The growth companies puzzle

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Abstract

While numerous empirical studies include proxies for growth opportunities in their analyses, there is limited evidence as to the validity of the various growth proxies used. Based on a sample of 1,942 firm years for listed UK companies over the period 1990 to 2004, we assess the performance of eight growth opportunities measures. Our results show that none of the measures has any success in predicting EPS growth. We term this the 'growth companies puzzle'. The second part of the paper looks at the ability of growth opportunity measures to predict growth in sales, assets and book equity. All the growth measures show some ability to predict growth in these dimensions. However, Tobin's *Q* (a widely used measure in the empirical literature) performs very poorly, while dividend based measures generally perform best. Growth companies do grow, but they do not grow in the key dimension (earnings) theory predicts. We suggest that a possible resolution of the puzzle may lie in the time-series behaviour of company earnings. Where profits are high, new capacity enters the market and reduces profitability. The profitability of new investment must therefore be balanced against the falling profitability of the original investments.

Keywords: Growth opportunities, growth proxies, firm growth.

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The Growth Companies Puzzle

1. Introduction

As recognised by Miller and Modigliani (1961), the value of the firm can be split into the value of assets in place and the value of growth opportunities. The value of these growth opportunities is the net present value of future investment projects. Growth opportunities may be a significant component of firm value, and since Miller and Modigliani's seminal paper, proxies for growth opportunities have been included in a wide variety of empirical finance studies. For example, prior studies have argued that the level of growth opportunities may influence the capital structure decision (e.g., Smith and Watts 1992, Gaver and Gaver 1993, Rajan and Zingales 1995, Goyal *et al*. 2002, Johnson 2003, Dahlbor and Upneja 2004 and Billett *et al.* 2007), the stock market reaction to finance decisions (Pilotte 1992, Denis 1994, and Burton *et al* 1996 and 2000), the level of abnormal returns in mergers and acquisitions (e.g., Georgen and Renneboog 2004), and also executive compensation (e.g., Smith and Watts 1992).

However, as growth opportunities are not directly observable, studies normally have to rely on various indirect measures for the presence of growth opportunities. There is, however, limited agreement on how best to measure the level of growth opportunities, and a number of alternative measures for the presence of growth opportunities are frequently used in empirical studies, including market to book proxies (Tobin's *Q*), earnings proxies (the Earnings/Price ratio) and dividend proxies (the Dividend/Price ratio). As well as simple proxies, which merely purport to rank firms according to their level of growth opportunities, there are also models (Kester 1984, Brealey and Myers 1991, Ottoo 2000, and Hirst *et al*. 2008) which are designed to quantify the value of a firm's growth opportunities. Overall, this paper will use eight different growth measures.

Miller and Modigliani (1961) and the subsequent growth opportunities literature define growth as the ability to make future investments which give returns exceeding the cost of capital. How can such investment be measured? Company growth can be measured in several ways, including sales growth, growth in equity and growth in total assets. If a company invests, it is likely to grow in all these ways. However, this type of growth may have been achieved by investment in zero or even negative NPV projects. To prove that a company has been a growth company in the Miller-Modigliani sense, the natural test is to look for growth in earnings per share. Earnings are, of course, measured with a degree of subjectivity, and EPS may be moved up or down by a change in financial structure. However, despite these difficulties, growth in EPS is our preferred measure of realised growth. If an investment generates profits above what is needed to service the finance it has employed, then it can be expected to increase the EPS for the original shareholders.

The first objective of this paper is to investigate how successfully growth opportunities measures perform when predicting future earnings growth. We shall calculate the relative predictive power of different growth opportunities measures, and observe whether the more complex models perform better than simple proxies. The analysis will be based on a sample of 1,942 firm-years for UK listed companies over the period 1990 – 2004.

Later, in the second part of the paper and in response to the results of our initial analysis, we shall look at the link between growth opportunity measures and subsequent growth in dimensions other than earnings. The paper will look at possible explanations for the nature of the growth predicted by growth opportunity measures.

2. Growth opportunities and realised firm growth

There are a number of recent studies which have used growth opportunity measures as predictors of subsequent company growth. They can be classified according to the variables used to predict growth, the variables used to measure realised growth, and the data-set employed.

The literature has tended, in general, to use growth proxies rather than growth models, as predictors. Notable papers in the literature include Lewellen *et al*. 1987, Collins and Kothari 1989, Chung and Charoenwong 1991, Smith and Watts 1992, Gaver and Gaver 1993, Rajan and Zingales 1995, Kallapur and Trombley 1999, Jacquier *et al.* 2001, Burton 2003, and Adam and Goyal 2008.

The most widely used predictor is the book-to-market ratio. The higher the ratio, it is argued, the larger the value of growth opportunities. The ratio appears in various forms including equity book-to-market, asset book-to-market, and Tobin's *Q*. All the above authors have used one or other of these measures.

A low earnings/price ratio is also taken to indicate the presence of growth opportunities (Kester 1984, Chung and Chareonwong 1991, Penman 1996, Jacquier *et al*. 2001, and Kallapur and Trompley 1999). The low earning yield today, it is argued, is justified because earnings will grow substantially in the future.

Similarly, a low dividend/price ratio is also taken to indicate potential growth. Authors using this proxy include Rozeff 1982, Gaver and Gaver 1993, Smith and Watts 1992, Kallapur and Trombley 1999 and Jacquier *et al*. 2001.

We use all these three as proxies, as they play a central role in the literature[1].

We also use three models of growth opportunities (Kester/Brealey and Myers 1984 and 1991, Hirst *et al*. 2008, and Ottoo 2000). These models will be explained in more detail later in the paper.

The study by Kallapur and Trombley (1999) has an objective, similar to ours, of testing the link between various growth opportunities proxies (but not the growth opportunities measures used in this study) and subsequent company growth. They look at growth in the book values of equity. However, as a robustness test, they also analyse future sales, asset growth and earnings growth, although their discussion of these results is brief. Kallapur and Trombley note that their results are generally robust to measuring realised growth based on growth in sales or assets, but the association between the growth proxies and earnings growth is much weaker. They argue that the weak association between the growth opportunities proxies and earnings growth "…could be attributable to measurement problems such as the greater variability of earnings and the relatively high frequency of negative reported earnings". (p. 509).

Our research design and data-set make a number of distinctive contributions to the literature. Firstly, we look at the performance of growth opportunities models as well as growth opportunity proxies. Secondly, reflecting the basic definition of growth companies, we focus on EPS as our measure of realised growth. However, we also analyse the ability of the various growth opportunities models to predict size growth, including growth in sales, total assets and equity. As a third contribution of our paper, we offer some resolution to the conflicting results between the failure of growth opportunities models to predict earnings growth but their ability to predict size growth. Fourthly, we look at firm growth over a ten year period, which gives a longer perspective than most other studies (for example, Kallapur and Trombley use three and five years). Finally, we add UK evidence to a literature which has worked almost exclusively with American data.

