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ECONOMIC ANALYSIS AND COMPANY ACCOUNTS*

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La contabilidad de las empresas proporciona una rica fuente de datos para el análisis de muchos problemas económicos. Sin embargo, las convenciones contables a menudo entran en colisión con los métodos relevantes para el análisis económico. Este trabajo trata tres de estos problemas: la medida del beneficio, la valoración del stock de capital, y la magnitud de los pagos impositivos. También se ejemplifica cómo pueden ser utilizados datos contables corregidos en la estimación de un modelo de inversión de las empresas.

1. Introduction

In recent years there has been a growth in interest among applied economists in company accounts as a source of data. In part this reflects developments in computer technology that have made such large microeconomic data sets comparatively easy to analyse. It also reflects the increasing availability of such data sets in convenient forms (which is itself related to developments in information technology). Micro data on individual firms has considerable attractions. In comparison with time series data the impact of aggregation is obviously reduced. The panel nature of company data sets permits firm-specific influences on behaviour to be taken into account. Microeconomic as well as macroeconomic questions of interest can be addressed —for example, differences in the behaviour of small and large firms. Finally there is wide variation across companies in many variables of interest - for example, output growth and factor prices - that can be exploited in econometric estimation. We would also suggest that some variables, such as effective tax rates, are best measured at the firm level. However company accounts also present the economist with serious data problems, both of coverage and interpretation.

Company accountants are employed to provide information for shareholders rather than economic researchers. In consequence, accounts provide no information at all on some aspects of company performance in which econo-

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mists are interested - for example, output prices, market shares, union coverage and stock market valuations. In other areas only limited information is available. For example, sales are reported rather than output, often with insufficient information on inventories to infer the value of production. Similarly total employment may be reported, but with no distinction between full time and part time or manual and non-manual workers. A second problem is that accounting concepts apparently found acceptable by shareholders may differ from the expected value and present value concepts desired by most economists. Examples here include accounting estimates of depreciation (Section 3) and the treatment of deferred taxation (Section 4). Finally there are certain accounting conventions that correspond to no sensible measurement criteria at all. Most notable in this respect is the continued adherence to historic cost valuations of capital assets, amounting to an almost complete neglect of inflation.

In some of these cases there is little the researcher can do but accept the limitations of the data provided. But in important areas there is other information found in company accounts that can be used to improve on the accounting variables directly measured. We concentrate on three areas that have received considerable attention in the literature. These are the inflation adjustment of measures of profit (Section 2) and capital (Section 3), and the measurement of company taxation and fiscal incentives (Section 4). In Section 5 we present an example in which some of these adjusted measures have been applied to estimate a model of company investment from accounts data for the UK.

2. Rates of Return

A substantial economics literature has used accounting measures of profitability. The uses to which such measures have been put have varied. Aggregate measures have been used as an indication of the incentive to invest in particular countries or industries. Probably more common is the use of such measures in industrial economics to assess the relationship between the profit earned in a firm or industry and various factors affecting that industry, such as concentration, barriers to entry and economies of scale. One important example of such an investigation is that by anti-trust authorities attempting to determine the relationship between a firm's market power and rate of profit[1]. In the light of these studies it is perhaps surprising that there is also a large body of literature (dating back to Harcourt (1965)) which argues that accounting rates of profit cannot be used to infer any meaningful economic information[2]. One particularly outspoken example of this literature is Fisher and McGowan (1983):

[1] Accounting rates of profit have been used in this way by anti-trust authorities in both the UK and the US.

[2] Partly in response to such criticisms, other measures of profitability have been used in the industrial economics literature, such as Tobin's Q (the ratio of the firm's market value to its replacement cost). See, for example, Lindenberg and Ross (1981), Salinger (1984) and Smirlock et al. (1984).

«there is no way in which one can look at accounting rates of return and infer anything about relative economic profitability or, a fortiori, about the presence or absence of monopoly... The literature which supposedly relates concentration and economic profit rates does no such thing, and examination of absolute or relative accounting rates of return to draw conclusions about monopoly profits is a totally misleading enterprise.»

There is no space here for more than a brief description of views underlying these two literatures. The starting point is to understand the complaints of Fisher and McGowan (and many others - for a review see Edwards et al. (1987). This view grounds the measurement of profitability in terms of the underlying economic activity, namely investment. It is well known that, given perfect capital markets, firms should undertake all those investments with a positive present value. It is also well known that, under certain conditions, this is equivalent to undertaking all investments with an internal rate of return (IRR) greater than the firm's discount rate. The literature on the appropriateness of accounting profits has therefore turned on the question of under what circumstances the firm's IRR is equal to its accounting rate of profit (ARP), defined as the ratio of profit to the value of capital employed.

