Measuring the Performance of Large Australian Firms

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Abstract: This paper is concerned with the measurement of company performance in the context of the IBIS panel data set of large Australian firms. The analysis provides a framework which distinguishes between: 'static,' 'comparative static' and 'dynamic' measures; and 'partial,' 'multiple' and 'total' measures. The chapter demonstrates that all of these measures are related to economic measures of firm profitability. Thus, some time is spent in defining profits and, in doing so, developing the linkages between economic and accounting concepts of performance. Finally, it relates the discussion of the conceptual issues of measuring performance to the information available in the IBIS database.

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1. Introduction

1.1. Introduction and background

Growing international competition has produced enormous pressure for Australian firms to become more efficient. A failure to keep pace with the improvements amongst foreign competitors results in increased import penetration, reduced exports, trade deficits, brancruptcies, liquidations and job losses. The static and dynamic performance of Australian companies is therefore of crucial concern. This chapter argues that a complete understanding of performance requires a knowledge of the range of measures available and the relationships between them.

The principal focus of the present paper, therefore, is to establish what is meant by firm performance. In doing so, we outline a number of the more important of the existing measures to be found in the literature, consider the ways in which these measures are related to one another and develop a taxonomy that can be used to understand these relationships. Key dimensions of this taxonomy concern the distinctions between ‘partial’ and ‘total’ and between ‘static’ and ‘dynamic’ measures of efficiency. We will see that economists and accountants tend to come at these measures from somewhat different directions, even if both begin from an accounting tautology. In the final analysis the precise choice of measure depends crucially on the use to which it is to be put. For example, measures of labour productivity change are important in the context of understanding changes in employment opportunities, but of only limited use in revealing the overall performance of companies and the resources at their disposal for investment in dynamic activities.

Our main focus is on overall company performance, rather than ‘partial’ indicators, such as labour productivity. In practice, it becomes clear during the discussion not only that the indicators are all linked to firm profitability, but that the linkage becomes closer as we move from ‘partial’ to ‘total’ measures. It seems important therefore to define what we mean by profits. Here we will see differences between the economic and accounting concepts of profits and between the way in which profits are conceptualised and how the measures are operationalised in company accounts. Such differences are particularly significant in the context of a study such as this, which draws heavily on firm accounts data in an analysis of economic perfomance. It is important from the outset to be clear that not all of these issues can be resolved given the data available.

In order to place the discussion of the economic concept of profits in context, it is important to say a few words about our underlying view of firm behaviour. We perceive firms as seeking to establish and exploit monopoly positions (Cowling and Mueller, 1978 and 1981; Littlechild, 1981). This should not be interpreted as implying that monopoly necessarily provides the greater stimulus to invention (related to the Schumpeterian hypothesis), only that firms undertake activities to maintain or enhance their future monopoly position. Part of current monopoly profits are reinvested in dynamic activities, such as R&D, advertising, training and the like, with a view to maintaining and increasing the firm's future monopoly position. The resulting flows of future monopoly rents provide the justification for the current investments. Note also that the 'static' efficiency of the firm at any given point in time, at least in part, is the result of its past investments in dynamic activities. The 'static' efficiency also effectively dictates what resources are available at that time for discretionary investments, such as research and development, that can be used to enhance future performance.

Section 2 continues with a brief review of performance measures found in the literature, with particular regard to Australian results. Section 3 provides a brief outline of the static and comparative static measures of productive efficiency. It develops a general accounting framework that can be used to explore both factor productivity and unit cost measures, and demonstrates that partial measures are nested within multiple and total performance indicators. In addition it argues that, while it is possible to analyse factor productivity change in the context of perfect competition, a fuller understanding requires the more general assumption of some degree of monopoly power. Finally, all of the measures can be shown to relate to the profit performance of the company. Section 4 considers dynamic performance, linking this to the intangible assets of the company. The discussion refers to the two principal themes to be found in the literature, relating to the 'knowledge production function' and 'market value' (Tobin's q) approaches. In particular, this section brings together the discussion of profits, dividends and market value of the firm. One outcome of this is to demonstrate that the 'backward looking' empirical specifications normally used to estimate the Tobin q model, outlined in Section 2, are significantly divorced from the 'forward looking' expectational relationships which underpin the determination of market values. Section 5 relates the earlier conceptual discussion to the practical issue concerning the measures of firm peformance that can be constructed from the IBIS data base. Finally, Section 6 draws the main conclusions of this paper.

1.2. Outline and approach

The paper focuses on the measurement of company performance in the context of the IBIS panel data set of large Australian companies. In doing so, it makes a distinction between: 'static,' 'comparative static' and 'dynamic' measures; and 'partial,' 'multiple' and 'total' measures. The paper is based upon an encompassing framework developed as background to this study, within which the various key indices reported in the literature are nested. In addition, it begins to provide linkages between economic and accounting concepts of performance, with a view to discussing the measures of performance available from the IBIS panel data base of large Australian companies.

The paper suggests that there are often good reasons to examine partial ‘static’ and ‘comparative static’ measures of firm performance. Labour productivity indices, for example, provide insights about employment prospects—in particular, when the rate of growth of labour productivity exceeds that of product demand, employment will be falling. On the other hand, the discussion makes it clear that it is generally difficult to make any inferences about overall performance from a single, partial measure. Rapid growth in labour productivity, for example, may be caused by a substitution towards capital or towards raw materials and intermediate inputs. Thus, the gains from rapid labour productivity growth may be off-set by low or even negative productivity growth amongst other factors.

While a somewhat clearer picture emerges if we examine total factor productivity, this still omits the role played by changes in factor and product prices. We demonstrate that it only really makes sense to explore this dimension of performance under conditions of imperfect competition: product price increases under perfect competition are simply a weighted sum of exogenously given factor price increases. It is shown elsewhere that the ‘static’ and ‘comparative static’ cost performance of the firm not only depends upon the rates of factor price increases, but also on a combination of the share of profits in total revenue and the own price elasticity of demand.

All of these indicators are shown to be subsumed within a profits-based measure, where actual performance is contrasted with the counterfactual of what would have happened in the absence of productivity change. Profits at a given point in time reflect an overall or ‘total,’ ‘static’ or ‘comparative static’ measure of firm performance. It is the profit stream over some longer-term period, or some summary measure of this stream, that provides a ‘total,’ ‘dynamic’ measure of firm performance. This view reflects our underlying conceptual model of firm behaviour, in which firms invest in tangible and intangible assets in an attempt to maintain or enhance their future monopoly power and profits stream. It is the (expected) additional future monopoly rents that are used to justify current discretionary investments in research and development, advertising, training, etc. This leads the paper to discuss the role of intangible assets in particular, drawing on both the ‘knowledge production function’ and ‘market value’ (Tobin’s q) approaches.