We next explain the growth proxies and models for valuing growth opportunities used in this study.

3. Growth models

Growth models do not simply rank companies according to their growth prospects; they go further and offer an estimate the proportions of company value accounted for by assets in place and growth opportunities, respectively. Kester (1984) and Brealey and Myers (1981, 1991[2]) develop similar models based on earnings for valuing assets in place (the KBM model), while Hirst *et al*. (2008) develop an alternative model based on dividends (the HDJ model). While numerous studies have used the relationship between book values and market values as a proxy for the level of growth opportunities, Ottoo (2000) takes this a step further to argue that the relationship can be used as a measure for the proportion of value accounted for by growth opportunities.

3.1. The Kester, Brealey and Myers model of growth opportunities

Kester (1984) and Brealey and Myers (1981) develop a simple model for decomposing the share price into the value of assets in place and the value of growth opportunities. Following Danbolt *et al*. (2002), we will henceforth refer to this as the Kester, Brealey and Myers, or the KBM, model.

Let P_s refer to the share price, P_a to the share value due to assets in place, and P_g to the element of share price due to growth opportunities:

$$P_s = P_a + P_g \tag{1}$$

As argued by Miller and Modigliani (1961), the value of assets in place can be seen as the present value of the uniform perpetual earnings of assets currently held by the firm. Kester (1984) therefore argue that the value of assets in place, on a per share basis, can be estimated as:

$$P_a = \frac{EPS}{K_s} \tag{2}$$

where K_s is the company's cost of equity capital.

In the KBM model, the company's earnings per share (EPS), valued in perpetuity, are thus assumed to generate the value of the firm's assets in place. The value of growth opportunities, P_g, can be calculated as:

$$P_g = P_s - \frac{EPS}{K_s} \tag{3}$$

For samples of 15 and 8 US companies, respectively, Kester (1984) and Brealey and Myers (2003) argue the value of growth opportunities often account for more than 50% of firm value.

In this paper, we calculate the percentage of equity value accounted for by growth opportunities, according to the Kester-Brealey-Myers model, as:

$$\%P_g\ KBM = \frac{P_s - \frac{EPS}{K_s}}{P_s} * 100 \tag{4}$$

where K_s is estimated using the capital asset pricing model:

$$K_s = K_f + \beta_s (K_m - K_f) \tag{5}$$

K_f refers to the risk free interest rate and K_m to the return in the stock market index.

Limitations of the KBM model

The KBM model, valuing assets in place as a level perpetuity of earnings, is only applicable where earnings are positive. The value of growth opportunities is very sensitive to the number for EPS, which may be volatile. To avoid one-off company surprises that may affect earnings outcomes, both Kester (1984) and Brealey and Myers (1996) base their analyses on earnings forecasts. Following Brealey and Myers, we use the average of the earnings forecast for the current year and the subsequent year[3].

As discussed by Danbolt *et al.* (2002) in their critical review of the KBM model, the model is also sensitive to the assumption regarding inflation. Brealey and Myers (2003) explicitly use a nominal risk free rate. However, if K_s is estimated using the traditional CAPM with a nominal risk free rate, there is an assumption that EPS will remain constant in *nominal* terms. Both Danbolt *et al* (2002) and Wall (2007) question this assumption. As argued by Danbolt *et al*. (2002), “It seems difficult to justify an assumption that the real EPS of UK corporations should decline at exactly the same rate as the purchasing power of the British pound”. (p. 205). Therefore, following Danbolt *et al*. (2002) and Wall (2007), we also estimate the KBM model assuming forecast earnings remain constant in *real* terms.

The real KBM model

As an alternative to the traditional KBM model, we also estimate the KBM model using a real rather than a nominal cost of equity capital (K_{sr}) for estimating the value of assets in place. The model for estimating the percentage of value accounted for by growth opportunities in this case is as follows:

$$\%P_g \ KBM_{real} = \frac{P_s - \frac{EPS}{K_{sr}}}{P_s} * 100 \quad (6)$$

where K_{sr} is estimated using a real risk free rate[4] in the capital asset pricing model, as follows:

$$K_{sr} = K_{fr} + \beta_s (K_m - K_f) \quad (7)$$

The traditional KBM model, by discounting EPS at a nominal rather than a real cost of capital, will tend to overestimate the value of growth opportunities. Wall (2007) notes that the overestimation will be particularly pronounced for low-growth firms. Note that the KBM model (in both nominal and real forms) will generate negative values for growth opportunities in many cases. However, the theoretical literature on 'negative growth' is sparse, and it is not clear that the model is appropriate in these cases. The latest edition of the Brealey and Myers text (Brealey, Myers and Allen 2006) includes an example in which the calculated value is growth opportunities is negative. They note the difficulty of interpreting this result. We shall return later to the problems posed by this issue.

While KBM_{real} adjusts for the effect of inflation, the model may still apply an inappropriate cost of capital. As recognised by Myers and Turnbull (1977), the systematic risk of companies' growth options may differ from the systematic risk of its real assets. Investors may therefore expect a different rate of return on growth opportunities than on assets in place. However, despite this insight, Brealey and Myers use the overall equity beta for estimating the present value of assets in place. If growth options have a higher level of systematic risk than the underlying assets in place, the beta for assets in place (and therefore the cost of capital for assets in place) should be less than the beta (and cost of capital) of equity. The KBM model – even when adjusted for inflation – may therefore apply too high a discount rate for the estimation of the value of assets in place[5], and thus overestimate the value of growth opportunities. The problem of distinct 'asset betas' and 'growth betas' is recognised in the next model.

3.2. The Hirst, Danbolt and Jones model of growth opportunities

Hirst *et al*. (2008) develop an alternative model for valuing growth opportunities. The Hirst, Danbolt and Jones (HDJ) model estimates the value of assets in place based on dividends rather than current (or forecast) earnings. As dividends tend to be more stable than earnings (e.g., Lintner 1956), the valuation of assets in place can be expected to be more stable in the HDJ than in the KBM model. Furthermore, to remove the effect of inflation, HDJ discount using a *real* rather than a nominal cost of capital. From the constant growth, dividend discount model (also known as Gordon's growth model, from his 1959 paper), the value of the share can be derived as the present value of a growing perpetuity of current dividends.