It should immediately be clear that the two will only be equal under special conditions. This is because they are completely different concepts: the IRR measures the profitability of a project over time and the ARP measures it at a particular moment. In addition to this is the question of the appropriate measurement of the capital stock and of current profit, most importantly the treatment of inflation.

The difference in concept between the IRR and the ARP raises the question of what the appropriate economic concept is. Note that the IRR of a project measures the profitability of a project over the whole of its life. Similarly the IRR of a company must measure its profitability over the whole of the company's life. But it is very difficult to think of interesting economic questions to which the IRR provides the answer, given that many companies have been in existence for decades and may continue for decades more. What is far more interesting is the rate of profit earned by a company over a specific period.

Edwards, et al. (1987) convincingly argue that such a useful economic measure can be derived from accounting data using an appropriate measure of the value of the firm at the beginning and end of the period under consideration. Thus, treating the beginning value of the firm as a cost and the end value as a benefit, the accounting rate of return (ARR) can be calculated in the same manner as the IRR, form

$$V_0 = \sum_{t=1}^{T} \frac{(F_t - K_t)}{(1 + r_{0,T})^t} + \frac{V_T \delta}{(1 + r_{0,T})^T} \qquad [1]$$

where $r_{0,T}$ is the ARR between periods 0 and T, V_t is the value of the firm at the end of period t, F_t is revenue generated in period, t, K_t is new captial required in period t and all cash flows are assumed to occur at the end of the period. Edwards et al. define V_t according to 'value-to-the-owner' rules, whereby

$$V_t = \min \{RC_t, EV_t\} \text{ where } EV_t = \max \{PV_t, NRV_t\} \quad [2]$$

where RC_t is replacement cost value, EV_t is economic value, PV_t is the present value of future net cash flows associated with current assets and NRV_t is the net realisable value. Intuitively, the 'value-to-the-owner' measures the minimum loss that a company would suffer if deprived of an asset.

The ARR is clearly very similar to the IRR, and can be compared with the discount rate over the period to determine abnormally high or low profits. Its great advantage, however, is that if the firm's assets are valued in accounts according to the value-to-the-owner rules, and if all changes in the book value of assets are incorporated in the profit and loss account, then the ARR can be directly calculated from accounting data. This would provide a justification to the use of accounting data for economic analysis.

The potential drawback, of course, is that these rules may not be followed by those who draw up accounting data. In particular, accounts based on historic cost valuations, which are commonly in use by accountants, do not obey these rules. The important question for potential users of accounts is then «do the accounts follow value-to-the owner rules?», or, if the answer is no, «can a reasonable approximation to data derived according to these rules be found?»

In answer to the first question, value-to-the-owner rules have been adopted (for at least some periods) in the UK, the US and Canada and a simplified version has been adopted in Australia and New Zealand. However, it must be recognised that the enthusiasm with which accountants use these rules varies, and dependence on historic cost accounts has tended to become more common as inflation rates have fallen. Below we outline adjustments that may be made to historic cost valuations of the capital stock to approximate value-to-the-owner valuations.

The ARR can be computed over a segment of a firm's life from the ARP for each period and the value of capital employed in each period. However, the resulting ARR will, of course, depend on the accounting conventions used to calculate the ARP as well as the value of capital employed. Adjustments also need to be made to historic cost measures of profit in order to approximate 'economic' profit. These have been widely discussed, and are summarised in Edwards et al. (1987) and Whittington (1983).

There are five main adjustments which need to be made to historic cost profits in order to correct for inflation. Briefly, they are as follows. First, the depreciation charge must be corrected so that the depreciation rate applies to the current value of each asset, rather than its historic cost value. Second, the real holding gain or loss on the ownership of fixed assets should be included in the measure of profit. (Essentially, any change in the value of an asset must be reflected in profit for the ARR to give meaningful information). Third, stock appreciation due to inflation should be substracted from profit. Fourth, the real holding loss on net monetary assets held over the period should be substracted. Fifth, the change in the real value of liabilities over the period should be reflected in profit.

An approximation of economic profit therefore can be derived from historic cost accounts. One example of this is the computer program developed at the Institute for Fiscal Studies to adjust the historic cost accounts of a sample of UK firms, as described in Mayer (1982). Table 1 gives an example of the vast difference in the ARP between the historic cost and inflation-adjusted data.