This message is reinforced in the market valuation approach to the measurement of dynamic firm performance. The review of the existing empirical literature describes the way in which the market valuation functions have normally been empirically specified, based upon Tobin’s q. This suggests that the current market value of the company is a function of its stocks of tangible and intangible assets. These stocks are again often constructed as perpetual inventory measures of past investments, appropriately depreciated, in tangible and intangible assets. This approach provides a method of obtaining a current valuation of the long-run contribution of investments in intangible assets, based upon the perceptions of (potential) investors. The analytical work presented in this chapter, however, suggests that the traditional empirical specifications are almost entirely ‘backward looking’, while market value is really driven by the expected future profits or dividends of the company which is almost entirely a ‘forward looking’ concept. Indeed, the paper demonstrates that both past and future investments in tangible and intangible assets determine expected future profit and dividend flows and, therefore, current market values. As a consequence, it appears extremely difficult to place any simple interpretation on the meaning of the coefficient estimated form a traditional Tobin’s q specification.

Having established a conceptual framework for the analysis of firm performance, we turn to the measures which can be constructed from the IBIS database. The partial measures, which were argued to be highly imperfect indicators of overall performance are, anyway, not available from the IBIS data. The strength of the IBIS database is in the measures of profitability that it provides, which we argued to be closely linked to overall or ‘total’ measures of performance. The absolute level of profits, however, is unlikely to be a reliable guide to performance unless some allowance is made for firm size. Profitability ratios offer a more reliable route and the chapter indicates a number that can be constructed from the IBIS data, including: return on equity, which is defined as profits after tax over shareholders’ funds; return on assets, which is defined as earnings before interest and tax over total assets; and EBIT margin, which is defined as earnings before interest and tax over revenue. A further measure, which requires information about market values, is gross market value over total assets, which is defined as market capital of equity and hybrids plus book debts over total assets. Another solution to the problem of size bias is to calculate the change in profits over time, although, again, some thought must be given to which profit line is chosen (ie. profits after tax would be affected by changes in tax rates, while both profits before and after tax would be sensitive to changes in interest rates and gearing).

The discussion then considers how closely the measures based upon accounting profit correspond to the desired measures of economic performance. It is argued that the two approaches are likely to differ least when considering the overall or ‘total’ long run performance of companies.

2. Review of the Literature

There is an enormous literature considering the definition and measurement of firm performance, as well as providing empirical estimates of performance. The following section introduces previous work that is pertinent to the analysis that follows, under the headings “‘Static’ Productivity and Efficiency,” “Dynamic Productivity and Performance” and “Market Valuation,” and introduces some threads that will be taken up in later sections.

2.1 ‘Static’ Productivity and Efficiency

It is well known that accounting profit is an imperfect proxy for economic profit. While economic profit focuses on expenditures at the time that they occur, accounting profit does not deduct all expenditures when they are made, but rather capitalises a number of different types of expenditure on the balance sheet and then depreciates or amortises them over time through the profit and loss statement. For example, the economic definition of profit correctly deducts expenditures on plant and equipment at the time the expenditure occurs, whereas accounting profits are calculated by capitalising the investment expenditure on the balance sheet (as an asset) and then depreciating the asset over its useful life (Copeland and Weston, 1992, page 24). Also, future monopoly profits may be capitalised in the value of the firm's assets in the form of goodwill, patents or trademarks (Krouse, 1990, page 422).

Copeland and Weston (1992) show that for an all-equity firm with no taxes, accounting profit can be transformed into economic profit by subtracting from accounting profit the gross value of investment undertaken during the year less the change in accumulated depreciation during the year. Krouse (1990) notes that when economic and accounting profits exhibit the same constant exponential rate of growth, the "staging" differences between accounting and economic profits wash out and the accounting and economic rates of return are equal. Bain (1951) showed that the ratio of accounting profits to shareholders' funds was highly correlated with the ratio of excess profits to sales, his ideal theoretical measure of profitability (the return on shareholders' funds is employed as a measure of profitability in Bosworth, Dawkins, Harris and Kells, 1997).

Noting that accounting profit is the sum of economic profit and the opportunity cost of a firm's investments, Krouse (1990) shows that the (economic) profits to sales ratio is equal to the following expression: $(p^a - r^*k)/R$, where p^a is accounting profit, r^* is an appropriate risk-adjusted rate of return, k is the opportunity cost of the firm's net investments and R is the firm's sales revenue. This expression demonstrates that the ratio of accounting profits to sales is "deficient" as a proxy for economic profits to sales to the extent that it ignores the value of $r^*(k/R)$ (Krouse, 1990, page 423).

A number of empirical studies have exploited the relationship that exists between certain measures of profitability and a commonly used measure of market power. Lerner's (1934) index of monopoly power, the ratio of a firm's price-cost margin to the price faced, has been shown, for constant marginal cost, to equate to the firm's profit to sales ratio (Krouse, 1990, page 421). Numerous researchers have used this relationship between profits to sales and market power to examine the relationship between industry concentration and firm profits (see Weiss, 1974, Long and Ravenscroft, 1984). Hyde (1997) utilises this relationship to examine market power in the Australian petroleum industry. For a more comprehensive overview of the literature concerning empirical estimates of firm performance, the reader is referred to the report of the **Industry Commission**... [Discuss Baumol's disease?].

2.2. Dynamic Productivity and Performance

The Knowledge Production Function

We specify the production function in the following form:

$$S_t = p(Q_t)Y_t = A\sum_{i=1}^{m} I_{t-i}^{\alpha_i} E_t^{\beta} M_t^{\gamma} \sum_{j=1}^{n} R_{t-j}^{\rho_j} \qquad (1)$$

where p(Q) is the component of price reflecting the changing quality of the product (Bosworth and Gharneh, 1995); Y is the volume of gross output, I is investment in tangible assets (ie. plant and machinery), E denotes employment, M is raw materials and intermediate inputs, and R is research and development (for an example, see Schott, 1978).[i] In what follows, E and M are treated as current inputs, which are supplied competitively by the market. I and R are the dynamic investments by the firm which form the mechanism by which new technologies are introduced and which allow the firm, in principle, to earn abnormal profits in the longer term. In other words, investments in I and R are undertaken as part of future rent-seeking behaviour.[ii] The R variables in equation (1) can be thought of as explaining the residual factor derived from a growth accounting approach. Thus, if this period's R&D is 'expensed,' its outputs should be observed in the stream of future profits as the equation controls for the physical volumes of current inputs into the production process. The reason for specifying the production function in this form is not to say something about the productivity of different vintages of capital, but about the key role of the rate of depreciation of both tangible and intangible assets. If I and R refer to the original (gross) values, then the relative values of the $\propto_i$ (across i) and ρ_j (across j) will reflect the rates of depreciation of the two types of assets respectively.