$$P_s = \frac{D_1}{K_{sr} - g} \tag{8}$$

K_{sr}, the company's real cost of equity capital, is calculated as in equation 7 above. D_1 refers to next year's dividend[6], while g refers to the (real) constant rate of growth. HDJ value assets in place as a level perpetuity of dividends for a non-growth company. Assuming the cost of taking up the growth opportunities next year is E*g, where E refers to the book value of equity per share, HDJ derive the value of assets in place as follows:

$$P_a = \frac{D_1 + E * g}{K_{ar}} \tag{9}$$

The cost of capital for assets in place is estimated using CAPM, but using the beta for assets in place, β_a, rather than the overall equity beta, β_s:

$$K_{ar} = K_{fr} + \beta_a (K_m - K_{fr}) \tag{10}$$

However, this still leaves the problem of how to estimate β_a. Hirst *et al*. (2008) show that the beta of the share can be calculated as the weighted average of the beta coefficient for assets in place and the beta for growth opportunities. Assuming that when growth opportunities are exercised the new investment has the same characteristics as the company's existing projects, HDJ show that:

$$\beta_g = \frac{P_a}{P_a \text{-} E} \beta_a \tag{11}$$

If the firm were to abandon its growth opportunities, dividends would remain level perpetuities in real terms (i.e., would grow over time in line with inflation). A consequence of the HDJ model is that the percentage of firm value accounted for by growth opportunities can be expressed as follows:

$$\%P_g \ HDJ = \frac{P_s - \dfrac{D_1 + E * g}{K_{ar}}}{P_s} * 100 \tag{12}$$

For a sample of 2,571 firm-year cases of UK companies with valuable growth opportunities over the 1990-2004 period, Hirst *et al*. (2008) estimate that growth opportunities, on average, account for approximately 33% of equity value.

Limitations of the HDJ model

The HDJ model has a unique feature in that it generates distinct beta values for both assets-in-place and growth opportunities. However, it also has significant limitations. By valuing assets in place based on capitalised dividends, the HDJ model is only applicable to companies paying dividends. While the majority of companies – at least in the UK[7] – pay substantial dividends, a number of firms do not. Furthermore, if high growth companies are the least likely to pay dividends, the application of the HDJ model may be skewed towards companies with lower levels of growth opportunities.

The HDJ model is similarly not applicable for companies with negative or zero book value, or where book value of equity exceeds the share price. Finally, the HDJ model can also generate negative values for growth opportunities. Since the model is very specifically based on company expansion, and expansion and contraction are not necessarily symmetric processes, Hirst *et al*. (2008) argue that these negative values should have no other interpretation than to indicate the absence of growth opportunities. Valuation models for growing firms are well-developed. For shrinking firms they are not. Our empirical analysis has to recognise this fact.

3.3. The Ottoo Excess Market Value models

Several prior studies have used the market-to-book ratio as a proxy for the presence of growth opportunities. If book values proxy for the value of assets in place, and "If the market recognizes the value of firms' growth opportunities, the firms with these opportunities should have market-to-book ratios that exceed one…" (Johnson, 2003, p. 232). Using the same argument, Ottoo (2000) present the Excess Value of the Firm (EVF) and Excess Value of Equity (EVE) models for estimating the value of growth opportunities, based on the extent to which the market-to-book value of assets (or the firm), or the market-to-book value of equity, respectively, exceeds one.

Following Ottoo (2000), we estimate the percentage of value attributable to growth opportunities based on the excess value models as follows:

$$\%P_g\ EVF = \frac{(MV\ Equity + BV\ Debt) - (BV\ Equity + BV\ Debt)}{(MV\ Equity + BV\ Debt)} * 100 \qquad (13)$$

$$\%P_g \ EVE = \frac{MV\ Equity - BV\ Equity}{MV\ Equity} * 100 \qquad (14)$$

where BV debt is calculated as the sum of book values of Loans and Short-term debt.

Ottoo (2000) apply his EVF measure to a sample of 107 US ‘emerging’ firms, which had never issued a cash dividend, and 101 ‘mature’ firms which had paid at least one dividend during the 1987-1993 period. Ottoo find that “On average, 63 percent of the market value of an emerging firm is accounted for by growth opportunities compared with only 7 percent for a mature firm”. (p. 125).

Limitations of the EVF and EVE models

While the market-to-book value, of which the EVF and EVE models are derivatives, is probably the most commonly used proxy for the presence of growth opportunities, these measures are not without limitations.

Excess Value of Equity cannot be meaningfully calculated if the book value of equity is zero or negative. While the Excess Value of the Firm can technically still be calculated with negative book equity – provided the company has a positive value of debt, which exceeds the negative book value of equity, so that the denominator in equation 14 remains positive – a negative book value is arguably unlikely to be an appropriate proxy for the value of assets in place.

However, even for positive values, the book value of equity is arguably an inappropriate surrogate for the value of assets in place. If the company’s current operations are the result of positive NPV investments, the market value of these operations will (at least under historic cost) exceed the book value of these projects by the NPV of future excess earnings. Thus, while EVF and EVE may *proxy* for the presence of growth opportunities, they are arguably likely to underestimate the value of assets in place, and consequently overestimate the proportion of value attributable to growth opportunities.

3.4. Proxies for the level of growth opportunities

In addition to the three measures of growth opportunities outlined above, we also use three proxies for the presence of growth opportunities. These proxies are all widely used in the literature, as discussed above. The detailed descriptions of our proxies are as follows:

Tobin's Q

Tobin (1969) defined *Q* as the ratio between the market value of assets and the estimated replacement cost. However, due to the difficulties in estimating replacement costs, we use a simple market-to-book ratio approximation of Q:

$$Q = \left(\frac{Total\ assets + MV\ equity - BV\ equity}{Total\ assets} \right) \tag{15}$$

It should be noted that our equation for *Q* is similar to that of the calculation of EVF above. However, while EVE is calculated using book value of debt calculated as the sum of Loans and Short-term debt, total assets also includes other liabilities such as trade credit. Still, we would expect *Q* and EVF to be highly correlated.

Earnings/Price Ratio

An alternative proxy for growth opportunities is the earnings/price ratio[8], calculated as follows:

$$\%EP = \frac{EPS}{P_s} * 100 \tag{16}$$

If investors are expecting significant growth in earnings, they will be willing to pay a high multiple of current earnings. Thus, a low EP ratio may be taken as a proxy for the market's expectations of future valuable growth.

The KBM model is closely linked to the inverse of the EP ratio. While both models are based on the relationship between the share price and earnings, the KBM model uses the company's cost of capital in capitalising earnings. As such, the KBM model allows for differences in risk (as captured by β_s in CAPM) when estimating the value of assets in place. By using forecast rather than realised earnings, the KBM model may also avoid the effect of one-off earnings surprises[9]. Still, we would expect the ranking of companies based on their estimated level of growth opportunities to be similar (with negative correlation) whether we undertake the analysis using the KBM measure or the EP ratio.

Dividends/Price Ratio

Growth companies may be expected to pay low dividends, instead retaining their earnings to pay for future investment. Thus, an alternative to the dividend-based HDJ model of growth opportunities is the simple dividends to price ratio (the dividend yield), calculated as follows:

$$\%DP = \frac{D_0}{P_s} * 100 \qquad (17)$$

We take a low DP ratio to be a proxy for high levels of growth opportunities. While there are significant differences between the DP and the HDJ model (not least the use of the risk-adjusted real cost of capital for assets in place in the HDJ model), we expect high negative correlation between the DP and HDJ measures of growth opportunities.