TABLE 1
Comparison of Historic and Inflation-Adjusted Measures of Accounting Rates of Profit

Year	Historic Cost	Inflation-Adjusted
1966	7.3	4.5
1967	9.4	7.0
1968	11.5	8.0
1969	12.5	8.5
1970	12.5	7.7
1971	12.6	6.6
1972	15.6	8.7
1973	17.4	8.2
1974	15.0	4.0
1975	14.3	−0.1
1976	22.9	6.3
1977	20.6	4.7
1978	19.9	5.9
1979	18.5	3.9
1980	13.6	0.1
1981	13.4	1.3
average	14.8	5.3

Source: Mayer and Meadowcroft (1984).

3. Capital Stock

Company accounts, like National Accounts, generally provide two concepts of the stock of fixed assets - a gross measure and a net measure. The gross capital stock simply accumulates the value of investment expenditures on assets currently held. The net capital stock writes down the value of these intitial expenditures to reflect the fall in the value of assets over time caused by ageing and obsolesence. (We can think of gross capital as assigning a weight of one to each asset on the books, whereas net capital assigns progressively lower weights to older assets). The former is normally considered to be most closely related to the concept of productive capacity, and is widely used in production function and factor demand applications. The latter is more related to the value of capital employed, and is used in measures of rates of profit discussed above and Tobin's Q.

Company accounts have a major advantage over National Accounts in that the capital stock estimates reported are based directly on the fixed assets in place and do not rely on an assumed retirements distribution. In the UK, company accounts have been used to assess the reliability of official capital stock estimates[3]. But there are disadvantages. The main problem with accounts measures is that assets (gross and net) are normally valued at historic cost[4]. That is, the purchase price of assets bought 20 years ago would simply be added to the purchase price of assets bought last year in arriving at the measure of today's capital stock. As Mayer (1988) notes, in an inflationary environment it is difficult to think of an interesting question to which historic cost valuations provide the answer. Assets purchased in the past at lower nominal prices are systematically undervalued, and to a degree that varies across firms depending on the age of their fixed capital, and also on their asset structure. Hence there is a need for historic cost valuations to be inflation-adjusted, which is the focus of this section. A second problem with company accounts concerns the depreciation assumptions used by accountants to measure the net capital stock. Typically the rates of depreciation implicit in company accounts are higher than those used in National Accounts or estimated independently.

The structure of all captial stock measures is illustrated in [3]. Here a_{st} shows the value of assets acquired in year s included in the capital stock at the end of year t, K_t. This is defined by

$$K_t = \sum_{s=1}^{t} a_{st} \qquad [3]$$

where year one is the first year in which the company acquired fixed assets. In the case of the gross capital stock at historic cost (HK_t), a_{st} measures the purchase price in year s of investment from year s remaining on the books in year t. If I_s denotes investment in year s and W_{st} denotes the purchase price of assets acquired in s that have been disposed of between s and t, then $a_{st} = I_s - W_{st}$ and

$$HK_t = \sum_{s=1}^{t} (I_s - W_{st}) \qquad [4]$$

[3] For example, Wadhwani and Wall (1986) and Smith (1987).

[4] The use of inflation-adjusted accounting conventions remains the exception rather than the rule, due principally to disagreement over the appropriate procedures. In the UK, current cost accounts were required in addition to historic accounts from 1981 to 1985, but have since become rare.

Adjusting for changes in the nominal price of assets since they were purchased, due to both general inflation and relative price changes, the gross capital stock at current replacement cost (RK_t) is

$$RK_t = \sum_{s=1}^{t} \left\{ (I_s - W_{st}) \left(\frac{P_t}{P_s} \right) \right\} \qquad [5]$$

where P_t is a price index for the assets held by the company. RK_t is an inflation-adjusted measure of gross capital expressed at current prices. The same measure could be converted to constant prices by multiplication by P_0/P_t for some base year zero.

Unfortunately RK_t cannot be constructed from the information in historic cost accounts. Most seriously, the age distribution of assets included in HK_t is not known. In addition there is only limited information on the distribution by type of asset, so the construction of an appropriate price index is also problematic. Given these data limitations, estimates must be constructed that rely on, and are sensitive to, auxiliary assumptions. We now describe two procedures that can be used with short time series of data and that have been used in applied work[5].

