The q Theory of Investment

Introduction

Tobin's q is defined as the ratio of the market value of installed capital to it's replacement cost. i.e.

q = market value of installed capital/ replacement cost of installed capital

The market value of installed capital is priced in the stock market and is the number of shares outstanding times their market price. The replacement cost of installed capital depends on the situation in the capital goods sectors. If the demand for capital goods is strong, the price of capital goods will rise.

If q>1, then firms have an incentive to increase their capital stock because capital once installed and producing goods and services is priced more highly than it's cost.
If q<1, then firms should scrap capital, close plants etc.

However as the Dixit and Pindyck analysis suggests, firms may delay expansion or contraction for some time and may only do so if q remains significantly above or below unity.

The Efficient Markets Hypothesis (EMH) suggests that share prices and thus the market valuation/ capitalisation of businesses reflect all available information regarding the business, its environment and its prospects. Thus, observed share prices impound information about business fundamentals such as earnings (profits), dividends, managerial performance, market conditions and the market's expectation of the future trends in such variables.

In theory, the share price and market capitalisation should be driven by arbitrage to accurately reflect the intrinsic value of companies. If a share price rises above the consensus view of the intrinsic value of the stock, agents will sell driving the price back to it's fundamental value.

Thus, the numerator of the q equation provides a correct indication of the current worth and likely prospects for the business. If a firm faces a q>1, then this is a signal that it should buy additional capital because the present value of the future earnings from such capital will be greater than its cost. Clearly, when a firm expands its capital stock it will face diminishing returns, i.e. the marginal product of capital will fall as the capital stock grows. This will tend to cause q to revert back towards unity. However, if the EMH is correct, share prices will provide firms and agents with correct signals regarding how to allocate capital. If a firm is well regarded by the markets, then q will rise and the firm should increase its capital stock. This can be achieved by either purchasing capital equipment or by taking over the assets of other firms.

Are Stock Markets Efficient?

The above account suggests that as long as stock market prices provide sound signals for owners and managers firms should make optimal investment decisions. It certainly appears that the markets are reasonably proficient at pricing firms <u>relative</u> to each other. For example, in February and March each year, the big UK banks all announce their annual results and dividend payouts. Analysts will have formed expectations of the likely content of this information and these estimates will already be impounded into share prices. Thus, the market will only adjust to surprises in the information released. Last year, The Royal Bank of Scotland plc announced a record rise in profits and a strong performance in all sectors especially from its operations in the US where its Citizens Bank subsidiary has been an aggressive acquirer of US banks. Abbey National announced worse than expected results including shortfalls in it's with profits endowment policies due to the Financial Service Authority's (FSA) new regulations on the solvency of such funds. News moves markets and RBS shares rose whilst Abbey National's fell sharply.

The share price and market valuations of both companies relative to each other adjust instantly to the release of such new information and it is likely that the new relative prices reflect the relative performance and prospects of the companies in a fairly accurate manner. However, there is evidence that the markets may <u>overreact</u> by writing up the value of successful firms by a more than is warranted and lowering the share price of poorly performing firms by more than is appropriate. De Bondt and Thaler construct portfolios of good and bad performers in a given period. In the next period, the portfolio of 'good performers' exhibits lower risk adjusted returns whilst the portfolio of 'poor performers' fares better than expected. This is taken to indicate that the market over reacts to good performance and bad performance.

It is less clear however that markets are quite as good at setting the <u>absolute</u> level of stock prices. The level of the stock market index depends inter alia on the current and likely growth prospects for the local and world economy. This in turn depends on current and expected fiscal and monetary policy. It is entirely possible and that each stock in the stock market index is correctly priced relative to each other but that the overall level of the market does not adequately reflect macro fundamentals.

In a series of publications, <u>Robert Shiller</u> has attempted to relate the overall level of the stock market to a measure of business fundamentals. Using the Gordon dividend model to construct a measure of fundamentals, Shiller demonstrated that, if the EMH is correct, the volatility of actual share prices should be less than the volatility of the fundamentals. However, his empirical work indicates that the opposite is the case. Share prices are too volatile given the trend in their underlying fundamental determinants. This is set out in Figure 1.

