Taxation and the Performance of Technology-based Small Firms in the U.K.

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ABSTRACT. This paper analyses a database of U.K. small companies in order to establish the profile of Technology Based Small Firms (TBSFs) in terms of their demography, financial structure and performance, and tax affairs. Following the evaluation of the impact of direct taxation on the high technology small companies, compared to that of their low technology counterparts, the paper briefly discusses the current policy debate about the nature and appropriateness of tax-based incentives for the development of this strategically important scale and type of enterprise.

1. Introduction

Recently, the small firms policy debate has focused on Technology Based Small Firms (TBSFs), the most dynamic segment of the small business economy with an international outlook, and the capacity to transfer innovation and technologically sophisticated skills across the industrial fabric (OECD, 1993). U.K. interest in TBSFs has lately received additional impetus when the white paper entitled "Competitiveness: Creating the Enterprise Centre of Europe" called for an investigation into the financial barriers faced by TBSFs, at "start-up" and during the early years of their development. During 1997, two influential organisations published reports on the prospects for and growth problems of small technology based firms "The Financing of Technology-based Small Firms" (Bank of England, 1997) and "Tec Stars" (CBI, 1997). Both of these inquiries concluded that public policy support was both justifiable and necessary in order to enhance the growth prospects of this high value added, export oriented sector.

In a review of policy and practices relating to high technology small firms in the U.K., Oakey (1997), critically notes that the policy debate and support for TBSFs is characterised by long periods of apathy, punctuated by sudden bursts of concern (often marked by subsequent government inquiries). In the context of the current resurgence of interest in TBSFs, a similar pattern appears to be emerging of increased interest at the end of the 1990's, following a lapse in concern at the beginning of this decade. However, the objective of this research is to contribute to the renewed concern by examining the tax position of technology-based small companies in order to inform the policy debate on TBSF taxation.

This study uses the NatWest Manchester Business School (MBS) Tax Models[1] (Chittenden et al., 1996, 1998, 1999a, 1999b; Poutziouris et al., 1999), to measure the impact of taxation on TBSFs. The NatWest MBS Tax Model for small limited companies monitors, over time, the impact of the tax regime on this sector (i.e. income tax, corporation tax, national insurance tax, local business rates and compliance costs). In addition, the model estimates the total value of tax revenues that accrue to the Exchequer from all small independent companies with less than 100 employees. The NatWest MBS Small Company Tax Index shows that the burden of taxation has remained quite stable during the 1990s. It has been argued that the costs of compliance with tax rules (e.g. for the collection of PAYE and VAT) weighs most heavily upon the youngest and smallest firms in the United Kingdom economy, and their ability and desire to grow is consequently hampered by

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this onerous tax regime (Chittenden et al., 1996, 1999a; Poutziouris et al., 1999). However, it has also been observed that it is precisely such firms that must thrive if new wealth and jobs are to be created (Storey 1994).

The NatWest MBS Small Company Tax Model utilises a stratified database of 5910 small companies, categorised as high- or low-tech activities. This allows a comparative analysis of the financial and tax affairs of TBSFs and their low-tech counterparts. Moreover, since all companies in the database are more than two years old, the sample is biased towards early stage "survivors", which have a much higher propensity to grow than new start-ups, most of which fail (Hall, 1995).

Following this introduction, Section Two of this paper introduces the issues critical to the debate on small business taxation. Section Three reviews literature on the development of TBSFs, and lays the foundation for the analysis of Section Five. Section Four explains the methodology used in this paper, while Section Five presents the results of a comparative analysis of the performance and tax affairs of high- and low-tech SMEs. The paper concludes with a set of policy recommendations designed to assist TBSFs towards strengthening their capital base, and sustaining their investment-based growth strategies.

2. Taxation and small firms

The responsibility of the government (and its agents) is to create a *pro-enterprising* fiscal and legislative climate that encourages business start-ups and investment in the survival and growth of sustainable ventures. Although taxation epitomises the *intervention* of the state in the operation of the market, this topic has received limited research attention, at least from the small business perspective. Theory and research methodologies have tended to address issues of taxation at the macro-economic level, whilst micro-economic investigations have been restricted to the large corporate sector, which accounts for the majority of U.K. tax revenues accruing from the business community (Chittenden et al. (1998) estimate this to be approximately 77 per cent).

Historically, a number of studies have been investigating the impact of the excess burden of taxation on businesses (Meade, 1978; King and Wookey, 1987, Devereux, 1991). However, more research effort is now directed to the tax affairs of SMEs (Bannock, 1984; Bannock and Peacock, 1989; Watson, 1990; Rees and Shah, 1994, Chittenden, 1991, 1994; Chittenden et al., 1996, 1998, 1999a, 1999b; Davies et al., 1996; Poutziouris et al., 1999), which are linked to the discussion relating to the chronic financial barriers. Small businesses face a number of challenges if they are to progress from micro-businesses into larger, often fast growing, small businesses (ACOST, 1990; Aston Business School, 1991; Cambridge Small Business Research Centre, 1992).

One of the most consistently cited barriers to growth is access to adequate types of finance (Storey, 1994) because (amongst other reasons) the levels of information asymmetry and agency costs are higher for such firms (Peterson and Schulman, 1987). Moreover, lending decisions are external to the firm, and are often based on criteria that are also external to the business (e.g. bank manager preferences). It should be noted that the above capital market imperfections are especially unfavourable to TBSFs, since they exacerbate their major problem of under-capitalisation (Westhead and Storey, 1997; Oakey 1995). Indeed, because of capital constraints, it has been generally recognised (Bolton, 1971; Watson, 1990) that the taxation system could play an important role in ensuring that small businesses are not unnecessarily disadvantaged by a growing "finance gap". To quote Bolton (1971):

> Moreover what is required for the health of the (small firms) sector is an economic and taxation system which will enable individuals to acquire or establish new businesses out of personal resources and to develop these on the base of retained profits. Without this no institutional financing arrangement can preserve the small firms sector (Bolton, 1971, p. 192).