The simplest approach is to replace the distribution of price adjustments involved in [5] by a single average price adjustment applied to the observed HK_t. That is, a replacement cost value is estimated as

$$\hat{RK}_t = HK_t \left(\frac{P_t}{P_{t-A_t}} \right) \qquad [6]$$

where A_t is an estimate of the average age of assets held at the end of year t. At best this must be viewed as a crude approximation. Obviously the average age is not known and has to be estimated, either from accounts data or from other sources[6]. Moreover, no simple average is appropriate in the sense that [6] would exactly reproduce RK_t. Biases are particularly obvious where inflation has been rising or falling, or where the age distribution of assets is skewed. This procedure has also been criticised for failing to exploit all the relevant information that is available in company accounts. Nevertheless it is widely used in practice[7].

The second approach is to use an iterative procedure, obtaining an estimate of RK_t by applying an updating rule to an estimate of RK_{t-1}. From equation [4] we can derive the identity

$$HK_t = HK_{t-1} + I_t - HDISP_t \qquad [7]$$

[5] Where long time series of data are available, procedures that cumulate past investment expenditures may also be contemplated.
[6] Mayer (1982) describes several ways to approximate asset lives and ages from accounts data.
[7] For example, Mairesse and Dormont (1985), Arellano and Bond (1988).

where $HDISP_t$ is the historic cost gross valuation of assets that were disposed of during year t. All the elements of [7] are observed in historic cost accounts. Similarly from [5] we obtain

$$RK_t = RK_{t-1}\left(\frac{P_t}{P_{t-1}}\right) + I_t - RDISP_t \qquad [8]$$

where $RDISP_t$ is the replacement cost gross valuation of assets disposed of in year t. Historic cost accounts thus provide the appropriate valuation for current investment but not for current disposals. The problem of estimating $RDISP_t$ from $HDISP_t$ is analogous to that of estimating RK_t from HK_t. Wadhwani and Wall (1986) suggest using a similar average price adjustment, so that iterative estimates of RK_t are obtained as

$$\hat{RK}_t = \hat{RK}_{t-1}\left(\frac{P_t}{P_{t-1}}\right) + I_t - HDISP_t\left(\frac{P_t}{P_{t-B_t}}\right) \qquad [9]$$

where B_t is an estimate of the average age of assets disposed of during year t. Wadhwani and Wall (1986) consider several ways of estimating B_t, but find that none produces more satisfactory results than the simple expedient of setting B_t to an integer constant (8 years) for all firms in their sample. Errors introduced by this average price adjustment will have a smaller impact on the replacement cost estimates in this procedure, although persistent errors will be cumulated. The iterative procedure also requires an initial value for RK_t, usually obtained from equation [6]. This technique has been used in applied work by Nickell and Wadhwani (1987).

This discussion has omitted several complications that arise with actual accounts data. In particular, historic cost accounts do not always provide genuine historic cost data. On occasions, some of the assets included may have been revalued or adjusted for exchange rate movements. Unfortunately these revaluations are generally not carried out on a consistent basis either over time or across companies, and arbitrary changes can make historic cost accounts still harder to interpret. However when information on revaluations is available it can be incorporated into the inflation adjustment, at least with the iterative procedure.

Returning to [3], if K_t is interpreted as the net capital stock at historic cost (HN_t) a_{st} must be reinterpreted as the purchase price of investment from year s remaining on the books in year t less the proportion of this value that has been written off as depreciation. Letting d_s denote this latter proportion, we have

$$HN_t = \sum_{s=1}^{t}\{(I_s - W_{st})(1 - d_s)\} \qquad [10]$$

Again adjusting for nominal price changes, the net capital stock at replacement cost (RN_t) is

$$RN_t = \sum_{s=1}^{t} \left\{ (I_s - W_{st})(1 - d_s)\left(\frac{P_t}{P_s}\right) \right\} \qquad [11]$$

As before, RN_t cannot be constructed from the data in historic cost accounts.

Iterative procedures are much the most common technique for inflation adjusting net capital stock measures. A popular method assumes that the firm's fixed assets depreciate at constant exponential rate (d) over time. In this case, abstracting from disposals, each term $(I_s - W_{st})(1 - d_s)$ can be replaced by $I_s(1 - d)^{t-s}$, from which it follows that

$$HN_t = HN_{t-1\delta}(1 - d) + I_t \qquad [12]$$

$$RN_t = RN_{t-1}(1 - d)\left(\frac{P_t}{P_{t-1}}\right) + I_t \qquad [13]$$

The assumption of geometric depreciation conveniently allows estimates of RN_t to be derived from the simple updating formula [13]. Variants of this procedure have been used by Mayer and Meadowcroft (1984), Blundell et al. (1988) and Hayashi and Inoue (1988).