4. The data set

Our analysis of the proxies and measures for the level of growth opportunities is based on data for the UK Financial Times All-Share constituent companies over the period from January 1990 to December 2004[10]. We start with an initial sample of 6,163 firm-years for which we are able to obtain (from *Datastream*) the core accounting and market data required to calculate at least one of the growth opportunities measures.

As can be seen from Table 1, it is not possible to calculate the growth opportunities proxies for all the 6,163 cases in our data set. The calculations fail either because necessary data is missing or because the data has a numerical value that makes it impossible to complete the calculation meaningfully. Since the different measures and proxies require different data, the number of useful cases that can be derived from our data set varies greatly between the different measures and proxies, ranging from 3,769 firm-years for HDJ to 5,970 firm-years for *Q*. To reduce the influence of outliers, we also trim the top and bottom 2.5% of each distribution. In addition, as HDJ explicitly argue that their model is not appropriate for companies with negative growth opportunities, this brings the maximum sample for analysis based on this measure down to 2,515 firm-years. We are able to estimate all eight measures and proxies for a balanced sample of 1,942 firm-years.

Table 1 about here

4.1. Data characteristics: The level of growth opportunities

Descriptive statistics for the growth opportunities measures and proxies are contained in Table 2. It should be noted that even though we have trimmed the top and bottom 2.5% of the distribution of each of the growth opportunities proxies, some large negative values remain. Thus, while the traditional KBM model suggests growth opportunities on average account for approximately 38% of firm value, the median is four percentage points higher, at 42%.

As discussed in section 3.1, by applying a nominal cost of capital, the KBM model may overestimate the value of growth opportunities. Applying a real cost of capital, we estimate the mean proportion of firm value accounted for by growth opportunities to be in the region of 12%. The HDJ model also applies a real cost of capital, but is based on dividends rather than earnings, and also adjusts the beta for the presence of growth opportunities. The HDJ model suggests growth opportunities account for about 30% of firm value.

Ottoo's EVF and EVE market-to-book ratio models, suggest growth opportunities on average account for 60% and 71% of firm value, respectively. However, as discussed in section 3.3, by effectively assuming all current projects were zero NPV investments, EVE and EVF may overestimate the value of growth opportunities.

While the remaining variables may proxy for the level of growth opportunities, they do not give estimates of the proportion of value accounted for by growth opportunities. We obtain a mean *Q* ratio of 2.03, while the EP ratio averages 6.85% and the DP 2.93%.

Table 2 about here

The different measures and proxies clearly produce different estimates for the *level* of growth opportunities. However, do they identify the same companies as having either high or low levels of growth opportunities? We explore this next, by analysing the correlations between the various proxies for the level of growth opportunities.

4.2. Data characteristics: Correlations between growth measures

The correlation matrix between the various growth opportunities proxies is provided in Table 3. Note that we would expect positive correlations between all measures except between the other growth proxies and either EP or DP, for which growth companies are expected to have low values. All the growth measures are significantly correlated, with the predicted sign, with the exception of the correlation between EVE and DP, which is not significant[11].

However, the correlation coefficients vary substantially between the various measures for the level of growth opportunities. While the levels of growth opportunities based on the KBM and KBM_{real} models are very different, these measures of growth opportunities are, as one would expect, highly correlated (correlation coefficient of 0.98). However, the correlations between KBM and the other proxies, while significant, are fairly low. The correlation with the other earnings based measure, EP, is -0.55, while the next highest correlation is with HDJ, at 0.29.

The dividend-based HDJ model is, as one would expect, significantly correlated with the DP, although the correlation coefficient (at -0.55) suggests these models are not perfect substitutes. Somewhat surprisingly, the HDJ model is also significantly correlated with the market-to-book based proxies of EVF, EVE and Q, with correlation coefficients between 0.58 and 0.78. The various market-to-book based proxies are, as one would expect, highly correlated, with correlation coefficients between 0.56 and 0.81.

Overall, while the various proxies and measures for the level of growth opportunities are significantly correlated, the correlation coefficients are far from unity. The proxies and measures are therefore unlikely to be perfect substitutes. This raise an important question: Which proxy is most closely related to future earnings growth? We explore this next.

Table 3 about here

5. Growth opportunities and future earnings growth

Our preferred measure of realised growth is growth in EPS. This variable has been chosen because it most clearly identifies firms which have undertaken valuable, positive NPV, investment projects. However, the choice of this variable causes problems for our analysis.

To avoid spurious correlation with the earnings-based growth proxy (which incorporate EPS_0), we calculate the base level of earnings from which we estimate future earnings growth as the average of earnings for the years t-1 and t+1:

$$EPS_{-1+1} = \left(EPS_{-1} + EPS_{+1}\right)/2 \tag{18}$$

There has been substantial empirical work of the time-series properties of EPS. Both Fama and French (2000), using US data, and Allen and Salim (2005), using UK data, have found strong evidence of mean reversion in the ratio of earnings (before interest and tax) to total assets. In the US, a simple partial adjustment model gives an estimated rate of mean reversion of 38% per year, while for the UK data, the rate is 25%. These findings, as the authors recognise, are not surprising. It is to be expected in a competitive environment, that high profits will be reduced by the arrival of new capacity in the market. Similarly, low profits will tend to rise as competitors and capacity exit. We hypothesise that growth companies will be able to grow EPS, in the medium term, by undertaking positive NPV investments. However, the time series evidence shows that there are other regularities in the pattern of earnings. This underlying pattern must be kept in mind when interpreting our results, and we shall return to this issue later in the paper.

As one-off company surprises may affect earnings outcomes, we calculate realised future earnings as three-year averages of earnings centred 3 and 5 years into the future, as follows:

$$EPS_{+2+4} = \left(\sum_{+2}^{+4} EPS \right) / 3 \tag{19}$$

$$EPS_{+4+6} = \left(\sum_{+4}^{+6} EPS \right) / 3 \tag{20}$$

We also analyse longer term earnings growth, based on the ten year average of earnings from year 2 to year 11:

$$EPS_{+2+11} = \left(\sum_{+2}^{+11} EPS \right) / 10 \tag{21}$$

We measure earnings growth scaled by Total (Book) Assets per share (TAS) at time zero. Growth in earnings from time zero (the average of years -1 and +1) to year three (the average of years 2, 3 and 4) is thus calculated as:

$$EPS\,Growth_{+2+4} = \frac{EPS_{+2+4} - EPS_{-1+1}}{TAS_0} \tag{22}$$

with growth for the other time periods calculated similarly[12]. We recognise that there will be significant errors in the measurement of both the numerator and the denominator of the EPS growth variables. Given the purpose for which we are using them, the accounting measures of earnings and assets may have substantial deficiencies.

