pushed the equilibrium point A upward toward point B, the market can only continue to further adjust upward from B, seeking a stable equilibrium level at a higher value of PE, which it finds at point C. The new market PE at C resides at a stable equilibrium, where it will remain for an extended period of time. Eventually, this short run equilibrium is again disturbed by long run forces, which will cause the PE ratio to once again cycle downward to point A in Stage 1 of Figure 5.

FIGURE 5
LONG RUN SHIFTS IN EQUILIBRIUM FROM LOW PE



Stage 1 Stage 2 Stage 3

The foregoing discussion thus provides a rationale for the observed tendency of the market PE to behave cyclically over time. Each of the equilibrium points at both A and C are short run equilibrium levels of the price earnings multiple. Neither of them, however, is stable in the long run. The accumulation of long run forces over time, such as changes in interest rates, will eventually generate cyclical movements of the market PE between its values at the short run equilibrium points A and C.

CONCLUSION

This paper models the fluctuations of the market PE over time. The nonlinear supply and demand curves for stocks give rise to stable short run equilibria which lie above and below the midrange of the spectrum of PEs. Unlike Shiller's analysis, the model requires no overshooting and offers an explanation as to why the market PE may deviate substantially from its historical mean for long periods of time. Unlike the efficient markets argument, the model explains why the market would be expected to deviate from the midrange, an unstable equilibrium, and why having departed greatly from this value, the market would eventually cause PEs to revert not just to the mean but beyond in a continuing cycle. There are, however, periods in which extreme policy actions by the central bank may interfere with the cyclical behavior of the market PE. For example, the recent stock market crash created conditions for the PE to move to its lower equilibrium level. Instead, the prompt and aggressive action of the Federal Reserve to sharply lower interest rates has reversed the shifts in the demand and supply curves, thereby preventing the market PE from falling.

Our model also bears other interesting policy implications. It suggests that the central bank can shorten the span between equilibrium points A and C by preemptively opposing variations in interest rates before PEs reach extreme levels. In contrast, a common criticism is that the Federal Reserve hesitated too long in preemptively raising interest rates in the years prior to 2000, thus allowing these ratios to reach historic highs, and raised rates as the market approached its peak.

On the other hand, the model suggests that, since the midlevel equilibrium point is unstable, such efforts by the Federal Reserve to stabilize the market around its historical mean value are likely to be difficult in any case. Of course, Greenspan has stated that market stabilization is not a policy goal of the Fed, but his public comments often suggest that the wealth effect of the market on consumer behavior is indeed a matter of concern. Our model indicates that efforts by the Fed to keep the market from demonstrating "irrational exuberance" or its opposite under conditions of extreme pessimism would be difficult but not impossible.

To prevent the market from reaching an extreme equilibrium point such as C in Figure 3, the Fed must raise interest rates preemptively as PEs begin to depart from the unstable equilibrium at point B. The higher interest rates would increase supply and decrease demand, moving point C nearer to B. This would limit the increase in the market PE. The Federal Reserve may also do well to bolster these efforts to limit excess valuations by raising margin requirements, an action it has been criticized for refusing to take in the past. In the context of our model, a change in margin requirements would shift the demand curve for stocks, but would do so without the undesirable effects on the real economy that result from interest rate changes. The Fed could do the opposite as the market falls toward the lower equilibrium point A. Unfortunately, such policy efforts would succeed only if executed with extreme accuracy and foresight and if interest rate policy is not constrained by factors other than the stock market. This is, of course, unlikely since the Fed's primary goals are stabilization of prices, output, and unemployment. Targeting these more important goals, the Fed is unlikely to make the necessary interest rate adjustments to compress the swings suggested by our model even if it is capable of identifying the proper timing and extent of rate adjustments necessary to do so.

ENDNOTES

1. The historical average value for market PE is represented by the arithmetic mean of the PE multiple for the S&P 500 index over the entire 20th century.
2. Strictly speaking, the model requires nonlinearities in only some of the underlying demand and supply curves. For example, the demand curve of rational investors or the supply curve of firms for new issues can be linear without affecting our main results.

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