The major issue in applying this technique concerns the appropriate choice of depreciation rate, d. As noted above, the rates of depreciation that are implicit in company accounts tend to be significantly higher than those used in National Accounts. Based on a comparison with current cost accounts estimates available in the early 1980's, Bond and Daniels (1990) find that a depreciation rate of 23% for plant and machinery is suggested in a sample of 397 UK companies. In contrast, King and Fullerton (1984) suggest that a rate of 8% is implicit in UK National Accounts. An independent estimate based on used asset price data for the United States suggested a rate of 13% for aggregate equipment (Hulten and Wykopf, 1981). Company accountants are sometimes accused of being too prudent in writing down assets for depreciation, but there remains considerable uncertainty as to what more appropriate rates of economic depreciation should be. Moreover, appropriate rates may well vary over time. For example, unusually high depreciation may have occurred at the times of the energy price shocks in the 1970s, as energy intensive equipment rapidly became obsolete.

A related problem concerns the distribution of depreciation rates across companies. Since different assets depreciate at different rates, and companies employ assets in different combinations, it is inappropriate to apply a common depreciation rate to all companies. Company accounts generally include some information on asset mix, although in the UK this is normally limited to a division between plant/machinery and land/buildings. Standard practice is to apply a different depreciation rate for each asset type identified, although this procedure is complicated in the UK by the absence of a similar division of recorded investment and the consequent need to impute the investment split. Bond and Daniels (1990) found that even this approach allowed for too little company heterogeneity with UK data. Superior results were obtained by first estimating the distribution of depreciation rates implicit in historic cost accounts and then incorporating this distribution into the iterative inflation adjustment procedure. This particular problem may be less acute in countries such as Japan where company accounts provide much more information on the asset mix of both capital stock and investment.

This section has highlighted the difficulties of inflation adjusting the capital stock measures found in company accounts. Measurement errors are inevitable in this context, and this suggests the importance of investigating the sensitivity of empirical results to different capital stock estimates. Research to date has proved somewhat encouraging. Mairesse and Dormont (1985), Nickell and Wadhwani (1987) and Bond and Devereux (1988) have all considered this issue, and found that the estimated coefficients in various investment and employment models have not been highly sensitive to the capital stock estimates used.

4. Taxation

There are clearly many areas of economic interest and significance concerning taxes on company profits. They can probably be grouped under the two headings of incidence and behavioural response. Although the formal incidence of the tax is on the company itself, it is clear that the tax must be borne by individuals connected in some way with the company: its shareholders, employees or customers in the form of lower profits, lower wages or higher prices, respectively. In addition, the influence of taxation on a company's behaviour can clearly stretch to all aspects of its activities, the main issues commonly examined being the effect on investment in fixed assets and inventories, labour demand and wages, sources of finance and payment of dividends.

The empirical investigation of any of these issues obviously requires reasonable data on companies' tax liabilities. At first sight, company accounts might seem the ideal source of such data - there is almost always an item named «taxation» in company reports. However, the data found under such a heading is not always straightforward to interpret. The difficulties in its interpretation vary across countries. In some countries (Sweden and Italy, for example) accounts are closely related to the structure of the tax computation. In others (for example, the UK) they are not. In this section we describe briefly some of the difficulties faced by the use of UK accounting data.

The single most important factor is known as deferred taxation. This problem arises out of a distinction between the information which the accountant is aiming to give the company's shareholders, and the requirements of economic research. The accountant primarily tries to make an assessment of the tax that will, at some time, be due on profits made in a particular accounting period. Thus the «net of tax profit» declared by the accountant is an estimate of the final income attributable to shareholders, taking into account all liabilities arising as a result of activities in this accounting period. However, this does not imply that the tax liability declared is payable in the current period. It should also be noted that, typically, no allowance is made by the accountant for the fact that the deferred tax is not paid until a later date, and so should be discounted back to the current period.