The contribution of the intangibles, R, can be written:

$$\frac{\partial S_{t+1}}{\partial R_t} = \rho_1\left[\frac{S_{t+1}}{R_t}\right], \frac{\partial S_{t+2}}{\partial R_t} = \rho_2\left[\frac{S_{t+2}}{R_t}\right] \ldots \frac{\partial S_{t+n}}{\partial R_t} = \rho_n\left[\frac{S_{t+n}}{R_t}\right] \qquad (2)$$

and, although we do not report it directly, an analogous relationship can be written for the role of investment in tangible assets (see Hall and Mairesse, 1995; Griliches, 1995).[iii]

2.3. Market Valuation

The principal alternative is to use the market's assessment of the value of the company's tangible and intangible assets. For limited companies, the literature suggests that, "...the principle of maximisation of shareholder wealth provides a rational guide for running a business and for the efficient allocation of resources in society...” (Horne, et al. 1990. p.14). Following the Tobin’s q literature, market value can be defined somewhat more broadly to reflect the market value of equity, preference shares and debt. Market value is a forward looking measure which reflects the stream of future profits and is, therefore, not so sensitive to short term random factors as the current profitability. On the other hand, it is subject to the issue of how the market views long-term investments and, thereby, the effects of imperfect and asymmetric information and short-termism. In general capital markets are assumed to be efficient, but short-termism has been hotly debated in a number of countries.

The relationship underlying the market value approach can be viewed as an extension of Tobin’s q (Tobin, 1969), incorporating not only the tangible, K, but also the intangible assets, G, of the company (Hall, 1993, Bosworth and Stoneman, 1994):[iv]

$$V_t = f(K_t, G_t) \tag{3}$$

where, V denotes the market value of the company. V can be valued as equity, plus preference shares and debt, and can be conceptualised as the amount that a buyer would have to pay for the company as a going concern. In the long term we may think of this as the discounted sum of future dividends (and interest). The market valuation approach appears to be based upon the following type of expression for intangible assets:

$$G_t = g\left[\phi_1 R_{t-1}, \phi_2 (1-\delta^R_{t-2}) R_{t-2}, \ldots, \phi_n (1-\delta^R_{t-n}) R_{t-n}\right] \tag{4}$$

We should note that ϕ_j is the market valuation of R&D carried out j periods ago and, in addition, δ^R is the rate of depreciation of the R&D asset created. The stock of tangible assets is again given by an analogous expression. In much of the empirical work to date, however, the stocks have been measured as some form of net of depreciation perpetual inventory measure, in the case of intangibles, $R_t = \sum_{j=1}^{n} R_{t-j}(1-\delta^R)^{j-1}$, (also on occasion, by analogous patent measures); and the value of intangibles is then approximated by $G_t = \phi R_t$ (where ϕ is some weighted average of the ϕ_j outlined above). This parallels the use of perpetual inventory measures of tangible assets. The potential problems of prejudging the weights are fairly obvious (see, for example, the discussion in Hall, 1993).

In order to simplify matters, in what follows we assume that there is a constant rate of depreciation and that, once depreciation is accounted for, the market values of each unit of R&D are equally valued, at ϕ. However, before doing so, it seems important to be clear about the implications of this. The distinction between the two weights, ϕ and $(1-\delta^R)$, may not be artificial in this context, for example, where measures are based upon accounting conventions there may be a distinction between the market and accounting valuations. More fundamentally, however, there may be a difference between the economic value of the 'real' amount of the asset remaining and the market's valuation of the remaining 'volume' of the asset. In other words, the market may simply get it wrong, at least in the short run.

In the case of intangibles, therefore,

$$G_t = (1-\delta^R)G_{t-1} + \phi R_{t-1} \tag{5}$$

and, if as previously, the relationship can be assumed to hold for all periods:

$$G_t = \phi[R_{t-1} + (1-\delta^R)R_{t-2} + (1-\delta^R)^2 R_{t-3} + (1-\delta^R)^{n-1}R_{t-n}] + (1-\delta^R)^n G_{t-n} \tag{6}$$

where the final term disappears as $n \rightarrow \infty$ if $0<\delta^R<1$. Equation (9) represents the way in which the stock of intangibles has normally been included in the empirical literature, as a perpetual inventory measure of the net stock of R&D (or other IP). A similar equation can clearly be written for the returns to investment in physical plant and machinery.

3. Static and Comparative Static Measures of Productive Efficiency

It is possible to demonstrate that the various static measures can be derived from the general accounting tautology:

$$pY = \sum_{i=1}^{n} w_i X_i + \Pi \tag{7}$$

where: R is total revenue, formed as price, p, times output, Y; total costs, C, are formed by factor prices, w, multiplied by the volume inputs, X, summed across the n different types of inputs, i=1, ..., n; finally, Π denotes total profit (we return to the definition of profit in more detail below). The static measures traditionally found in the literature are fairly easily linked to equation (1). The principal ones are measures of physical productivity, such as $\frac{X_j}{Y}$, and real unit costs, $\frac{w_j}{p}\frac{X_j}{Y}$. We leave the discussion of these at this stage, partly because much of what we have to say about the strengths and limitations of the comparative static measures carries over directly.