From a fiscal policy perspective, Bannock (1984) argues that taxes adversely affect the motivation of small business owners to establish and subsequently expand their businesses. Taxation has an asymmetrical impact on the "risk-reward ratio" since poor business performance, or failure is tax-free, while the profits that accrue from success *are* taxed. Moreover, since investment capital for expanding small business, is primarily generated through retained profits (Storey, 1994; Michaelas

et al., 1999a, 1999b) taxation must, by reducing retained profits, thereby reduce the amount of funds that are available for business owners to invest. However, the present tax regime offers incentives for individuals to invest in large firms, through pension schemes and PEPs, but there are few incentives for re-investment in small businesses. Poutziouris et al. (1999) revealed that three of the four most important tax planning mechanisms used to reduce tax bills in small firms, involve extracting money out of the business either as increased salaries or pension scheme contributions. Moreover, small firms suffer disproportionately in relation to their larger counterparts due to the bureaucratic burden associated with the collecting of government taxes (i.e. principally PAYE and VAT from their employees and customers) (Sandford et al., 1989; SBRT, 1996; Chittenden et al., 1996, 1998, 1999a, 1999b).

A number of measures have been targeted at U.K. small businesses in order to compensate for the non-neutrality of the above noted tax system as it applies to SMEs (OECD, 1993). These initiatives include reduced corporation tax rates on small profits; simplified collection methods for employees income taxes (PAYE); the improved administration of Value Added Tax (e.g. higher registration thresholds, "cash" accounting schemes etc.); increased thresholds for capital transfer taxes, and special relief for firm ownership transfers within the family. However, the tax burden borne by small or young companies remains disproportionately high (compared to larger businesses), while the unfavourable tax treatment of retained profits (compared with private savings schemes e.g. pensions, TESSAs etc.), reduces the funds available to business owners for expansion purposes, and renders the retention of profits within the business less attractive.

3. Technology based small firms: a special case

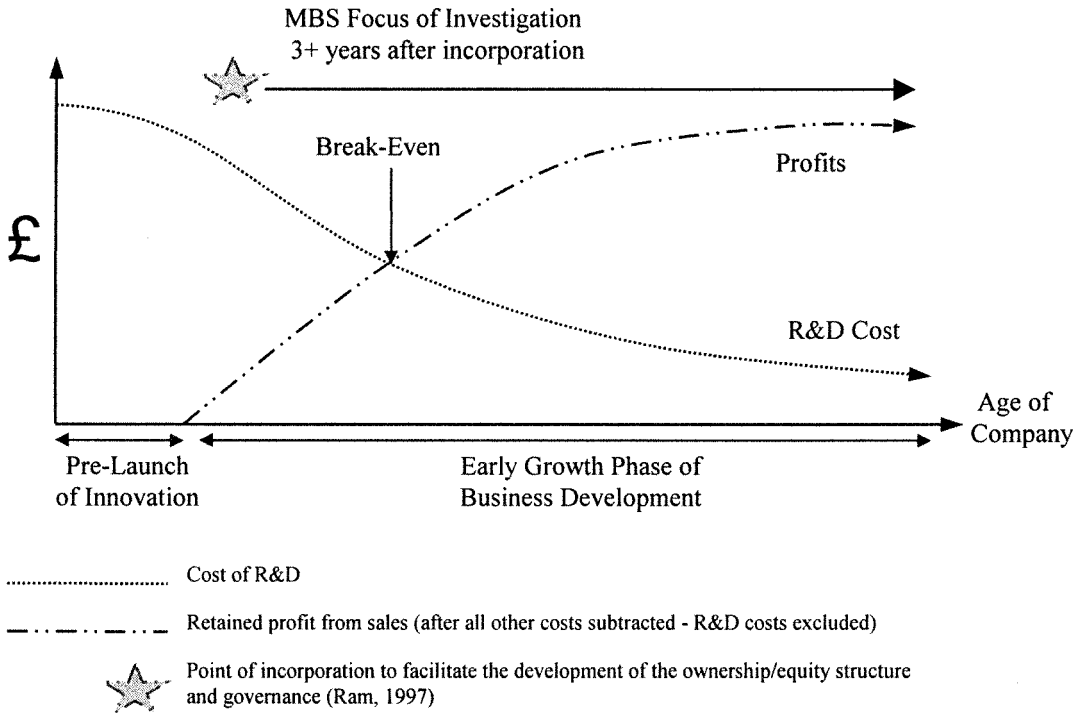
Politicians and industrialists frequently advocate the support of high technology industries in their role as facilitators of innovation throughout the economy (OECD, 1993). High technology ventures have the potential to create sophisticated highly skilled employment (Breheny and McQuaid, 1987), and subsequently wealth derived from high profit margins (The Commission on Public Policy and British Business, 1997, p. 43). Moreover, TBSFs act as a "seedbed" for totally new industrial activity (ACOST, 1990). Their technological know-how may provide specification-based competitive advantages, which may lead to rapid economic and employment growth (Oakey and Rothwell, 1986; Westhead and Cowling, 1995). However, scientifically sophisticated entrepreneurs often lack managerial expertise and/or capital, and this combined deficiency can result in TBSFs being perceived as 'too risky' and thus unattractive for external financial backers (Oakey, 1991).

This problem is exacerbated by the reality that high technology activities operate in "start of cycle" industries, characterised by long product gestation periods involving protracted "lead-times" for the development of new technologies, typified by the emerging biotechnology sector (Roberts, 1991). However, as a new industry sector matures, the majority of early entrants do not survive due to bankruptcies, mergers and acquisitions etc. (Hall, 1995), while only a very few enterprises subsequently expand and prosper.