5.1. Growth opportunities measures as predictors of earnings growth

On average, the EPS of our sample companies grew by 1.18% of initial total assets from years -1+1 to years +2+4 (EPS Growth_{+2+4}), rising to 1.50% for EPS Grow_{+4+6} and 2.27% for EPS Grow_{+2+11}. Further information about earnings growth for our sample is given in the top section of Table 4.

Table 4 about here

The correlations between our measures of growth opportunities and subsequent earnings growth over the three different time periods are reported in the top section of Table 5. The message from this table is clear. Growth opportunity measures have very little if any link to subsequent realised earnings growth. Over the shortest of our three periods, there is no significant correlation between any of our growth opportunity measures and subsequent growth. For our middle period, the relationship with HDJ is significant at the 5% level and with EVE at the 1% level. However, in both cases the sign of the relationship is opposite to the prediction. EVE predicts lower growth, not higher growth. Over the longest of our three periods, HDJ and EVE continue to have the wrong sign and other measures are insignificant with the exception of EP and DP. Both these variables are significant (at 5% and 1% respectively) and have the predicted sign. Over the longer term, these simple proxies seem to be the best, indeed the only, measures capable of predicting earnings growth. Tobin's *Q*, which, with the other market-to-book measures is the most widely used proxy for growth opportunities, proves to be entirely insignificant over all three time periods. There is support in the literature for this result. For example, while Kallapur and Trombley (1999) found the MTB of assets to be the best proxy for predicting future growth in book values, they found the association to be much weaker for earnings growth.

The more complex growth models have no advantage over the simple proxies. In every case where they have a significant correlation, the sign is wrong. With the partial exception of EP and DP, the outcome of our analysis is that growth opportunity measures don't predict earnings growth.

Table 5 about here

5.2. Growth opportunity measures as predictors of relative earnings growth.

Average earnings have varied with booms and recessions over our sample period, as evident from Figure 1. A major determinant of earnings growth may be the general movement of the economy over that particular time period.

Figure 1 about here

To allow for this effect, we also calculate *Excess* earnings growth, by subtracting the average earnings growth for UK companies during the period of analysis from the measured level of firm growth[13]. Thus, for example, *Excess* Earnings Growth$_{+2t+4}$ scaled by TAS, is calculated by subtracting the growth in general market earnings over the same period (also scaled by TAS). The growth of general market earnings is calculated for each calendar year, and firm excess earnings growth is calculated as the difference between realised earnings growth for firm *i* and the average earnings growth for UK companies during the same time period. Descriptive statistics for excess earnings growth are given in the bottom half of Table 4, while the correlations between the various growth measures and realised excess earnings growth are reported in the bottom half of Table 5.

This method of calculating excess earnings growth ensures that the mean and median of this variable is small. However, when excess earnings growth is correlated with subsequent realised growth, the relationship is no stronger than for unadjusted earnings growth. Over the short period, *Q* is significant at the 10% level. No other purported growth measure is significant at any level. Over the medium term, only HDJ and EVE are significant (at the 5% level), but the relationship has the wrong sign. For our long period, HDJ and EVE still show up as significant but with the wrong sign, while only DP manages to be both significant (at the 5% level) and to have the right sign. Generally the growth opportunity measures perform no better as a predictor of excess earnings growth than they did for unadjusted earnings growth. While only Pearson correlations have been reported here, Spearman correlation gives a very similar picture.

6. The Growth Companies Puzzle

As discussed in the previous section, *none* of the measures used in the literature to identify growth companies actually succeeds in picking out companies which will grow their earnings – the key variable which enhances investment value. We term these results the ‘growth companies puzzle’.

Kallapur and Trombley (1999), using US data and a different set of growth opportunity measures, report similar results. However, they dismiss their findings and suggest that their results are due to measurement errors, the variability of earnings and the removal of companies with negative earnings from the data set.

We, too, have had to remove negative-earnings cases from our data set, but there is no reason to believe that this damages the validity of our results. 16% of the cases in our data set have earnings that are negative, zero, or missing. There is no theoretical reason to suggest that growth opportunity measures should not work successfully for the remaining sub-set of positive-earnings companies. Earnings are surely measured with an error, and after removing the cases with negative earnings, the remaining data set will, on average, have positive earnings residuals. Measurement of subsequent earnings growth from this base will therefore, on average, understate the underlying level of growth in company earnings. However, we would still expect to find that growth opportunities measures had power to distinguish companies according to the rate at which their future earnings will grow.

While errors in the measurement of earnings certainly exist, they are not so large and overwhelming that they have resisted meaningful statistical analysis in other contexts. For example, Ball and Brown (1968) and subsequent papers have shown that share prices are strongly responsive to earnings numbers.

In short, we believe that the 'growth companies puzzle' is a genuine phenomenon, not a statistical mirage. The variety of our own tests, the size of our data set and the fact that our results are consistent with earlier work, all suggest that the 'growth companies puzzle' is a genuine relationship that needs to be investigated and, if possible, explained. This will be the task of the second part of the paper.

6.1. Growth opportunity measures and realised growth in sales, assets, and equity

We now look to see whether companies with growth opportunities grow in dimensions other than earnings. We look at three measures of size growth, specifically sales growth, assets growth and equity growth, and shall investigate how these variables are linked to the eight growth opportunities measures used earlier.

In a similar way to earnings growth, we calculate three year growth in sales, assets and book equity as the change from the average for years -1 and +1, to the average of years 2, 3 and 4. We scale the variables by sales, total assets or equity at time zero. We define each of these variables by the following equations:

$$Sales\,Growth_{+2+4} = \frac{Sales_{+2+4} - Sales_{-1+1}}{Sales_0} \tag{23}$$

$$Total\ Assets\,Growth_{+2+4} = \frac{Total\ Assets_{+2+4} - Total\ Assets_{-1+1}}{Total\ Assets_0} \tag{24}$$

$$Equity\,Growth_{+2+4} = \frac{Equity_{+2+4} - Equity_{-1+1}}{Equity_0} \tag{25}$$

Longer-term growth, $Grow_{+4+6}$ and $Grow_{+2+11}$, are calculated similarly.

The basic statistics relating to each of these variables is shown in Table 6. On average, for our sample, total assets grow most strongly (by an average of 162% for the long period), equity grows by 147%, and sales grow most slowly (127%).

Table 6 about here

Table 7 shows the correlation coefficients between all the different measures of growth. All are highly significantly related, but note that the two measures of earnings growth have a high correlation and the three measures of size growth are also strongly linked. The relationships between earnings growth and size growth measures are notably weaker.

Table 7 about here

Table 8 shows the performance of our eight growth opportunities measures in predicting future size growth. The general conclusion from the table is plain. Growth opportunities measures are far more successful at predicting size growth than earnings growth. Pearson correlations are shown, but the Spearman numbers give a similar picture. The correlation coefficients for all growth opportunity measures and for all time periods have the right sign. However, there are significant differences in the level of the correlation coefficients.