Allowing imperfect competition, p=**p**(Y), total differentiation of equation (*) can be written as[v],

$$\frac{\Pi}{pY}\left[\frac{1}{\Pi}\frac{d\Pi}{dt}\right] = \sum_{i=1}^{n}\frac{w_iX_i}{pY}\left[\frac{1}{p}\frac{dp}{dt} - \frac{1}{w_i}\frac{dw_i}{dt} + \frac{1}{Y}\frac{dY}{dt} - \frac{1}{X_i}\frac{dX_i}{dt}\right] + \frac{\Pi}{pY}\left[\frac{1}{p}\frac{dp}{dt} + \frac{1}{Y}\frac{dY}{dt}\right] + \frac{1}{\varepsilon_p}\left[\frac{1}{Y}\frac{dY}{dt}\right] \qquad (8)$$

where ε_p denotes the own-price elasticity of demand. However, this particular form of the equation clearly exhibits the linkages between profitability, productivity and unit costs. The first part of the right hand side confirms that, if the rate of change in the price of any input, i, exceeds the rate of growth in product price, this has a deleterious effect on unit costs; similarly, if the rate of growth of the volume of the ith input exceeds the rate of growth of output, this reduces factor productivity and increases costs. Note the more complex role of the final set of terms: (i) ε_p is only constant under very restrictive conditions; (ii) changes in Y are not independent of changes in p, and *vice versa*; (iii) ε_p, as it has been defined, is non-positive. We ignore the issues of quality change in inputs and outputs in the present theoretical discussion, but note that increases in the quality of output at a faster rate than inputs should be productivity increasing.[vi]

We can now explore the relative roles of physical productivity by imposing various restrictions on equation (2). If we assume perfect competition in both product and factor markets, then not only is $\varepsilon_p = -\infty$, but also any increase in factor prices is experienced by all firms in the industry and passed on in terms of an increase in product price. Hence the rate of increase in prices in equation (2) is equal to the share weighted sum of increases in input prices, $\sum_{i=1}^{n}\frac{w_iX_i}{pY}\left[\frac{1}{p}\frac{dp}{dt} - \frac{1}{w_i}\frac{dw_i}{dt}\right] = 0$. The observed rate of change of physical productivity is the difference between the rate of change in profits with productivity change (ie. zero under perfect competition) minus the rate of change of profits without productivity change (which would have been negative), ie. $\sum_{i=1}^{n}\frac{w_iX_i}{pY}\left[\frac{1}{Y}\frac{dY}{dt} - \frac{1}{X_i}\frac{dX_i}{dt}\right]$, which is the traditional measure of total factor productivity change to be found in the literature. Hence, any firm which fails to introduce the available productivity improvement in the face of given changes in input and output prices will experience a reduction in profit to a level below the minimum acceptable. Finally, we note that the various partial measures, such as output per unit of input and output per unit of capital, are by definition lodged in equation (2). As we have noted, partial measures can be of interest in their own right, but they are difficult to interpret in the absence of information about what is happening to the productivity of other factors. Thus, improved labour productivity may be the result of substitution towards capital (with the effect of even decreasing capital productivity) or raw materials and intermediate inputs. Thus, improvements in labour productivity may not be reflected in corresponding increases in total factor productivity.

We now return to equation (2) in order to focus on the role of unit costs. The resulting comparative static measures have a more intuitive explanation than the wholly static measures, which are little more than factor shares. In this instance, we assume that the rate of growth in output is equal to the share weighted growth in inputs, $\sum_{i=1}^{n} \frac{w_i X_i}{pY} \left[\frac{1}{Y}\frac{dY}{dt} - \frac{1}{X_i}\frac{dX_i}{dt} \right] = 0$, which implies that physical output per unit of input remains unchanged. Thus, any change in firm performance must stem from differences in the rates of growth of product and factor prices, $\sum_{i=1}^{n} \frac{w_i X_i}{pY} \left[\frac{1}{p}\frac{dp}{dt} - \frac{1}{w_i}\frac{dw_i}{dt} \right] + \frac{\Pi}{pY} \left[\frac{1}{p}\frac{dp}{dt} + \frac{1}{Y}\frac{dY}{dt} \right] + \frac{1}{\varepsilon_p} \left[\frac{1}{Y}\frac{dY}{dt} \right]$, bearing in mind the effects that this will have on product demand. Note that there is no point in assuming a competitive environment; if we do, then, following the discussion of the last section, the chosen performance measure collapses to zero. This is only to be expected, as competitive firms have no control over either factor input prices or product prices, and such changes cannot be part of the individual firm’s performance indicator.[vii] It has been demonstrated elsewhere that the precise result depends upon whether we look at the change in nominal profits, real profits or profit share.[viii]

4. Dynamic Measures

We continue to point out the relationship between profitability and, in this instance, the dynamic performance of the firm. At this stage we continue to be less than fully precise regarding the measurement of profits. We return to the latter in detail in Section 5 below. Two alternative approaches can be found in the literature: the first is based upon a ‘knowledge production function,’ which links current dynamic activities to developments in productivity, costs and, thereby, to the stream of future profits; the second examines the market valuation of the firm which reflects (potential) investors’ views about the worth of its tangible and intangible assets.[ix] We have shown elsewhere that these two approaches are analytically compatible (Bosworth, 1996) and, in the present chapter, we focus mainly on the market valuation approach.

In this section we return to the assumption that abnormal profits of the firm are the result of past investments in monopoly power. The crucial linkage comes from the fact that the long run market value of the company is the discounted sum of future dividends (Sawyer, 1981, p. 157). This can be demonstrated in a fairly straightforward manner (Horne, *et al.* 1990, pp. 50-51):

$$r_t = \frac{d_t + s_t - s_{t-1}}{s_{t-1}} \tag{9}$$

where: r is the rate of return during period t; d_t is the dividend payment at the end of period t; s denotes share price and (s_t-s_{t-1}) indicates the capital gain from an increase in share price; t refers to end of period values. Rearranging this expression and calculating the rate of return over n periods, we can write,

$$s_{t-1} = \sum_{\tau=1}^{n} \frac{d_{t-1+\tau}}{(1+r)^{\tau}} + \frac{s_{t-1+n}}{(1+r)^{n}} \tag{10}$$

where $\frac{s_{t-1+n}}{(1+r)^{n}} \rightarrow 0$ as $n \rightarrow \infty$, and the price of a share as a long-run investment is simply a function of the (expected) stream of dividend payments. These dividends are determined by the future profits of the firm, which are driven by the discretionary investments of the firm, such as research and development, R, and investment in new plant and machinery, I. In making this calculation, at least two elements have to be taken into account. First, the profits which arise from past investment in physical plant and machinery and R&D (which can be assumed to continue whether or not the firm invests in these in the present or future). Second, the investor will take a view about the future profits that arise from current and future investment activities.