Oakey (1995) associates the industry gestation period with disproportionately high "front-end" R&D expenditure caused by the protracted "lead-times" required for the development of novel products. The R&D process consumes the founders' equity capital and generally prevents profitability until "break even" can occur. Figure 1 shows the "gestation period" commonly associated with new high technology ventures.

This period is dominated by "front-end" R&D costs, where resources are invested in the development of prototype products and/or services. Eventually, the successful launch of a product may lead to improved financial performance and early growth, resulting in the consolidation of the business as a limited company (Ram, 1997). Incorporation facilitates the development of the ownership structure, with entry/exit rules for additional owners/directors which, when new capital is injected into the growing business is likely to help ameliorate some of the financial constraints noted above (Hannah and Caroll, 1992; Storey, 1994).

However, the impact of taxation on the financial affairs of an individual TBSF might be expected to be more onerous than for low tech-



Source: Derived from Oakey (1995).

Figure 1. The gestation period: Investment in R&D and the eventual flow of profits.

nology small firms where, the new product gestation phase is either much shorter or non-existent. In addition, for the purposes of this research, TBSF companies have been dichotomised between manufacturing and service activities. As previously discussed, the birth of a TBSFs is partially regulated by the level of entry barriers. Such barriers relate mainly to the capital resource requirements that characterise their advanced technical and production requirements. Therefore, manufacturing based activities (e.g. biotechnology) are more likely to have relatively high start-up costs (or barriers to entry), and may require a critical mass of R&D staff before production can be undertaken (exemplifying a difficult-start-up). In contrast, high tech services (e.g. computer related services) might be expected to be characterised by lower capital requirements and the operational flexibility of small-scale operations (i.e. soft-start ups).

Thus it may be expected that TBSFs will differ in their financial performance and taxation characteristics, both between high- and low-tech firms, and in addition between TBSF manufacturing and service businesses.

3.1. *The definition of high technology small firms*

For the purpose of our research, the selection of TBSF activities, has been based on a three digit Standard Industrial Classification (SIC) grouped into "manufacturing" or "service based" and "high-tech" or "low-tech" based activities, and all other low-tech businesses (see Table I). The operationalisation of more widely acceptable definition of high tech activity which utilises the intangible asset related financial data has been restricted by the fact that the majority of sample firms fail to capitalise investment in intangible assets (patents, licenses, accumulated research and development). This is because TBSFs are financially constrained and lack resources to carry out formally intangible investments (OECD, 1993) or due to the fact that they find it more tax efficient to absorb development costs into operating expenditures which are fully tax deductible.

The development of high-tech classification schemes deserves more research. As Balwin and Gellalty (1998) demonstrated there is a need to consider both quantitative (research and development financial data) and qualitative (evidence of innovations, registration of patents etc.) information in order to classify business ventures into high tech and low-tech sectors. Table I shows the activities that have been identified as high technology sectors.

The key criteria for selecting these clusters of high tech ventures were the theoretical doctrine relating to the product and profit life cycle (Schumpeter, 1939; Vernon, 1966). New and high technology activities operate in "start of cycle" industries characterised with protracted lead-times to develop innovations and exploit new technologies (as exemplified by the biotechnology industry). As the industry matures the majority of the early entrants tend to drop out of the competitive arena (bankruptcies, mergers, acquisitions etc.) (Hall, 1995), and only a few enterprises will survive and prosper by continuously developing new product innovations and extending their customer base.

Parallel to the product cycle, Markusen (1985) highlights the existence of a profit cycle. High tech pioneer firms may enjoy rapid growth and windfall profits from the development of technologically sophisticated products, but fierce competition, complex industrial dynamics during the gestation period, coupled with poor management, may reduce the survival and growth potential of such TBSFs. Oakey (1995) associates the industry *gestation period* with disproportionate higher (end-front) R&D expenditure required by the protracted "lead-times" in the development of novel products. The R&D process consumes primarily start-up equity capital (personal and familial money) and generally depresses profitability of TBSFs.

Roberts (1991) conceptualised a business growth model, which encapsulates the product and profit life in the context of the gestation period. During the early stages of growth HTSFs encounter financial constraints for this critical phase of business development requires high research and development expenditure, protracted "lead-times" on product development and a growing need to achieve "compensating sales" through the launch of the prototype products (and services). Profits recorded during this early growth phase will be ploughed back in order to invest in the further development of innovative products necessary for the diversification of sales income and of the client base (Oakey, 1995).

In accordance with Figure 1, it is our *a priori* assumption that the propensity of TBSFs to generate taxable profits as they progress through the stages of business growth. The main objective of this explorative research is to evaluate the impact of U.K. tax regime on the post-survival of TBSFs, as they develop during the gestation period.

3.2. *Financial and tax affairs of TBSFs: some hypotheses*

This paper is one in a series of reports based upon a substantial research project on the burden of taxation in small firms commissioned by NatWest Bank. Two financial models have been built that measure the total tax burden borne by small firms. Output from these models (one for unincorporated firms, and the other for small limited companies) is in two forms. First a Tax Index that monitors,

TABLE I
Industrial classifications categorised as TBSF sectors

SIC 1992	Business activity
244	Manufacture of pharmaceuticals, medical, chemical and botanical products
300	Manufacture of computers and other processing equipment
310–316	Manufacture of electrical machinery and apparatus n.e.c.
321–323	Manufacture of radio television and communication equipment and apparatus
331–335	Manufacture of medical, precision, and optical instruments, watches and clocks
721–726	Computer and related service activities
731	Research and Development (science-related) Services

over time, the impact on the small business sector of the tax regime (i.e. tax payments and the cost of compliance to the tax regime). Second the models estimate the value of tax revenues that accrue to the Exchequer from the small business economy (see, for example, Chittenden et al., 1999a, 1999b).