The two KBM measures have very similar levels of performance. Adjusting for inflation does not appear to improve the outcome. Both KBM measures rank near the middle of the league table in predicting size growth. The two Excess Value models also give very similar performances. They are equally poor and rank near the bottom of the league. Indeed, the only measure that is worse is Tobin's *Q*. *Q* is very widely used in the literature to identify growth companies, but its use in this context seems to be a mistake. In our data set, *Q* not only performs badly (along with the other measures) in predicting earnings growth; it also performs badly in predicting our three size growth variables, where alternative growth predictors do much better.

The EP measure performs relatively well, but the best predictors of size growth turn out to be the dividend-based measures DP and HDJ. There are nine sets of correlation coefficients, combining the three different size measures with the three different time periods. HDJ is the 'winner' for five of these sets (in the sense that it has the highest correlation coefficient with subsequent realised growth), and DP is the 'winner' for four. It seems that dividends are the strongest basic source of information about future company size growth. Even then, the correlations with future growth are relatively low.

Table 8 about here

7. Analysis

Our empirical results pose an obvious paradox. Why don't growth companies grow their earnings? The 'growth company', possessing positive NPV investment opportunities, has played a prominent part in the valuation literature from Miller and

Modigliani (1961) onwards. Is it possible to identify such companies in the real world? None of the eight measures used in this paper succeeded in predicting earnings growth, and ours is not the only study to have observed the same absence of a relationship. Kallapur and Trombley (1999) noted the same effect but attributed it to measurement problems and the high variability of earnings.

In the light of the results reported above, this explanation is inadequate. This paper has employed a sizeable data set and used a number of measures of earnings, all of which are averaged over several years. The results should be robust even if earnings are measured with significant errors.

Growth opportunity measures, or at least some of them, do predict company growth in terms of sales, assets and equity. Growth companies are investing and selling more, but this does not seem to be associated with a rise in EPS.

One possibility is that investment is being misdirected. The investment projects that are being undertaken do not cover their cost of capital and do not enhance either earnings or value for investors. There is, of course, a substantial theoretical literature which suggests that managers may undertake investments for reasons other than the benefit to shareholders. But if this was the whole story, and there was no link at all between investment decisions and shareholder interests, then it is hard to believe that the present system of corporate governance could have survived.

There is another possibility consistent with our findings. Growth opportunities measures may successfully identify companies with profitable investment opportunities; those investment may be undertaken; but the EPS of the company overall does not rise because the earnings generated by the new investments are cancelled out by falling earnings on the company’s old assets. To fit our empirical findings, the companies with the strongest growth opportunities would also have to be the companies whose earnings from existing assets was going to fall most steeply.

Is such a model plausible? We would argue that it is. In fact, it is exactly what we should expect in competitive markets where changes in demand are stochastic, new capacity takes time to come on stream, and profits are determined by the level of demand in relation to capacity. When demand is high in relation to production capacity, then

i) Profitability will be abnormally high, and

ii) It will be profitable to embark on an investment programme to expand capacity.

As capacity is expanded to meet demand, profitability for the company (and the industry) will fall to normal levels. The studies of Fama and French (2000) and Allen and Salim (2005) have demonstrated the tendency of profit levels to revert to the mean, and, in their explanation for this phenomenon they have suggested that high profits are eroded by the arrival of new capacity and low profits are raised by the removal of capacity. If growth/investment opportunities are viewed in this context, the relationship between growth opportunities and future earnings growth becomes unpredictable. While the growth in equity and total assets may be the result of positive NPV investment, the profits gained on the new investment may or may not exceed the reduction in profit on the original assets. We have no way to predict whether the total earnings of companies with growth opportunities will rise or fall.

8. Conclusion

This paper has assessed the ability of eight different growth opportunity measures to predict subsequent firm growth. The first part of the paper looks at the ability to predict earnings growth, the type of growth that theory suggests is most directly associated with growth companies and which is most directly linked to shareholder value. Using UK data drawn from all companies in the Financial Times All Share Index over the 15 year period 1990 – 2004 inclusive, we find that none of the measures is successful in predicting earnings growth. We term this finding the 'growth companies puzzle'. We argue that the 'puzzle' is a genuine finding, not a statistical aberration or the product of measurement errors, and that it needs explanation.

The second part of the paper tests the ability of the eight growth opportunities measures to predict company growth in sales, assets and equity. Here our results are very different. Growth opportunities measures do succeed in predicting growth in these other dimensions, although some measures perform notably better than others. Tobin's *Q* performs poorly. The two dividend-based measures perform best.

The paper suggests a possible explanation for these apparently conflicting results. The inability of the growth opportunities measures to predict earnings growth is in marked contrast to the significant correlation between most growth opportunities measures and size-based measures of subsequent firm growth. If higher profitability in a competitive market is associated with a shortage of production capacity, then investment in new capacity will have a positive NPV, but will also tend to reduce the profit associated with existing capacity. For growth companies the net effect on a company's EPS becomes unpredictable. Studies which show strong patterns of mean-reversion in company earnings would be consistent with this explanation.

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Table 1. Sample

		KBM	KBM_{real}	HDJ	EVF	EVE	Q	EP	DP
Initial sample	6,163								
Missing data:									
EPS forecast missing, negative or zero		-1,012	-1,012						
EPS_0 missing								-1,017	
Beta missing		-712	-712	-1,042					
Dividend missing or zero				-594					
Dividend missing									-854
Book value of equity missing or negative				-110	-205	-205	-205		
Price below book value				-648					
Book value of debt missing					-53				
Total Assets missing							-88		
		4,439	4,439	3,769	5,905	5,958	5,870	5,146	5,309
Outliers									
Trim top and bottom 2.5%		-221	-221	-189	-295	-297	-293	-152	-266
Estimated HDJ P_g negative				-1,065					
Maximum sample for growth proxies		4,218	4,218	2,515	5,610	5,661	5,577	4,994	5,043
Balanced sample	1,942								

The table contains information on the sample construction. We start with an initial sample of 6,163 firm-years for UK Financial Times All-Share constituent firms over the period from 1 January 1990 to 31 December 2004 with sufficient data for the calculation of at least one of the growth opportunities proxies applied in this study. The variables are various measures or proxies for the level of growth opportunities, with KBM referring to the level of growth opportunities as measured using the Kester-Brealey-Myers model (with a nominal cost of capital); KBM_{real} to the Kester-Brealey-Myers model with a real cost of capital; HDJ to the Hirst-Danbolt-Jones model for measuring growth opportunities; EVF to the Excess Value of the Firm, or the extent to which the market-to-book value of total assets exceed 1; EVE to the Excess Value of Equity, or the extent to which the market-to-book value of equity exceed 1; *Q* to Tobin's *Q*, EP to the percentage Earnings yield; and DP to the percentage Dividend yield. Where observations fail several data requirements, they are only recorded under "missing data" once, based on the first item of missing data.