This difference became very important in the UK during the late 1970s and early 1980s, when there existed generous depreciation allowances for tax purposes (100% in the first year for plant and machinery and 75% in the first year for industrial buildings). The existence of these allowances had the intended result that tax payments were reduced in periods of investment. However, it was required practice for accountants to declare a tax liability as if these allowances were only equal to the rate of depreciation used for accounting purposes. An extreme form of this state of affairs was common. This is when a company made a taxable loss in a particular period, and consequently paid no tax, yet indicated in its accounts that a substantial tax liability had arisen.

A second important issue in the UK is the treatment of the imputation system. Briefly, the company makes a prepayment (at the basic rate of tax) of the shareholder's income tax due on dividend payments. (This prepayment is confusingly known as Advance Corporation Tax, or ACT). ACT can be offset against the company's Corporation Tax charge, up to a limit given by the relative size of taxable profits and the dividend (gross of ACT). The residue, known as Mainstream Corporation Tax, can be regarded as the tax on the company, as opposed to the shareholder. However, the tax charge disclosed in the profit and loss account is normally the sum of the «mainstream» and «advance» elements, known often as «total» corporation tax.

There are two main ways that can be used by researchers to identify the corporate charge on company profits. One, proposed by Higson (1987), finds ACT due by taking the appropriate proportion of dividends, estimating how much of the ACT can be offset against the corporation tax liability by calculating taxable profit from the tax charge disclosed, and hence derives an estimate of mainstream corporation tax.

An alternative method is rather more complex, although it is more flexible. This is to apply the rules of the tax system in as exact a manner as possible to the accounting data on profit, investment in fixed assets and inventories, and other relevant items. This method is used by Devereux (1986) for the UK, and Devereux, Ratti and Schiantarelli (1988) for Italy. The advantage of this approach is that the relative importance of different rules and allowances in the tax system can be examined, and the effects of tax reforms on liabilities and incentives (ignoring behavioural responses) can be examined. The main drawback is the complexity of approximating the appropriate measurements of profit and investment, etc from accounts.

However, this procedure has been used to shed light on such questions as the extent of tax exhaustion in the UK. The table below shows estimates of the percentage of a sample of around 400 firms which either paid no tax (i. e. were fully tax exhausted) or were unable to fully offset ACT (i. e. were ACT exhausted) during the period 1971-1984. This information cannot easily be gleaned from the tax data in company accounts.

TABLE 2
Percentage of large UK companies tax exhausted
1971-84

Year	Percentage fully tax exhausted	Percentage ACT exhausted
1971	5.6	—
1972	12.1	—
1973	19.9	22.2
1974	37.6	45.5
1975	28.9	42.3
1976	26.0	36.1
1977	31.4	41.1
1978	28.4	40.3
1979	34.8	46.7
1980	39.5	51.7
1981	35.6	52.6
1982	38.8	55.1
1983	34.2	51.5
1984	25.9	47.6

Source: Devereux (1987). Based on a sample of 396 UK industrial and commercial companies.

Estimates of periods in which companies are tax exhausted may be important for assessing the fiscal incentives for company behaviour. For example, applied work on investment behaviour has taken a range of different approaches to the issue. By far the most common approach is simply to ignore it. Hayashi and Inoue (1988) go one step further by allowing tax rates to be zero in periods of tax exhaustion. However, this would normally be an overcorrection for the problem, since the existence of loss carry-forward provisions usually mean that the effects of taxation are delayed rather than cancelled altogether. Devereux (1989) investigated the impact of tax exhaustion on a sample of UK companies by constructing a measure of the cost of capital which is forward-looking and allows for firms to anticipate periods of tax exhaustion, and found that tax exhaustion did have a significant (although small) effect on investment decisions.

5. An Econometric Application

In this section we briefly consider an econometric application in which the published accounts of 202 UK manufacturing companies provided the main source of data. The example reported is the Q model of investment presented by Blundell et al. (1988). Company accounting data in a convenient computerised form was kindly made available by Datastream International from the commercial service they provide to investors. Measurement of the tax-adjusted Q ratio used required estimates of the firm's stock market valuation, its net capital stock at replacement cost, and various tax parameters including the present value of depreciation allowances. Since share prices and market valuations are not reported in accounts, the Datastream sample of companies was individually matched to a second data source, the London Share Price Database, which provides financial market data. Inflation adjusted estimates of net capital were obtained using the iterative procedure described in Section 3. Depreciation rates similar to those found in UK National Accounts were assumed, and company heterogereity in the asset mixture between plant/machinery and land/buildings was allowed for. Effective values of the fiscal incentive variables allowing for periods of tax exhaustion and loss carry forward provisions were estimated using the model of company taxation described in Section 4.