The NatWest MBS Tax Models have shown that the total tax burden borne by small firms is dependent upon the following variables:

- The absolute size of businesses;
- Their asset structure (i.e. the proportion of fixed assets to total assets);
- Their liability structure (i.e. the proportion of total assets funded by interest bearing debt);
- Their trading performance (i.e. levels of profitability and owners remuneration);
- The level of directors and employees remuneration.

Various research studies have shown that TBSFs can be expected to differ from their low-tech counterparts across most of the above dimensions. As a result, it must be expected that the U.K. taxation regime will have a different impact on TBSFs when compared to their low-tech counterparts. The reasons for such differences are discussed in more detail below.

3.2.1. *Demographic profile: business size and age*

The majority of TBSFs are founded during the early development stages of new industries and are therefore likely to be particularly innovative in "leading edge" volatile areas of technology (Garnsey et al., 1994). However, TBSFs are likely to be younger and smaller (Garnsey et al., 1994), financially constrained and hindered by shortage of managerial and entrepreneurial skills to market their technologically sophisticated, novel products/services (Westhead and Storey, 1997). Although they are more likely to grow (Westhead and Cowling, 1995), new technology based firms are identified as more "risky ventures". This is exemplified by the paucity of venture capital investment in HTSFs (Wilson, 1993). We can expect these TBSFs to be younger and smaller than more established low-tech counterparts.

H1: TBSFs tend be (younger) and smaller in scale of operations (measured in total assets)

It has been demonstrated that taxes are regressive in nature falling more heavily on smaller firms (Chittenden et al., 1996; 1998; 1999a, 1999b). We could therefore argue that TBSFs will incur higher tax burden than low-tech counterparts which will, on average, be older and larger in size.

3.2.2. *Asset structure (i.e. the ratio of fixed assets to total assets)*

The asset structure of TBSFs is governed by sectoral and market-imposed conditions as captured by Robert (1991) in his conceptualisation of a four-stage model for technology-based business growth. In summary, the phases of his models are:

- *seed* (period of conception, R&D and evaluation of commercial viability);
- *start-up* or *launch of the firm* (this can take the form of *soft-start* which requires minimal R&D input and small capital investment i.e. the computer-related activities, characterised with low entry barriers and plethora of micro-firms (with narrow turnover and asset base), creating a crowding effect (Garnsey et al., 1994); or *hard start* which involves higher risk coupled with larger initial capital commitment i.e. biotechnology manufacturing industries characterised with high entry barriers and poor survival rates;
- *early growth* follows and is characterised by rapid and profitable marketability of innovative product(s)/service(s), (risk diminishes with profitability growth); and
- *sustainable growth* (characterised with rapid growth, diversified customer and producer base, financial needs generally met through the retention of profits).

The entry barriers for TBSFs relate mainly to the capital resource requirements that characterise their advanced technical and production functions. Therefore, the financial constraints faced by TBSFs of all sizes (see below) will mean that both high-tech manufacturers and service businesses will have lower fixed assets to total assets ratio than their low-tech counterparts.

H2: TBSFs are more likely to have a lower asset base

Since investment in fixed assets (e.g. complex production machinery) results in a deduction from profits in order to "write off" the cost of these assets over their useful working lives (known for taxation purposes as capital allowances), high-tech firms will have restricted potential for these deductions, and therefore higher tax charges in proportion to total assets are likely to ensue, than typical for equivalent low-tech firms.

3.2.3. *Liability structure (borrowings to total assets)*

Most TBSFs are financially constrained, and hindered by a shortage of managerial skills with which to market their novel products/services (Westhead and Storey, 1997). Oakey (1997) argues that the resulting dependence of TBSFs on internally generated capital is caused in part by the shortage of external finance available to TBSFs, coupled with the introspective and autonomous nature of technical entrepreneurs. Therefore it is expected that TBSFs will exhibit lower gearing ratios (i.e. borrowings to total assets) than low tech small firms, since TBSFs strive to finance early stage business development with internally generated capital (i.e. equity and retained income) which involves lower borrowing and subsequent interest payments.

H3: TBSFs are more likely to be less leveraged

As a result TBSFs will have proportionately less tax relief on interest paid and will, consequently, pay more corporation tax as a proportion of total assets than low tech-firms.

3.2.4. *Trading performance (profitability)*

Profitability (measured as the return on total assets) may be expected to vary between TBSFs depending upon whether individual businesses experience "soft" or "hard" start-ups. Soft-starts require minimal R&D inputs, and low levels of capital investment (e.g. many computer-related software services) and are characterised by relatively low entry barriers. The large number of micro-firms entering these soft start-up sectors may create over-capacity resulting in price competition once the business has become established (Garnsey et al., 1994). However, small "soft-start" technology based businesses may be relatively successful in the early (micro) stages of growth, but will subsequently find it quite difficult to expand (Oakey, 1995). Where growth does take place, returns (profitability to total assets) are expected to be average.

H4: TBSFs are likely to be less profitable as their profitability is inversely related to the gestation period; and in particular to the volume of investment in research and development.

The more "hard start", higher risk start-ups (e.g. biotechnology manufacturing) require larger initial capital commitments and are characterised with high entry barriers and poor survival rates during the early years of trading (Garnsey et al., 1994; DTI, 1997). In these early years, "hard-start" TBSFs encounter financial constraints because of high research and development expenditure, protracted "lead-times" on product developments, which are eventually mitigated in successful firms by "compensating sales" derived from the launch of the prototype products and services (Oakey, 1995). However, those "hard start" TBSFs that survive (i.e. mainly in manufacturing) are likely to produce highly competitive products with high profit margins (e.g. in bio-medicine) and thus have higher tax liabilities than low technology small manufacturing firms.

3.2.5. *Directors and employees remuneration*

The level of directors and employees remuneration depends amongst other factors (e.g. unionisation trends, level of technical skill, the substitution of capital for labour etc.) mainly by the level of profits, discounted for the internal capital requirements of the venture, essential to escape from the adversaries characterising the gestation period.