Table 2. The Level of Growth Opportunities

	N	Mean	Median	Std.	Min.	Max.	Q1	Q3
Measures of growth opportunities								
KBM	1,942	38.44	42.49	26.05	-84.34	98.82	26.03	55.68
KBM_{real}	1,942	11.55	16.76	38.11	-146.06	98.30	-7.56	37.11
HDJ	1,942	30.09	27.48	20.20	0.02	80.28	12.81	44.33
EVF	1,942	60.16	61.91	19.12	4.91	94.85	47.45	74.78
EVE	1,942	71.18	73.10	16.45	12.33	97.71	60.41	84.26
Growth proxies								
Q	1,942	2.03	1.82	0.82	1.02	5.96	1.48	2.31
EP	1,942	6.85	6.44	3.36	0.07	22.58	4.82	8.16
DP	1,942	2.93	2.85	1.20	0.56	7.39	2.08	3.68

The variables are as defined in Table 1.

Table 3. Correlation Matrix for Measures of Growth Opportunities and Growth Proxies

	KBM	KBM_{real}	HDJ	EVF	EVE	*Q*	EP
KBM							
KBM_{real}	0.977***						
HDJ	0.294***	0.284***					
EVF	0.140***	0.100***	0.661***				
EVE	0.089***	0.056**	0.778***	0.806***			
Q	0.233***	0.233***	0.576***	0.721***	0.555***		
EP	-0.545***	-0.556***	-0.201***	-0.097***	-0.043*	-0.237***	
DP	-0.192***	-0.201***	-0.551***	-0.081***	-0.008	-0.239***	0.293***

The table contains the Pearson correlation coefficients between the various measures of growth opportunities and growth proxies. The variables are as defined in Table 1. *, **, and *** indicate that the coefficients are significant at the 10%, 5% or the 1% level, respectively.

Table 4. Realised Future Earnings Growth

	N	Mean	Median	Std.	Min.	Max.	Q1	Q3
Earnings Growth								
EPS $Grow_{+2+4}$	1,631	0.0118	0.0098	0.0550	-0.2434	0.2374	-0.0063	0.0338
EPS $Grow_{+4+6}$	1,352	0.0150	0.0118	0.0759	-0.3211	0.3918	-0.0170	0.0466
EPS $Grow_{+2+11}$	665	0.0227	0.0113	0.0672	-0.2319	0.3854	-0.0092	0.0460
Excess Earnings Growth								
Exc. EPS $Grow_{+2+4}$	1,631	-0.0061	-0.0065	0.0538	-0.2446	0.2208	-0.0265	0.0157
Exc. EPS $Grow_{+4+6}$	1,352	-0.0035	-0.0064	0.0745	-0.3300	0.3818	-0.0351	0.0273
Exc. EPS $Grow_{+2+11}$	665	0.0006	-0.0010	0.0675	-0.2571	0.3626	-0.0311	0.0236

Earnings growth is calculated as specified in equation 22, while the calculation of and Excess (market adjusted) earnings growth is explained in section 5.2 of the paper.

Table 5. Growth Opportunities and Future Realised Earnings Growth

	Predicted sign	$Grow_{+2+4}$	$Grow_{+4+6}$	$Grow_{+2+11}$
Earnings Growth				
Sample		1,631	1,352	665
KBM	+	0.030	0.043	0.054
KBM_{real}	+	0.040	0.039	0.058
HDJ	+	-0.014	-0.069**	-0.070*
EVF	+	0.015	-0.000	-0.051
EVE	+	-0.033	-0.074***	-0.151***
Q	+	0.030	-0.001	0.004
EP	-	-0.015	-0.022	-0.082**
DP	-	-0.008	0.025	-0.105***
Excess Earnings Growth				
Sample		1,631	1,352	665
KBM	+	0.022	0.028	0.042
KBM_{real}	+	0.020	0.029	0.038
HDJ	+	-0.003	-0.066**	-0.073*
EVF	+	0.034	0.006	-0.049
EVE	+	-0.011	-0.069**	-0.147***
Q	+	0.045*	0.016	-0.003
EP	-	0.012	-0.013	-0.063
DP	-	-0.006	0.018	-0.091**

The table contains Pearson correlation coefficients between realised earnings growth and various measures and proxies for the level of growth opportunities. *, **, and *** indicate that the coefficients are significant at the 10%, 5% or the 1% level, respectively. Cells which are shaded indicate that the coefficient is significant and of the predicted sign.

Table 6. Alternative Measures of Realised Future Company Growth

	N	Mean	Median	Std.	Min.	Max.	Q1	Q3
Sales Growth								
Sales $Grow_{+2+4}$	1,636	0.4380	0.3420	0.4458	-0.4145	2.7165	0.1486	0.6066
Sales $Grow_{+4+6}$	1,370	0.8254	0.5974	0.9214	-0.5303	5.4356	0.2422	1.1229
Sales $Grow_{+2+11}$	666	1.2677	0.8404	1.4046	-0.4521	8.0218	0.3515	1.6744
Total Assets Growth								
TA $Grow_{+2+4}$	1,633	0.5149	0.3909	0.5475	-0.4178	3.1919	0.1688	0.6793
TA $Grow_{+4+6}$	1,371	0.9988	0.6912	1.1507	-0.5128	7.1967	0.3141	1.2807
TA $Grow_{+2+11}$	670	1.6167	1.0109	2.0019	-0.3810	11.6506	0.4468	1.8987
Equity Growth								
EQ $Grow_{+2+4}$	1,598	0.5122	0.3835	0.6109	-0.5207	3.9077	0.1485	0.6722
EQ $Grow_{+4+6}$	1,342	0.9630	0.6420	1.1922	-0.5826	7.4972	0.2219	1.2560
EQ $Grow_{+2+11}$	636	1.4722	0.9134	1.8277	-0.3219	12.0582	0.3843	1.8877

Sales growth, Total Assets growth and Equity growth are calculated as specified in equations 23, 24 and 25 in the paper.