First, therefore, we deal with past investments that are still making an economic profit in the current period. Again, we illustrate this using the case of research and development flows, although a similar equation can be written for investment in physical plant and machinery. The contribution of past R&D on the future profit flow can be written:

$$\Pi^{R}_{t-1,t-n} = \sum_{k=1}^{n-1} \sum_{j=1}^{n-k} S_{t+k} \left[1 - \frac{1}{R^{\rho}_{t-j+k}} \right] \left[\frac{1}{1+r} \right]^{k} \tag{11}$$

where: S denotes future output, r is the rate of interest used in discounting, t is the current time period, j denotes past years of investment and k generates the future years in which the benefits are felt. The depreciation in R&D is accounted for by differences in the ρ_{j+k}, and it is assumed to become obsolete after being in existence n years. Thus, the weight ρ reflects the age of the investment, the equation accounts for the contribution of all R&D back to t-n, and the most recent R&D which is relevant occurred in period t-1. In addition, the stream of future profits that arise from current and future R&D, which can be written as:

$$\Pi^R_{t,t+\infty} = \sum_{k=0}^{\infty} \sum_{j=1+k}^{n+k} \left\{ S_{t+k}\left[1 - \frac{1}{R_{t+k}^{\rho\, j-k}}\right] - p^R_{t+k} R_{t+k} \right\} \left[\frac{1}{1+r'}\right]^j \qquad (12)$$

Again, k generates the year in which the R&D takes place. The investment activity in question begins in period t, as this is the first R&D that does not yield dividends until period t+1 and the discount factor is $\frac{1}{1+r'}$. However, it can be seen that equation (12) contains terms infinitely into the future, although, as normal, the discount factor places greater weight on earlier rather than later investments. The rationale for an infinite stream lies in the fact that, even if a current investor is not interested in the very long term, future investors (who will buy ownership from the current investor) will be. It is not clear, however, that the risk adjusted rate of discount should be the same between past and future investments; in general, we might expect that r'>r.

We now define the economic profit of the firm from its R&D as, $\Pi^R = \Pi^R_{t-1,n+t-1} + \Pi^R_{t,t+\infty}$, and a similar value can be placed on economic rents from the technologies introduced through investment in physical plant and machinery, Π^I. From the investors' viewpoint, however, their income depends on when the economic profits are declared and the retention ratio. If we define the retention ratio for economic profit, η^e_t (and for accounting profit η^a_t), and assume the discount rate is the same for past and future investments,[x] then the market value of the company can be written (see Sawyer, 1981):

$$V_t = \sum_{t=0}^{\infty} (1-\eta^e_t)\Pi^e_t \left[\frac{1}{1+r}\right]^t \qquad (13)$$

It is important to note that this analysis raises an important questionmark about the market valuation functions traditionally specified in the empirical literature. The traditional specifications are entirely "backward-looking," based entirely upon past investment in R&D (and physical plant and machinery). Equations (11) and, especially, (12) are essentially "forward-looking"; the role of past investment is through its impact on future economic profit and dividends. This suggests that the interpretation of the coefficients found in formulations to be found in the current empircal literature, such as equation (13) are, at best, complex, reflecting some forward-predictor of behaviour (future investments) and profits from past investments. This suggests that the standard Tobin's q model appears to be based on some form of adaptive rather than rational expectations.

5. Performance and Profits in the IBIS Data Set

5.1 Operationalising the Measures

The earlier sections have suggested that all of the measures of firm performance are related to some degree to the profitability of the enterprise. Indeed, as we move away from the 'partial' measures (which are, anyway, difficult to interpret in isolation) towards overall or 'total' measures, the link with profits becomes increasingly close. This conclusion is important because the IBIS panel data set is weak in terms of partial measures, but relatively strong in terms of information about profitability. However, it is still important to gain an understanding of the nature of the profit variables available and the degree to which such measures reflect the underlying economic concepts outlined above.

5.2 Background: Accounting Information

The standard set of Australian company accounts consist primarily of three statements: profit and loss, balance sheet and cashflow statement. The IBIS database contains variables which correspond to most of the variables on the profit and loss statement as well as the balance sheet. In addition, it has some variables from the cashflow statement.

Profit and Loss Statement

Table 1 below sets out a basic profit and loss (P&L) statement for an Australian company. The P&L statement includes information on revenue, expenses and profits. It is concerned with "flow" variables. In the table, an asterisk indicates that this information appears on the IBIS database.

Table 1: The profit and loss statement

Sales revenue	*
Other revenue	*
Total revenue	*
[Expenses]	
Earnings before interest, depreciation and tax (EBDIT)	*
Depreciation	*
Earnings before interest and tax (EBIT)	*
Interest revenue	*
Interest expense	*
Net interest expense	*
Profit before (income) tax (PBT)	*
(Income) tax	*
Profit after tax (PAT)	*
Outside equity interests in profit	*
Profit after tax attributable to shareholders	*
(Abnormal items)	*
(Extraordinary items)	*

We have included depreciation in the profit and loss statement even though it is not strictly a P&L item. The reason for doing so is that it is often useful to "add back" the depreciation expense to earnings before interest and tax to arrive at a definition of earnings which is less dependent on accounting fictions. Similarly, it will probably be sensible to add back abnormal and extraordinary expenses to profit after tax so as to derive an "underlying" after tax profit measure.

A crude costs item can be derived from the database by taking the difference between revenue and, say, earnings before depreciation, interest and tax. Such a measure includes not only raw materials and intermediate inputs, but also the wage bill. By implication, standard Australian accounts and, hence, the database, are not very helpful in breaking out expenses or costs into their various components such as material inputs and the wage bill. As a consequence, unlike firm accounts published in a number of other countries, it is not possible to derive a measure of value added which can be used in the construction of factor productivity or unit cost measures. The comparative strength of the database is in its profit measures, which we have argued to be related to the overall or 'total' performance of the firm.

Balance Sheet

The balance sheet describes the size and composition of a company's assets and liabilities and, hence, unlike the P&L statement, it is concerned with 'stock' variables. Table 2 provides an example of a balance sheet, where asterisks are again used to indicate which variables are available from the database.

Table 2: Balance sheet (or statement of assets and liabilities)

Assets	*Current assets*	
	Cash	*
	Receivables/trade debtors	*
	Inventories	*
	Other	*
	Total current assets	*
	Non-current assets	
	Receivables/trade debtors	
	"Investments"	
	Property, plant and equipment	
	Intangibles	*
	Other	
	Total non-current assets	*
	Total assets	*
	(Tangible assets)	*
Liabilities	*Current liabilities*	
	Trade creditors	*
	Borrowings	
	Provisions	
	Other	
	Total current liabilities	*
	Non-current liabilities	
	Trade creditors	*
	Borrowings	
	Provisions	
	Total non-current liabilities	*
	Total liabilities	*
Shareholders' funds	Share capital	
	Reserves	
	Retained profits	
	Shareholders' equity attributable to shareholders	
	Outside equity interests in controlled entities	
	Total shareholders' equity	*

Note: Current and non-current trade creditors are aggregated in the database.