H5: The level of director and employees remuneration will be lower in TBSFs because of the compressed profitability during the gestation period.

Indeed, more research is needed to establish trends about remuneration packages across industries. However we can tentatively argue that the value of employee and directors taxes paid by a

company primarily depends upon their level of remuneration. It might be expected that, since TBSF production tasks are labour intensive and complex, they will be unable to substitute capital for labour as in the mass-production standardised low value added operations. Moreover, as a result TBSFs will have relatively low levels of investment per employee compared with low-tech firms. The narrow capital asset base of TBSFs (referred to above) and the dependence on technically sophisticated staff (instead of substituting capital for labour) may be expected to result in employment taxes representing a larger proportion of the total assets of TBSFs than would be the case for low tech firms.

In the next section, these research hypotheses will be examined utilising data in the NatWest MBS Tax Model that measures the impact of taxation on the U.K. the Small Company Sector.

4. Data and research methodology

All the data used in this study was gathered from the Lotus One-Source Database of U.K. small companies, thus ensuring consistency in the treatment of the basic accounting information. A total number of 5,910 firms that satisfied the definitional and data requirements for the research were randomly selected. The selection criteria were:

- Independent ownership status
- Private limited companies, with or without a share capital
- Small companies (i.e. employing less than 100 workers)

The data comprises of 5910 micro and small companies with business and financial information covering the 1993–1996 period. Table II shows the size and sectoral distribution of sample firms.

Using the NatWest MBS Tax Model, the taxes paid by each sample firm (comprising corporation tax, directors' taxes, employers and employees National Insurance contributions and employees income tax) were estimated using the 1997/98 tax rules. Additionally, the database was used to calculate a number of demographic and performance measures for sample firms. The variables, including definitions, used to test the research hypotheses are listed in Table III.

Statistical analysis was then conducted to compare the tax performance of TBSFs with their low-tech counterparts. To do this a General Linear Factorial Model (ANCOVA – Analysis of Covariance) model was developed, where total tax burden (ration of total taxes to total assets), as the dependent variable (DV), was regressed against a number of independent variables (IVs) representing the above hypotheses.

Analysis of Covariance (ANCOVA) is an extension of analysis of variance in which main effects and interactions are assessed after DV scores are adjusted for differences associated with one or more covariates. Thus, in our models, the main effects of technology intensity (industry) on total tax burden, is examined after controlling for the effects other variables (covariates) can have on the total tax burden (the DV). Under such circumstances, ANCOVA increases the power of an F-Test for a main effect of interaction by removing predictable variance associated with covariate(s)

TABLE II
Distribution of TBSFs (by size of employment and across sector)

Sector	Number of employees				
	1–4	5–9	10–19	20–99	Total
Type 1: All other (Low-Tech) activities*	694	745	690	1139	3268
Type 2: Low-Tech manufacturing	246	270	371	812	1699
Type 3: High-Tech manufacturing	50	30	40	64	184
Type 4: Low-Tech services	56	90	85	125	356
Type 5: High-Tech services	298	31	22	52	403
All sectors	1344	1166	1208	2192	5910

* Agriculture, mining, construction and distribution.

TABLE III
Definition of variables

Variable	Definition
Corporation tax	Corporation tax paid by firms using the NatWest/MBS Tax Model (1997/98)
Directors taxes	Taxes paid by company directors in 1997/98 – income tax and employees NIC
Owners taxes	Corporation tax + directors taxes in 1997/98
Employees taxes	Employers plus employees national insurance contribution and employees income tax in 1997/98
Total taxes	Owners taxes + employees taxes in 1997/98
Age	Age of company
Size	Total assets
Profitability	Return on total assets (ROTA) in 1996
Asset structure	Ratio if fixed assets to total assets in 1996
Liability structure	Gearing = Total debt to total assets in 1996
Directors remuneration	Remuneration per director in 1996
Employees remuneration	Remuneration per employee in 1996
Sector	**Definition**
Type 1	All other (Low-Tech) activities
Type 2	Low-tech manufacturing
Type 3	High tech manufacturing
Type 4	Low-tech services
Type 5	High-tech services

from the error term (Tabachnick and Fidell, 1996). In other words, covariates are used to assess the "noise" where "noise" is undesirable variance in the DV that is estimated by scores on covariates. The DV scores and means are adjusted to remove the linear effects of the covariates before analysis of variance is performed on these adjusted values. The effect of the adjustment is to provide a (usually) more powerful test of differences among groups uncontaminated with differences on covariates. In our case, the ANCOVA models are used to examine the differences in the tax burden firms in different sectors (with different technology intensity) after controlling for the effect that other variables (covariates, e.g. profitability, asset structure), which could be sector specific, have on the tax burden faced by sample firms.

Following the comparative evaluation of the differences between the financial and tax variables of high and low technology firms, the NatWest MBS Tax Index was computed to assess the total impact of taxation on the two stratified samples of small companies.

5. The financial performance and tax affairs of TBSFs

Table IV presents the results of the ANCOVA model, where tax burden is regressed against the different independent variables and covariances.

5.1. *Sector type*

As can be seen in Table IV below, the sector type variable (dependent variable or factor) is statistically significant indicating that there are significant differences in total tax burden faced by businesses operating in different industries with different technological intensity. Furthermore, with the exception of the age variable, all the other covariates are statistically significant, indicating that tax burden is partly determined by these effects. The ANCOVA model, however, adjusts for these effects so that the F-Test estimated for the sector type variable examines differences in tax burden incurred by businesses in different sectors, after controlling for the covariate effects. When statistically significant effects are found in a design with more than two levels of a single IV

TABLE IV
ANCOVA model: Total tax burden

Source	Type III Sum of squares	df	Mean square	F-statistic	Significance
Corrected model	65.358*	11	5.942	257.328	0.000
Intercept	19.775	1	19.775	856.448	0.000
Factors					
Sector type (1–5)	0.057	4	0.444	19.250	0.000
Covariates					
Age	0.057	1	0.057	2.486	0.115
Size	24.913	1	24.913	1078.964	0.000
Profitability	6.749	1	6.749	292.276	0.000
Asset structure	0.602	1	0.602	26.089	0.000
Liability structure	0.944	1	0.944	40.886	0.000
Directors remuneration	6.262	1	6.749	292.276	0.000
Employee remuneration	11.000	1	11.000	476.422	0.000
Error	124.892	5409	0.023		
Total	508.379	5421			
Corrected total	190.250	5420			

* R Squared = 0.344 (Adjusted R Squared = 0.342).