Table 7. Correlation Coefficients Between Various Measures of Future Growth

	Earnings growth	Excess Earnings Growth	Sales Growth	Total Asset Growth
$Grow_{+2+4}$				
Earnings Growth				
Excess Earnings Growth	0.973***			
Sales Growth	0.205***	0.210***		
Total Asset Growth	0.183***	0.194***	0.751***	
Equity Growth	0.187***	0.201***	0.569***	0.742***
$Grow_{+4+6}$				
Earnings Growth				
Excess Earnings Growth	0.985***			
Sales Growth	0.222***	0.223***		
Total Asset Growth	0.197***	0.198***	0.802***	
Equity Growth	0.160***	0.171***	0.635***	0.789***
$Grow_{+2+11}$				
Earnings Growth				
Excess Earnings Growth	0.998***			
Sales Growth	0.292***	0.291***		
Total Asset Growth	0.251***	0.250***	0.833***	
Equity Growth	0.206***	0.206***	0.657***	0.881***

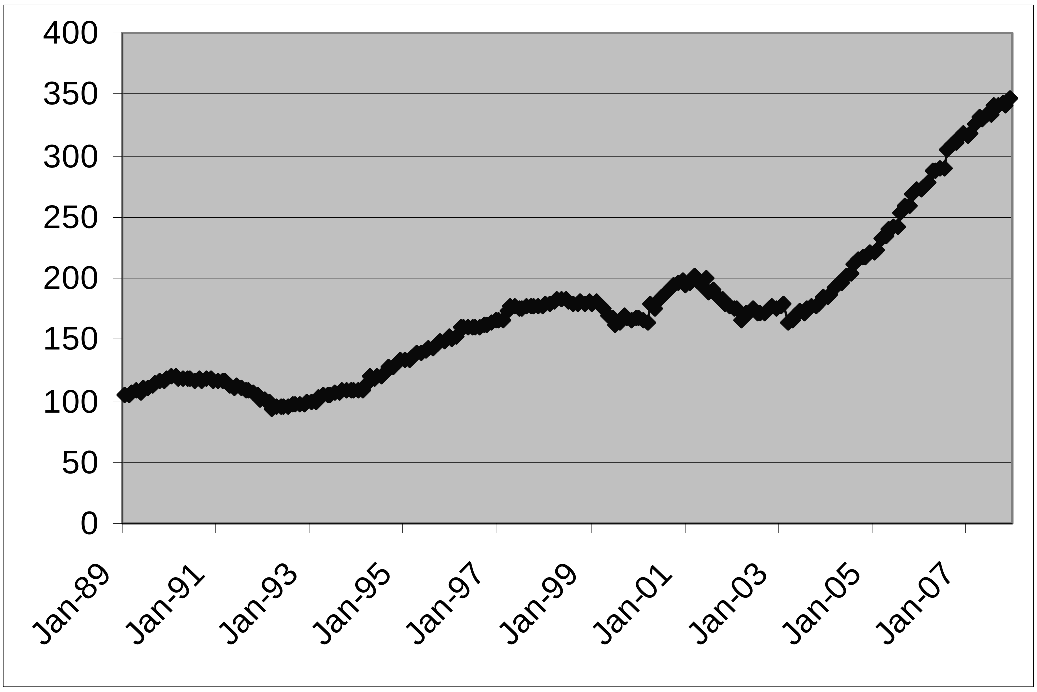
The table contains the Pearson correlation coefficients between the various measures of realised future firm growth. *, **, and *** indicate that the coefficients are significant at the 10%, 5% or the 1% level, respectively.

Table 8. Growth Opportunities and Company Sales, Assets and Equity Growth

	Predicted sign	$Grow_{+2+4}$	$Grow_{+4+6}$	$Grow_{+2+11}$
Sales Growth				
Sample		1,636	1,370	666
KBM	+	0.131***	0.152***	0.147***
KBM_{real}	+	0.132***	0.143***	0.129***
HDJ	+	0.138***	0.136***	0.234***
EVF	+	0.035	0.044	0.087**
EVE	+	0.029	0.048*	0.090**
Q	+	0.032	0.018	0.054
EP	-	-0.056**	-0.079***	-0.126***
DP	-	-0.176***	-0.154***	-0.264***
Total Assets Growth				
Sample		1,633	1,371	670
KBM	+	0.127***	0.136***	0.094**
KBM_{real}	+	0.128***	0.131***	0.082**
HDJ	+	0.148***	0.161***	0.199***
EVF	+	0.056**	0.067**	0.104***
EVE	+	0.053**	0.083***	0.124***
Q	+	0.057**	0.066**	0.081**
EP	-	-0.077***	-0.098***	-0.126***
DP	-	-0.168***	-0.143***	-0.165***
Equity Growth				
Sample		1,598	1,342	636
KBM	+	0.068***	0.086***	0.061
KBM_{real}	+	0.072***	0.088***	0.043
HDJ	+	0.208***	0.221***	0.184***
EVF	+	0.108***	0.129**	0.067
EVE	+	0.140***	0.165***	0.142***
Q	+	0.053**	0.091***	0.033
EP	-	-0.037	-0.087***	-0.107***
DP	-	-0.143***	-0.129***	-0.114***

The table contains Pearson correlation coefficients between realised future growth in sales, total assets and equity and various growth opportunities measures. *, **, and *** indicate that the coefficients are significant at the 10%, 5% or the 1% level, respectively. Cells which are shaded indicate that the coefficient is significant and of the predicted sign.

Figure 1. Time-series of earnings for UK total market index



Notes

[1] We have not included a number of other variables which make more fleeting appearances in the literature, such as gearing, R&D and share price volatility.

[2] While the model was included in the 1st edition (1981) of the Brealey and Myers textbook, the model was more fully discussed and given more prominence from the 4th edition (1991) onwards.

[3] We use the average of the consensus I/B/E/S earnings forecast, at the financial year end, of current year earnings (F1MN) and earnings for the following year (F2MN).

[4] We use the yield on index linked Gilts as the real risk free rate.

[5] The KBM model estimate the value of assets in place based on K_s (using the overall equity beta, β_s) rather than the cost of capital for assets in place, K_a (using the beta for assets in place, β_a).

[6] D_1 is estimated from current dividends, adjusted by the estimated growth rate.

[7] In their study of the dividend behaviour of UK listed companies over the 1990s, Renneboog and Trojanovski (2005) found 85% of the firms to pay dividends, with dividend yields averaging 3.1%.

[8] We base the analysis on EP rather than the inverse PE ratio to reduce the influence of outliers when EPS is small.

[9] In the EP model, we use EPS_0.

[10] The subsequent analysis of future earnings growth is based on EPS data for the period from January 1989 to December 2007.

[11] There is overall relatively little difference in the correlations whether we base the analysis on Pearson or Spearman (rank) correlations. We therefore simply report and discuss the Pearson correlations.

[12] Earnings growth measures are only calculated if data is available for each firm year in that earnings measure. Thus, for EPS $Grow_{+2+4}$, EPS data must be available for years -1, 1, 2, 3 and 4. However, in order to reduce survivorship bias, we do not require data to be available for all growth measures. In the calculations that follow, we use the earnings per share measure WC05201 (obtained from *Datastream*), which include negative earnings. (Note the Datastream variable 'EPS' gives a value of zero for loss-making firms, and is as such not suitable for our analyses).

[13] From our total dataset of 6,163 observations, we are able to estimate EPS $Growth_{+2+4}$ for 4,794 firm-years, EPS $Growth_{+4+6}$ for 3,672 firm-years, and EPS $Growth_{+2+11}$ for 1,809 firm-years. We use the earnings growth for these samples to estimate market EPS Growth. Market earnings growth is calculated for each calendar year, based on between 133 and 460 observations.