Figure 1 – Real Stock Prices vs Real Dividend based Estimate of
Fundamental Value
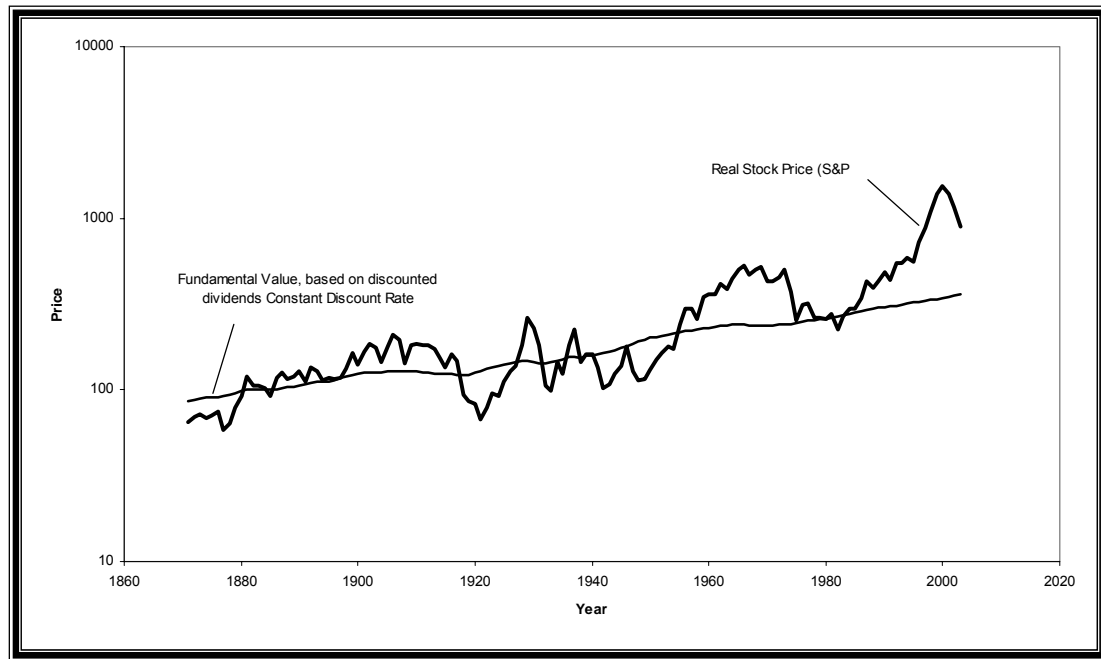
Source: Robert Shiller

Figure 1 indicates that actual real US stock prices are more volatile than the
volatility of a measure of fundamental value based on dividends would
suggest. In particular this analysis suggests that the US stock market has
been significantly overvalued relative to the fundamental worth of companies
in recent years. This result has been confirmed for the UK by Brad DeLong.

Thus, stock markets appear to suffer from 'bubbles' which result in surges in
share prices and significant departures from historical norms of variables such
as price earnings ratios and dividend yields. Such a phenomenon was
witnessed in global markets in the mid to late 1990's. Led by unrealistic
valuations of the prospects of internet/ dot com, telecom and high tech
manufacturing, markets moved massively above level suggested by historic
fundamentals. Indeed, Cassidy outlines that conventional share valuation
techniques based on pricing a company relative to earnings or dividends were
abandoned. Dot Com companies with no track record of sales or earnings
were valued on the basis of prospective market share, prospective sales or
prospective profits/earnings. These valuations were then widely touted by
analysts who were often working for the investment banks who were
preparing to float the company on US stock exchanges.

Apologists argued that these deviations were due to the advent of a 'New
Economy' which somehow justified these new relationships. Shiller was
unimpressed with such notions and predicted that a correction was inevitable.

This kicked in 2000/01 after when equity prices began to slide. The downturn in real US share prices can be seen in Figure 1. The US stock markets were not the only markets affected by this bubble. Figure 2 sets out the situation for the UK.

Figure 2 – Real UK Stock Prices: 1880 to 2004
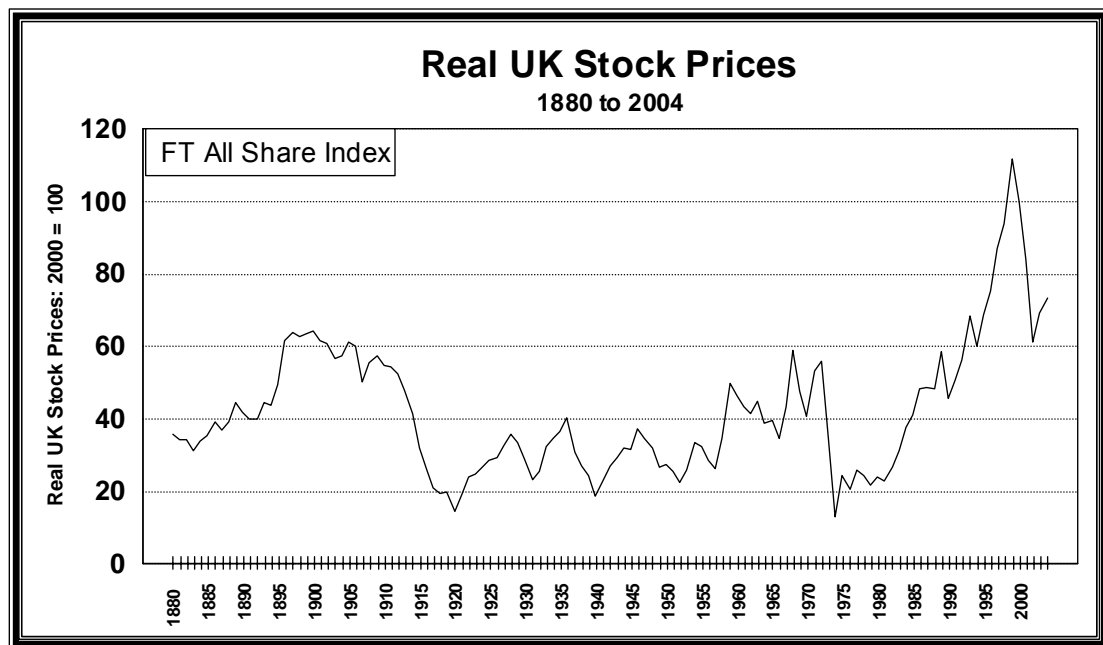
Figure 2 illustrates the extent of the bubble as it applies to the UK. In 2000, UK shares were circa 2.5 times the real average value for the 1880 to 1990 period. The UK stock market began to boom in the mid 1990s and has retrenched considerably since 2001. There is no corresponding change in conventional valuation measures such as dividend yield or earnings per share which can be used to explain this phenomenon.