(in our case the IV (sector type) has five levels), it is often desirable to pinpoint the nature of the differences. We need to see which groups differ significantly from each other, or whether there is a simple trend over sequential levels of an IV. To examine whether means (average tax burden) are the same for all five levels of the sector type IV a pairwise multiple comparison test was computed, based on the Bonferroni test.[2]

As can be seen in Table V, total tax burden appears to differ significantly between the different sector types. The only exception is Low-Tech Mfg and Low-Tech Services sectors, which appear to face a similar tax burden. Even so, it could be argued that TBSFs pay higher taxes than low-tech firms, when tax is expressed as a proportion of their total asset base. As can be seen in Table V, total tax burden as a ratio of total assets is about 27.9% in Low-Tech Services, 45.8% in High-Tech Services, 25.4% in Low-Tech Manufacturing and 30.4% in High-Tech Manufacturing.

Although, taxes paid (as a percentage of total assets) are higher in high-tech firms, the average tax bill for low-tech firms (which tend to be more sizeable) is larger than that of high-tech firms in both sectors, as shown in Table VI. Even though, in absolute terms owners of TBSFs pay less tax than their (relatively larger) low-tech counterparts, the impact of taxation in relation to firm size is systematically and significantly higher for high-tech companies.

An initial interpretation of these results could be that the differences are chiefly the result of the different size distributions of the high tech and low tech samples because micro-companies (i.e. of 1 to 9 employees) in all sectors tend to have proportionately fewer total assets. Another explanation for this observation is that high-tech firms achieve a higher return on their assets, and hence pay higher taxes relative to their size, compared to their low-tech counterparts. This is particularly evident in the service sector where micro-companies proliferate and tend to have a small turnover-base and a low level of investment in assets. In fact, the results of the ANCOVA model presented in Table IV above point out that a number of variables such as size, profitability and asset structure has an effect on the tax burden faced by small firms. Furthermore, the results indicate that even when adjusting for these effects, the magnitude of the tax burden in small firms is directly related to industry differences, and in particular technology intensity differences.

The question that arises now, is whether there is an interaction between the different IVs, where IVs can be either factors (in our case sector type)

TABLE V
Total tax burden to total assets: Comparison of means (Bonferroni Test)

Variable	All other	Manufacturing		Services	
	Low-Tech	Low-Tech	High-Tech	Low-Tech	High-Tech
Total taxes to TA	21.7%	25.4%	30.4%	27.9%	45.8%
One-way ANOVA F-Statistic	126.566	Significance		0.000*	

Mean difference in total tax burden ratios between sector type pairs

Pairs (Sectors)		Mean difference (I)–(J)	Std. error	Significance
(I)	(J)			
Low Tech Other	Low Tech Mfg	–0.037	0.006	0.000*
	High Tech Mfg	–0.087	0.015	0.000*
	Low Tech Services	–0.061	0.011	0.000*
	High Tech Services	–0.241	0.011	0.000*
Low Tech Mfg	High Tech Mfg	–0.050	0.015	0.009*
	Low Tech Services	–0.025	0.011	0.294
	High Tech Services	–0.204	0.012	0.000*
High Tech Mfg	Low Tech Services	0.026	0.018	0.000*
	High Tech Services	–0.154	0.018	0.000*
Low Tech Service	High Tech Services	–0.179	0.015	0.000*

* The mean difference is significant at the 0.05 level.

TABLE VI
Weighted average taxes paid per company (£000s)

	All other	Manufacturing		Services	
	Low-Tech	Low-Tech	High-Tech	Low-Tech	High-Tech
Corporation tax	23.455	25.174	21.440	36.216	13.413
Directors' taxes	28.732	35.438	35.504	45.541	18.583
Employers NIC	46.768	64.439	58.249	70.512	33.659
Employees income tax	50.972	71.222	63.004	73.375	42.762
Employees NIC	20.098	29.053	26.414	18.433	8.255
Total tax burden	170.025	225.325	204.611	244.076	116.671

or covariates (in our case, age, size, profitability, asset structure, liability structure, directors and employees remuneration). In other words, we need to look at the extent to which industry differences are related to age, size, profitability etc., and whether these interaction are related to tax burden, our dependent variable.

To do this, we first build a multiple regression model (see Table VII below) where we regress tax burden against the different variables included as covariates in the ANCOVA model presented above, as well as a set of dummy variables introducing the sector type effects. This helps in visualising the direction of the relationship between the different independent variables and tax burden (the dependent variable).

We then, build a second ANCOVA model, similar to the one presented above, but this time

TABLE VII
Multiple OLS-Regression model: Total tax burden

Independent variables	Coefficient	Std. error	t-statistic	Significance
Dependent variable = Tax burden (total taxes to total assets)				
Constant	0.171	0.007	25.795	0.000*
Age	-2.14×10^{-4}	0.000	–1.577	0.115
Size	-4.18×10^{-5}	0.000	–32.848	0.000*
Profitability	0.166	0.010	17.906	0.000*
Asset structure	–0.040	0.009	–5.108	0.000
Liability structure	–0.061	0.010	–6.394	0.000*
Directors remuneration	8.26×10^{-4}	0.000	16.469	0.000*
Employees remuneration	6.63×10^{-3}	0.000	21.827	0.000*
Sector type dummies (Missing sector: All other low-tech)				
Low-tech manufacturing	0.023	0.005	4.828	0.000*
High-tech manufacturing	0.047	0.012	3.620	0.000*
Low-tech services	0.029	0.009	3.122	0.002*
High-tech services	0.078	0.011	7.285	0.000*
R Square	0.344			
Adjusted R-Square	0.342			
F-Statistic	257.328*			

* Significant at the 0.05 level.

we include in the model a number of two-way interactions between the factor (sector type) and the covariates (age, size, profitability, asset structure, liability structure, directors and employees remuneration) (see Table VIII, below). Where we find significant interaction effects, we build a number of cross-tabulations that help in analysing and interpreting these effects.