The choice of sample illustrates a number of issues in the use of company panels. Data was only available on stock market quoted companies, and attention was restricted to firms whose main product (reported by Datastream) was in manufacturing. Repeated observations on the same companies were required, so that only companies that had survived for the required number of years were included. Companies that had been involved in mergers or major acquisitions were excluded. Twelve month accounting periods were required, so firms that had changed the date of their accounting year end were excluded. Firms with some data missing were also excluded. The resulting sample contained 202 companies with a varying number of between 8 and 10 continuous observations over the period 1975-84. The sample is clearly not random in several respects. Selection bias issues in this kind of sample are considered in Meghir (1988). Non-random entry is controlled for by specifying individual-specific effects. Under certain (restrictive) conditions non-random exit may be allowed for in the same way.

The investment equation was estimated using a two-step Generalised Method of Moments estimator developed by Arellano and Bond (1988a) and described in Arellano (this issue). Individual-specific effects are removed by first-differencing. Lagged instruments control for the induced simultaneity, as well as random errors of measurement Griliches and Hausman (1986). This estimation procedure was implemented on a microcomputer using GAUSS and the DPD program Arellano and Bond (1988b).

Table 3 reports the results for a basic specification of the Q investment model. The dependent variable $(I/K)_{it}$ denotes gross investment as a proportion of net capital for company i in year t and Q_{it} denotes the tax-adjusted Q ratio. Detailed definitions and alternative specifications can be found in Blundell et al. (1988). The equation is estimated in first-differences and includes one lag of each variable. Year dummies are included and found to be highly significant. There is no indication of second order serial correlation. A common factor test of the hypothesis that the included dynamics are generated by an $AR(1)$ disturbance is not rejected. The model appears to be well specified, but Blundell et. al. find that further explantory variables (sales and cash flow) are significant in addition to Q.

TABLE 3
A Q Investment Equation for UK Manufacturing Companies
Dependant variable = $\Delta\ (I/K)_{it}$
1975-84 202 companies 1913 observations

ΔQ_{it}	$\Delta Q_{i,t-1}$	$\Delta(I/K)_{i,t-1}$	$m2$	$z1$	$z2$	Sargan	Comfac
0.0077 (5.04)	−0.0025 (−2.87)	0.2575 (15.8)	0.45	258.9	246.2	97.7	0.64

1. Year dummies (not reported) are included.
2. Asymptotic t-ratios are reported in parentheses. Standard errors and test statistics are robust to general time-series and cross-section heteroskedasticity.
3. $m2$ is a test for second-order serial correlation in the residuals, asymptotically distributed as $N(0,1)$ under the null of no serial correlation.
4. $z1$ is a Wald test of joint significance of the reported coefficients, asymptotically distributed as χ^2 (3) under the null of no relationship.
5. $z2$ is a Wald test of joint significance of the year dummies, asymptotically distributed as χ^2 (9).
6. The Sargan statistic is a test of the over-identifying restrictions exploited, asymptotically distributed as χ^2 (75) under the null.
7. The Comfac statistic is a Wald test, of the common factor restriction, asymptotically distributed as Student's t.

Source: Blundell, Bond, Devereux and Schiantarelli (1988).

This example illustrates how reported accounts can be used as a data source for the econometric modelling of company behaviour. In this paper we have emphasised some of the difficulties that must be faced by the economist when employing data from company accounts. However the quality of the raw data can be greatly improved by the use of suitable correction procedures and, where possible, by supplementing accounts data with other sources of company information. Whilst the remaining limitations must be recognised, it is the case that company accounts provide a rich source of cross-section information, permitting differences in behaviour across different types of firm to be identified. For example, Fazzari, Hubbard and Petersen (1988) suggest that the importance of liquidity constraints for investment depends on the firm's financial structure, and Nickell and Wadhwani (1987) find differences in the wage and employment behaviour of unionised and non-unionised firms. Whilst this microeconometric work is still in its infancy, the economic analysis of company accounts data should provide an exciting research agenda for the next decade.

References

Arellano, M. and Bond, S. R. (1988a): «Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations», Institute for Fiscal Studies, Working Paper No. 88/4.

Arellano, M. and Bond, S. R. (1988b): «Dynamic Panel Data Estimation using DPD - A guide for users», Institute for Fiscal Studies, Working Paper No. 88/15.

Bond, S. R. and Daniels, A. (1990): «On estimating the net capital stock from company accounts», Institute for Fiscal Studies, mimeo.