Total shareholders' equity is definitionally equivalent to net assets (ie. total assets less total liabilities). 'Tangible assets' is reported in parentheses because, while it appears on the database, it is not a single balance sheet item, but the aggregation of all the (current and non-current) asset items minus the intangible assets line. Intangible assets include patents, brand names, mastheads and goodwill (loosely, the excess of the book value of an asset over its market value). However, given the discussion in earlier sections of this chapter, it is useful to note the presence of an accounting estimate of intangibles.

There is no neat measure of debt on the database. It is possible to arrive at a measure of debt plus provisions and other liabilities by subtracting trade creditors from total liabilities. Such a measure however is not wholly satisfactory, as the provisions item is potentially a significant and possibly volatile balance sheet category.

Another shortcoming is the absence of a measure of physical capital such as the property, plant and equipment line in Table 2. The earlier discussion noted the potential importance of investment in various forms of physical capital, especially plant and machinery, as a mechanism for the adoption of new technologies produced ouside of the firm in question. Given the significance of this variable, it is important to attempt to find some proxy measure. A backdoor way to arrive at something like this would be to take the tangible assets line (which includes non-physical assets such as cash and short-term securities) and subtract from it current assets. The resulting figure, however, relates to 'non-current tangible assets,' which includes not only physical capital, but also 'investments' (shareholdings in other companies etc.) and non-current trade debtors. The last of these is clearly not something we would want in a measure of physical assets, although it is likely to be small relative to the value of physical assets, and neither is it desirable to have 'investments' in such a measure.

Cashflow Statement

The cashflow statement differs from the profit and loss statement primarily in that, as the name suggests, it is concerned only with actual cash flows, and not mere book entries such as depreciation, revaluations and provisions - all of which impact on the profit and loss statement. The cashflow statement shows the company's actual cash position rather than its accounting profits. In practice, the IBIS database is not very comprehensive when it comes to the cashflow statement, although two key items are available: depreciation and R&D expenditure.

5.3 Measures of Performance

Productivity and unit cost

It is clear from the earlier discussion that it is not possible to construct a value added measure, neither is it possible to disentangle the relative sizes of the labour input from that of raw materials and intermediate inputs. There is not even a direct measure of physical assets, such as plant and machinery. Thus, the IBIS data do not lend themselves to the construction of the various partial productivity (or unit cost) measures. The only indicators that can be derived are sales per employee and sales per unit of tangible assets, where the latter is proxied by tangible assets of over one year to maturity. While these measures are not without interest and can be found from time to time in the literature, they have severe limitations and where they appear in the present study, they should be interpreted with some caution. As we have noted, an increase in (real) sales per employee or (real) sales per unit of 'capital' may be the result of changes in the degree of 'buying-in' raw materials and intermediate inputs.

Profitability

As a starting point to measure profitability we may select the level of profits for our profitability measure. This raises the question of which profit line to use; EBDIT, EBIT, PBT, PAT etc. EBIT (and EBDIT) relates to the entire economic entity in that it is the return to all holders of claims to the company's profits, except wage and salary earners (recall that EBDIT is calculated by adding depreciation to EBIT).[xi] PBT is subsequent to the satisfaction of the claims of debt holders. PAT is subsequent to the claims of debt holders and to the claims of the income taxing government; in other words, PAT is the return to equity holders (both in the parent company and subsidiaries). Profit after tax after outside equity interests is the return to equity holders in the parent company only. This line gives the amount that may be paid in dividends. (In Australia, companies cannot pay out dividends to shareholders except from the profit after tax line; the remaining profits not paid out as dividends appear in the balance sheet as retained profits). The various profit measures may be summarised as follows:

Table 3: Alternative accounting measures of profit

Profit measure	**Relevant holders of claims**
Earnings before interest and tax (EBIT)	Shareholders, debt holders, government
Profit before tax (PBT)	Shareholders, government
Profit after tax (PAT) before outside equity interests	Shareholders (of parent company and of partly-owned consolidated subsidiaries)
Profit after tax after outside equity interests	Shareholders (of parent company only)

Given that information is available over time, as well as across companies, each of these levels of profits may be summed (with or without discounting) or averaged to derive a 'long-term' or 'dynamic' measure of performance.

The obvious problem with using levels of profits to measure profitability is that such measures are biased by firm size. An extremely inefficient and unprofitable firm may nevertheless have positive profits and, if it is large, have higher profits than a smaller, more efficient and profitable firm. A solution is to express profits as a proportion of some "size" variable, such as total assets, net assets or revenue; that is, in the form of a profitability ratio.

Recalling that the P&L relates to flows while the balance sheet is concerned with stocks, we note that certain items on the P&L naturally correspond with items on the balance sheet. For example, positive values on the net profit after tax attributable to shareholders line are (if not paid as dividends) additions to the retained profits line on the balance sheet. These correspondences are relevant for the calculation of profitability ratios. It is not very meaningful, for example, to compare profit after tax with total assets, as the former variable relates just to equity holders in the company, while the latter is financed by both equity holders and debt holders. Accordingly, in creating ratios one would normally pair profit after tax with net assets (shareholders' funds), and earnings before interest and tax with, say, total assets. Table 4 suggests some meaningful correspondences between balance sheet variables and profit and loss variables.

Table 4: Corresponding Variables from the P&L and Balance Sheet

P&L variable	Balance sheet variable	Reason
EBIT, EBDIT, Revenue	Total assets	Relates to whole company, including outside equity interests, debt holders etc.
PAT, before outside equity interests	Gross shareholders' funds	Relates to all equity holders, including equity holders in subsidiaries
PAT, after outside equity interests	Shareholders' funds attributable to members of the parent company	Relates only to equity holders in the parent company

We have until now considered ratios between P&L variables and balance sheet variables. An alternative is to calculate ratios using variables within the P&L or the balance sheet; eg. EBIT over revenue; or total liabilities over total assets. The former ratio is called the margin or EBIT margin, and has been used variously as a measure of profitability and market power. The latter is a species of gearing measure.