5.2. *Age of business*

As can be seen in Table VII, age exhibits a negative relationship with tax burden, however, the relationship is not found to be highly significant. Nevertheless, in the second ANCOVA model presented in Table VIII, where interaction effects are included, we find that the interaction effect between age and sector type is significant. Taken together these relationships suggest that although age per se does not seem to be related to tax burden in a systematic way, the age distribution of businesses across industries is such that a age and industry together determine tax burden in a systematic way. To examine the direction of this relationship we compute a One-Way Analysis of Variance (One-Way ANOVA) to examine if there are significant differences in the age distribution of businesses across industries. As can be seen in Table IX, average age of business differs significantly across industries. The multiple comparison tests presented in Table IX, suggests that businesses in high-tech sectors (both manufacturing and services) are systematically younger than all their low-tech counterparts.

Integrating the results presented in Tables VII, VIII, IX, it would appear that age has a weak negative effect on tax burden but this effect becomes significant in high-technology small firms which are on average younger than their low-tech counterparts.

In fact, as shown in Table X, where we estimate average tax burden (total tax to total assets) across sector type and age bands, we can clearly see that age has a direct negative relationship with tax burden only in high-tech businessess (both manufacturing and services). The relationship between age and tax burden is not clear in the other sectors.

5.3. *Business size*

Reverting back to Table VII, where we present the results of the OLS regression model, we can see

TABLE VIII
ANCOVA model with interaction effects

Source	Type III sum of squares	df	Mean square	F-statistic	Significance
Corrected model	68.451[a]	39	1.755	77.541	0.000[b]
Intercept	6.489	1	6.489	286.690	0.000[b]
Factors					
Sector type (1–5)	0.770	4	0.192	8.502	0.000[b]
Covariates					
Age	0.006	1	0.006	0.263	0.608
Size	6.835	1	6.835	301.943	0.000[b]
Profitability	1.746	1	1.746	77.126	0.000[b]
Asset structure	0.063	1	0.063	2.782	0.095
Liability structure	0.379	1	0.379	16.479	0.000[b]
Directors remuneration	2.275	1	2.275	100.513	0.000[b]
Employees remuneration	4.659	1	4.659	205.811	0.000[b]
Sector type ∗ Age	0.277	4	0.069	3.059	0.016[b]
Sector type ∗ Size	0.506	4	0.127	5.589	0.000[b]
Sector type ∗ Profitability	0.360	4	0.090	3.981	0.003[b]
Sector type ∗ Liability structure	0.133	4	0.033	4.888	0.027[b]
Sector type ∗ Asset structure	0.204	4	0.051	2.258	0.061
Sector type ∗ Directors rem.	0.545	4	0.136	6.019	0.000[b]
Sector type ∗ Employees rem.	0.739	4	0.185	8.162	0.000[b]
Error	121.800	5381	0.023		
Total	508.379	5421			
Corrected total	190.250	5420			

[a] R Squared = 0.344 (Adjusted R Squared = 0.342).
[b] Significant at the 0.05 level.

that size exhibits a negative relationship with tax burden. This suggests that taxation is regressive falling more heavily on smaller firms. Furthermore, in Table VIII, we find a significant interaction effect between size and sector type in determining tax burden. In fact, we can see in Table XI that TBSFs are systematically smaller in size than their low-tech counterparts both in the manufacturing and in the services industry. The weighted average of total assets is substantially smaller in high tech manufacturing and service activities than in equivalent low-tech sectors. DTI figures on the size distribution of firms by sector reveal similar patterns (DTI, 1997).

Moreover, as can be seen in Table XII, where we estimate average tax burden (total tax to total assets) across sector type and size bands, we can clearly see that size has a direct negative relationship with tax burden, and this is especially obvious in the high-tech businesses (both manufacturing and services). The relationship between size and tax burden is not clear-cut in the other sectors. In fact, in low-tech services the relationship between tax burden and size appears to be positive.

5.4. *Profitability*

As one would expect, Table VII, reveals a strong positive relationship between profitability (return on total assets) and tax burden (total tax to total assets). What is even more interesting, is the significant interaction between profitability and sector type illustrate in Table VIII, where we present the results of the second ANCOVA model.

In fact, we can see in Table XIII that TBSFs achieve a higher return on their assets compared to their low-tech counterparts. This is particularly evident in the service sector where micro-companies proliferate and tend to have a small turnover-base and a low level of investment in assets.

TABLE IX
The age profile of sample firms (weighted averages)[a]

Variable	All other	Manufacturing		Services	
	Low-Tech	Low-Tech	High-Tech	Low-Tech	High-Tech
Average age	23.3	23.6	14.8	19.9	11.1
One-way ANOVA F-Statistic	71.528	Significance		0.000[b]	

Pairwise multiple comparison tests (Bonferroni Test)
Mean difference in firm age between sector type pairs

Pairs (Sectors)		Mean difference (I)–(J)	Std. error	Significance
(I)	(J)			
Low Tech Other	Low Tech Mfg	–0.257	0.464	1.000
	High Tech Mfg	8.530	1.176	0.000[b]
	Low Tech Services	3.455	0.867	0.001[b]
	High Tech Services	12.225	0.820	0.000[b]
Low Tech Mfg	High Tech Mfg	8.787	1.205	0.000[b]
	Low Tech Services	3.712	0.905	0.000[b]
	High Tech Services	12.481	0.860	0.000[b]
High Tech Mfg	Low Tech Services	–5.075	1.410	0.003[b]
	High Tech Services	3.695	1.382	0.075
Low Tech Service	High Tech Services	8.769	1.129	0.000[b]

[a] By the distribution of firms in each cell of the database.
[b] The mean difference is significant at the 0.05 level.