Bond, S. R. and Devereux, M. P. (1989): «Testing the sensitivity of Q investment equations to measurement of the capital stock», in *Factors in Business Investment*, M. Funke (ed.), (Berlin: Springer).

Blundell, R. W.; Bond, S. R.; Devereux, M. P. and Schiantarelli, F. (1988). «Does Q matter for investment? Some evidence from a panel of UK companies», Institute for Fiscal Studies, Working Paper No. 87/12A.

Devereux, M. P. (1986): «The IFS model of the UK Corporation Tax», WP84.

Devereux, M. P. (1987): «Taxation and the cost of capital: the UK experience», *Oxford Review of Economic Policy*.

Devereux, M. P. (1989): «Tax asymmetries, the cost of capital and investment: some evidence from UK panel data», *Economic Journal*.

Devereux, M. P.; Ratti, M. and Schiantarelli, F. (1988): «Modelling corporate taxes in Italy», IFS mimeo.

Edwards, J. S. S.; Kay, J. A. and Mayer, C. P. (1987): *The Economic Analysis of Accounting Profitability*, Oxford, Oxford University Press.

Fazzari, S.; Hubbard, R. G. and Petersen, B. C. (1988): «Financing constraints and corporate investment», *Brookings Paper on Economic Activity*.

Fisher, F. M. and McGowan, J. J. (1983): «On the misuse of accounting rates of return to infer monopoly profits», *American Economic Review, 73*, pp. 82-97.

Griliches, Z. and Hausman, J. (1986): «Errors in variables in panel data», *Journal of Econometrics, 31*, pp. 93-118.

Harcourt, G. C. (1965): «The accountant in a golden age», *Oxford Economic Papers, 17*, pp. 66-80.

Hayashi, F. and Inoue, T. (1988): «Implementing the Q theory of investment in micro data: Japanese manufacturing 1977 - 1985», Osaka University mimeo.

Higson, C. (1987): Unpublished PhD thesis, London Business School.

Hulten, C. R. and Wykopf, F. C. (1981): «The measurement of economic depreciation», *Depreciation, Inflation and the Taxation of Income from Capital*, in C. R. Hulten (ed), Washington: Urban Institute.

King, M. A. and Fullerton, D. (1984): *The Taxation of Income from Capital: A Comparative Study of the United States, the United Kingdom, Sweden and West Germany*, Chicago and London: University of Chicago Press.

Lindenberg, E. and Ross, S. (1981): «Tobin's q ratio and industrial organisation», *Journal of Business*.

Mairesse, J. and Dormont, B. (1985): «Labor and Investment Demand at the Firm Level», *European Economic Review, 28*.

Mayer, C. P. (1988): «The real value of company accounts», *Fiscal Studies*, Vol. 9, *No. 1*, February.

Mayer, C. P. (1982): «A program for inflation adjusting published accounts», IFS Working Paper 31.

Mayer, C. P. and Meadowcroft, S. (1984): «Equity rates of return in the UK - evidence from panel data», *Reserches Economiques de Louvain, 50*, pp. 363-98.

Meghir, C. (1988): «Attrition in company panels», mimeo, Institute for Fiscal Studies, London.

Nickell, S. J. and Wadhwani, S. (1987): «Financial factors, Efficiency wages and employment: investigations using UK micro-data», Centre for Labour Economics Discussion Paper, LSE, London.

Salinger, M. A. (1984): «Tobin's q, unionization and the concentration-profits relationship», *the Rand Journal of Economics*.

Smirlock, M.; Gilligan, T. and Marshall, W. (19): «Tobin's q and the structure-performance relationship», *American Economic Review,* pp. 1051-1060.
Smith, A. D. (1987): «A current cost accounting measure of Britain's stock of equipment», *National Institute Economic Review,* May.
Wadhwani, S. and Wall, M. (1986): «The UK capital stock - new estimates of premature scrapping», *Oxford Review of Economic Policy,* Vol. 2, *No. 3,* Autumn.
Whittington, G. (1983): *Inflation Accounting: an introduction to the debate,* Cambridge: Cambrige University Press.

Abstract

Company accounts provide a rich data source for the analysis of many economic issues. However, accounting conventions are often at variance with the most relevant procedures for economic analysis. This paper discusses three such problems: the measurement of profit, the valuation of the capital stock and the size of tax payments. It also provides an example of the use to which corrected company accounting data can be put, namely the estimation of a model of company investment.

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