Finally, we might consider calculating ratios using accounting variables and information from other sources, such as market valuations. A common statistic is the ratio of a listed company's market capitalisation (that is, the market value of its ordinary equity shares, calculated as the number of such shares on issue multiplied by the share price) to its net assets, with the resulting figure reflecting the market's valuation of the firm's net assets. We might wish to compare a measure of profits, say EBIT or EBDIT, with the gross value of the firm, calculated as the firm's market capitalisation plus the (book) value of its debt plus the value of any other securities such as preference shares, warrants, convertible notes etc.

To summarise, the following table presents some profitability ratios that we might calculate. Some of the measures are readily calculable from the IBIS database, while others will require supplementing the database. For example, market capitalisation is not available from the database but is available from the ASX (and has been obtained for the largest 100 listed companies for the past five years). Accurate figures for debt and for hybrid securities (preference shares etc.) are not available from the database, but are reported in public company accounts.

Table 5: Profitability Ratios

Ratio	Requisite variables	Availability
Return on equity (ROE) (PAT over shareholders' funds)	PAT, shareholders' funds	IBIS database
Return on assets (ROA) (EBIT over total assets)	EBIT, total assets	IBIS database
EBIT margin (EBIT over revenue)	EBIT, revenue	IBIS database
Gross market value over total assets (market cap. of equity and hybrids plus book debts over total assets)	Market capitalisation of equity, market capitalisation of preference shares etc., book debts, total assets	Market capitalisation of ordinary shares and hybrids from ASX (number of shares and prefs. on issue from annual reports); book debts from annual reports or equivalent source; total assets from IBIS database.
Market value of equity over shareholders' funds	Market capitalisation of ord. shares, shareholders' funds	Market cap. from ASX; share funds from IBIS database

(Many return on assets (ROA) measures includes intangible assets in the denominator (as part of total assets), so that a firm with relatively high intangible assets which realises the same profit as another firm with the same level of tangible assets will have its ROA understated to the extent of the difference in the firms' intangible assets. In practice this type of situation is unlikely to occur as accounting standards and participants in the stock market force companies to be quite disciplined in the extent to which they record tangible assets. In Australia companies with relatively high intangible assets have frequently been judged negatively by the market and so firms have generally endeavoured to be conservative in valuing intangible assets. Accordingly, a company that does record significant intangible assets is likely to be confident that these assets will enhance its returns.)

Another solution to the problem of size bias is to calculate the <u>change</u> in profits over time. Again, thought must be given to which profit line is chosen. PAT would be affected by changes in tax rates, while both PBT and PAT would be sensitive to changes in interest rates and gearing.

Other ratios

In addition to profitability ratios, there exist a plethora of other accounting ratios such as debt service ratios, gearing ratios and stocks (inventory) ratios. Some of these could be readily calculated using the IBIS database, while others would require supplementation of the database from outside sources. Apart from accounting ratios, there are many market valuation ratios which may be looked at. These include dividends per share, earnings per share, dividend yield and earnings yield. These are not calculable using the IBIS database, but, in principle, are available from the ASX and other sources.

5.4 Economic *Versus* Accounting Profits

It is important to note that, even ignoring the ability of accountants to manipulate profit figures, accounting measures of reported profit are likely to be imperfect proxies for the underlying economic measures of performance.

Based upon the earlier, conceptual discussion, the most obvious problem concerns the fact that, although profits were at the heart of the overall or 'total' measure, the performance indicator was the difference between observed profits and the profits that would have occurred without the improvement in performance. In the static measures, with was the difference between observed profit and the profits that would have occurred if the improvements in physical productivity and the increases in factor prices had not taken place. In the dynamic measures, it was the difference between the profit stream with and without the discretionary investment, appropriately discounted. In the long run, the two measures will tend to converge, as, in the absence of discretionary investments, profits are eroded over time and fall to zero (firms will leave the market in the long run if profits fall below zero). In contrast, however, there is no guarantee that the two measures are necessarily closely correlated in the short run, as the counterfactual profits may be postive or negative (ie. in the simplest case the firm does not leave the market in the short run unless it is unable to cover its variable costs).

Other problems are more extensively discussed in the Industrial Economics literature (Krouse, 1990). In particular, a number of discretionary investments which impact on the firm's dynamic performance are 'expensed' and, hence, detract from current reported profit. This contrasts with the economic approach, which attempts to relate the future marginal income flows to the particular investment that generates them. The current accounting profits of a company and, by implication, measures such as the accounting rate of return, are driven by a whole range of earlier investments. The resulting relationships between accounting and economic profit, and the conditions under which they are approximately equal, have been widely discussed in the literature (Krouse, 1990, p. 422).

We have already noted this insofar as the costs of rent-seeking behaviour by firms is funded from current monopoly profits. Examples include advertising, training and research and development expenditures.[xii] This suggests that some measure of economic profit formed from the sum of reported profit and discretionary (dynamic expenditures) is required. The only discretionary investments that we have information about are R&D expenditures and investment in tangible assets. While, bearing in mind the limitations to the investment measure outlined above, these can be added to accounting profit (Mueller, 1967, Grabowski, 1968 and Grabowski and Mueller, 1978), there is still a measurement problem concerning the absence of similar information about expenditures on licences and knowhow, human resource development and market promotion of new products.

Further measurement problems surround the research and development variable because, while, in many countries accounting procedures now require firms to report R&D expenditures, this has not always been the case. In addition, the introduction of tax concessions, as in the case of Australia, may have affected both the accounting interpretation of what can be classified as being R&D, as well as the real level of such activity. It should be noted that, even if we can adjust for R&D in this way (see Hall and Mairesse, 1995) relatively few firms report market promotional expenditures and, even fewer, their outlays on training. However, this issue also poses some fundamental conceptual and theoretical problems. Current economic profit is a measure of current production and cost efficiency, which is in part determined by the success of past discretionary investments. The long-term efficiency of the firm at this point in time depends on the extent and success of its current discretionary investments, which depends their impact on future firm performance. This suggests that longitudinal information is required. This section therefore attempts to place the ‘static’ profit indicator in a dynamic context, again focusing on the relationships between the various measures of firm performance.

A further issues concerns the fact that future monopoly profits are often capitalised in the accounting value of the intangible assets of the company. Thus, care must be taken in the choice of the denominator of the various profit ratios. In the case of the Tobin’s q estimates, for example, the denominator of the dependent variable is, appropriately, the replacement book value of tangible assets.