As far as the q theory was concerned the market value of installed capital rose in the 1990s in most sectors and in most countries. In the sectors most affected (e.g. telecoms, computer manufacturing), huge investments in plant, equipment and infrastructure were made in businesses whose true performance did not merit it. These industries have spent the first part of the present decade restructuring. Thus, whilst the q theory can explain observed trends in investment, the fact that equity markets can for prolonged periods be over or undervalued means that the resulting levels and patterns of capital spending may prove less than optimal.

How Quickly Does Investment Respond to Q?

Although there is evidence that investment trends broadly follow trends in the q variable, q>1 can persist for some time before investment emerges to reduce the ratio. As indicated in the MEC – MEI analysis, capital goods prices

will rise in line with demand which serves to reduce q in booms. Secondly, firms experience considerable <u>installation costs </u>when raising their capital stock. The greater the scale of the investment project, the greater the demands on managerial resources and the greater the disruption to existing operations of the business. In general, the bigger the volume of investment undertaken in a given time period, the more costly it will be to install it. Thus, perhaps fortunately, firms will take time to move from their current capital stock, K to the desired capital stock, K* suggested by the q ratio. In addition, large projects take time to appraise, acquire the capital assets and put them in place. This explains why lags occur in moving to a new and higher capital stock.

How Does the Rate of Interest Fit In with Q Theory?

As we have previously established, if interest rates rise, the discounted value of expected fundamentals falls. Ceteris paribus, there is an inverse relationship between interest rates and share prices. Thus a rise in r will depress the numerator of the q equation. This will happen immediately as stock markets adjust instantaneously to interest rate changes. Higher interest rates will depress q and result in a lower desired K*.

The Financing of Investment

The q theory indicates that firms should issue new share capital to finance investment expenditure. However, survey work suggests that most investment in OECD economies is done via <u>internal finance</u>. This is accrued from retained earnings and depreciation. Such funds account for over 90% of capital spending in the UK and USA, 80% in Germany and 70% in Japan. Bank loans comprise the second largest source of funds for investment purposes. The availability of internal funding places a constraint on the speed at which firms will adjust toward a new higher K*. In this view, the level and timing of investment will depend on current corporate profitability. However, profitability is likely to be highly correlated with recent output growth and stock price growth. Nevertheless, according to the CBI Industrial Trends Survey, in the mid to late 1990s 25% of UK firms cited shortages of internal finance as a constraint when asked 'what factors are likely to limit (wholly or partly) your capital expenditure authorisations in the next 12 months. Only 7% cited cost of finance and 2% inability to raise external finance.

Conclusions and Summary on Investment

The largest factors cited by firms in the CBI survey as constraining investment in the 1990s were 'inadequate returns on investment' (46%) and uncertainty regarding demand (52%). This points clearly to a strong role for expectations regarding future demand and business confidence as a key determinant in investment spending. It also indicates that hurdle rates in the UK are likely to be relatively high as suggested by our 2 trigger model. Profitability and the availability of internal funds is another significant factor. If profits growth is

strong, business confidence will be high as will the q ratio. We can summarize the determinants of gross investment as follows

$$I_t = I\ (r_t/H_t,\ E_t(y),\ \pi_t,\ q_t)$$
$$(\text{-ve, +ve, +ve, +ve})$$

Where H is the level of the high hurdle r is the interest rate/cost of capital
$E_t(y)$ is expected demand governed by business confidence
π_t is profitability
q_t is Tobin's q

Business confidence and uncertainty will affect E(Y) greatly causing shifts in the investment function which may make the influence of other variables difficult to identify. The price of capital goods, PK and installation costs will govern how quickly firms close the gap between their current and desired capital stock.

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February 2005