5.5 Market Values

Market value data are not available on the IBIS data base. However, they are so important in the empirical literature on firm performance that it appears important to attempt to obtain relevant measures. There are two routes to this. First, to match on information from the Australian Stock Exchange. Second, to attempt to obtain estimates based upon the discounted sum of future profits. Neither are entirely without problems.

Stock exchange data relate primarily to equity shares, while the market value of the company is generally defined as the sum of the value of equity shares, preference shares and debt. In addition, only ‘quoted’ companies are covered, which comprise only about 17 per cent of the total sample of firms on the IBIS data base.

We have demonstrated that the market value of the company in the long run is equal to the discounted sum of expected future dividends. Based on the assumption of a constant profit retention ratio, the time series dimension of the panel data can be used to construct the discounted sum of future reported profits. Clearly, there may be differences between the expected and real values at any given point in time (although it might be argued that the real values are a better measure of actual performance), which drives a wedge between the two measures. In addition, the ‘forward’ construction of the index makes the resulting measures ‘dated’ and they are increasingly ‘truncated’ the closer to the present time that they are calculated.

The question regarding whether one should compare gross market value with tangible assets or with total assets can be answered by saying that each is justifiable and that these two methods measure different things; in the latter the measure is valuing intangible assets as well as tangibles. To say that the ratio should only use tangible assets is to say that intangibles are not or should not be valued by the market, which is contentious. Ideally and most generally both approaches would be used.

6. Conclusions

While there is a role for partial static and comparative static measures, in understanding firm performance, they cannot provide an overall or ‘total’ picture. Thus, it is important to combine both total factor productivity and total unit cost measures in providing an overall measure of static firm performance. In these more general measures it is possible to demonstrate that the outcomes are influenced by both profit share and the degree of monopoly power (represented by the own-price elasticity of demand). All of these measures can be shown to be related to firm profitability (although, as we show, not to the standard accounting measure). The relationship with profitability becomes closer as we move from ‘partial’ to ‘total’ measures. Such static measures can be calculated at a particular point in time or in terms of year-on-year changes.

A more complete understanding comes by fitting these measures into a dynamic context. This can be appreciated *via* the ‘knowledge production function’ and ‘market valuation’ (Tobin’s q) approaches. In this case, we have demonstrated that these dynamic measures of firm performance are again linked to the flows of firm profits and dividends (although, again, not to standard accounting measures). The pattern of profits over time is driven by investments, particularly those in intangible assets; the stream of dividends is determined by profits, discretionary investments which are expensed and by the profit retention ratio. The formal theoretical analysis of the dynamic aspects of performance raises some important questionmarks about the empirical specifications that can be found in the literature.

The links between firm performance and profitability prove to be important in the context of the IBIS data base, given that it has a range of profit measures, but little or no useful information that can be used to construct partial productivity or cost indicators. The analysis suggests the need for measures which are not biased by firm size, such as profitability ratios or rates of growth in profitability. A variety of profitability ratios can be constructed from the IBIS data, including: return on equity, return on assets and the EBIT margin. We noted Bain's preference for an 'excess profits' based measure, although this was found to be closely correlated to the accounting profits to equity ratio. In the context of the themes in the existing literature, it seems important to match on a measure of market values, to allow the construction of the market value over tangible assets. Such ratios are widely accepted and used in the literature, although subject to accounting manipulation and some distance from the 'ideal' economic measures. We have demonstrated that the correspondence between the economic and accounting measures is closer for 'dynamic' than 'static' performance and closer for 'total' than 'partial' performance.

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Endnotes

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i. Note the use of p(Q) here, as p(Q)Y would be the real measure of output observed in official statistics if the deflators were truly quality constant.

ii. The extent to which they fulfil this end depends upon the degree to which the rents can be appropriated by the inventor (ie. the firm undertaking the R&D) or the user (ie. the innovator). The more important the former, the greater the potential contribution of in-house R&D and the lower the contribution of investment to future economic profits. Low technology firms may find the returns to investment in embodied technologies produced by suppliers more effective, during the 'catching-up' phase, but sustained growth in the longer term might require a reorientation towards in-house R&D.

iii. A number of studies attempt to explicitly deal with the effects of inter-industry R&D, in particular R&D undertaken by other industries but bought in via purchases of tangible assets (Scherer, 1984 and Geroski, 1991). There are also studies that deal with the effects of spillovers from some R&D pool (Jaffe, 1986; Griliches, 1979; Bernstein and Nadiri, 1983; Megna and Klock, 1993).

iv. For a discussion of Tobin's q as an investment decision rule based upon panel data sets, see Blundell, et al. (1992).

v. This function can clearly be written in a number of ways, depending on what we want to assume about the nature of competition in the sector. A detailed discussion can be found in Bosworth (1996).

vi. This is discussed in Bosworth and Gharneh (1995).

vii. Macro models of this type generally also assume that factor prices (ie. wages) are set as a markup over product prices (Layard and Nickell, 1985; Layard, et al. 1991). Note that for the present purposes we are ignoring the effects of increased factor prices on factor productivity (efficiency wage effects) or on the quality of inputs that will be reflected in improvements in innovation and dynamic performance.

viii. It can be deduced that ε_p=-1 plays a crucial role in determining the discontinuity. This is not surprising, given that it forms an interesting cut-off point in the theory of monopoly demand. With a straight line product demand curve, ε_p=-1 occurs at the point the marginal revenue curve cuts the horizontal axis. Thus, no monopolist even with zero costs of production, would chose to operate in the range ε_p>-1. What is interesting, however, is the way in which the own-price elasticity and profit share interact to define the discontinuity for two of the three measures.

ix. Tangible assets relate to the firm's stock of physical capital (such as plant and machinery, buildings, vehicles, etc), while intangible assets refer to the stock of knowledge and goodwill. The firm suffers depreciation of existing assets over time and can increase either tangible or intangible assets through fixed capital investment or R&D respectively.

x. That is, there is no adjustment for the greater imperfect information and risk associated with future investments.

xi. Wage and salary earners receive their claims above the profit lines in the accounts, that is, from expenses. If the wage bill were available, we could calculate a measure of value added, that is the sum of all the income generated by the company, by adding the wage bill to EBDIT. In addition, while other sources of wage data are available, such as from the ABS, this is, at best, at the industry level and poses important problems both for firm specific effects and in matching where companies are diversified

xii. The accounting treatment of R&D expenditures differs both across countries and over time as accounting standards and guidelines change. In the UK, for example, it is possible to amortise certain development expenditures, but few companies presently chose to do so. See Bosworth and Gharneh (1995).