TABLE X
Tax burden (total taxes to total assets) across sector types and age bands

Sector type	Age bands		
	1–5 years	6–10 years	> 10 years
Low Tech Other	19.6%	23.5%	21.5%
Low Tech Mfg	25.2%	25.7%	25.3%
High Tech Mfg	34.6%	31.3%	29.1%
Low Tech Services	32.9%	33.6%	25.7%
High Tech Services	47.2%	46.3%	44.6%

Furthermore, as shown in Table XIV, even when we classify firms into different profitability bands, tax burden is higher in the TBSFs compared to low-tech counterparts (both manufacturing and services), in all profitability bands examined. In other words, the more profitable the firm is the higher the tax burden as a percentage of total assets, and this is especially true for high-tech businesses. It is also interesting to note that, tax burden as a percentage of total assets, is higher in loss making firms compared to more profitable ones. This is the result of employment taxes, which have to be paid no matter what the profitability of the business is.

5.5. *Liability structure (borrowings to total assets*

The results of the OLS regression presented in Table VII above suggest that there is a negative relationship between liability structure (gearing) and total tax burden. This is because interest on loans shields income from taxation, and highly geared businesses have proportionately higher tax relief on interest paid, and as a result, pay less corporation tax as a proportion of total assets.

What is even more interesting, is the significant interaction between gearing (liability structure) and sector type illustrated in Table VIII above,

TABLE XI
The size profile of sample firms (weighted averages)[a]

Variable	All other	Manufacturing		Services	
	Low-Tech	Low-Tech	High-Tech	Low-Tech	High-Tech
Average size Total assets (£000s)	£1,253	£1,183	£870	£1,323	£327
One-way ANOVA F-Statistic	23.716	Significance		0.000[b]	

Pairwise multiple comparison tests (Bonferroni Test)
Mean difference in firm size between sector type pairs

Pairs (Sectors)		Mean difference (I)–(J)	Std. error	Significance
(I)	(J)			
Low Tech Other	Low Tech Mfg	35.869	54.524	1.000
	High Tech Mfg	348.642	138.092	0.116
	Low Tech Services	–103.954	102.244	1.000
	High Tech Services	892.135	96.228	0.000[b]
Low Tech Mfg	High Tech Mfg	312.773	141.444	0.027[b]
	Low Tech Services	–139.823	106.728	1.000
	High Tech Services	856.266	100.979	0.000[b]
High Tech Mfg	Low Tech Services	–452.596	165.793	0.064
	High Tech Services	543.493	162.152	0.008[b]
Low Tech Service	High Tech Services	996.089	132.958	0.000[b]

[a] By the distribution of firms in each cell of the database.
[b] The mean difference is significant at the 0.05 level.

Table XII
Average tax burden across sector types and size bands

Sector type	Size bands (number of employees)			
	1–4	5–9	10–19	20–99
Low Tech Other	21.8%	25.4%	24.1%	18.0%
Low Tech Mfg	25.4%	32.2%	27.7%	22.1%
High Tech Mfg	34.5%	32.4%	30.6%	27.5%
Low Tech Services	16.3%	22.3%	31.2%	33.9%
High Tech Services	49.6%	39.4%	39.3%	36.5%

where we present the results of the second ANCOVA model. This suggests that liability structure affects tax burden, and because sector type is related to liability structure there is a combined effect on tax burden. It is expected that TBSFs will exhibit lower gearing (borrowings to total assets) than low tech small firms since TBSFs must finance early stage business development with internally generated capital (i.e. share capital, retained profits and family resources) (Roberts, 1991; Moore, 1993; Murray, 1994; Mason and Harrison, 1994). In fact, we can see in Table XV that TBSFs have a lower gearing ratio compared to their low-tech counterparts. This is particularly

TABLE XIII
The profitability (ROTA) of sample firms (weighted averages)[a]

Variable	All other	Manufacturing		Services	
	Low-Tech	Low-Tech	High-Tech	Low-Tech	High-Tech
Profitability (ROTA)	7.6%	7.7%	11.3%	10.8%	51.7%
One-way ANOVA F-Statistic	259.321	Significance		0.000[b]	

Pairwise multiple comparison tests (Bonferroni Test)
Mean difference in profitability ratios between sector type pairs

Pairs (Sectors)		Mean difference (I)–(J)	Std. error	Significance
(I)	(J)			
Low Tech Other	Low Tech Mfg	–0.1%	0.007	1.000
	High Tech Mfg	–3.7%	0.108	0.426
	Low Tech Services	–3.2%	0.013	0.157
	High Tech Services	–44.1%	0.014	0.000[b]
Low Tech Mfg	High Tech Mfg	–3.6%	0.019	0.547
	Low Tech Services	–3.1%	0.014	0.256
	High Tech Services	–44.0%	0.014	0.000[b]
High Tech Mfg	Low Tech Services	0.5%	0.022	1.000
	High Tech Services	–40.4%	0.022	0.000[b]
Low Tech Service	High Tech Services	–40.9%	0.018	0.000[b]

[a] By the distribution of firms in each cell of the database.
[b] The mean difference is significant at the 0.05 level.

Table XIV
Tax burden (total tax to total assets) across sector types and profitability bands

	Net profitability (return on total assets: ROTA)			
	Losses	0–5%	5–15%	> 15%
Low Tech Other	23.8%	17.4%	18.6%	30.5%
Low Tech Mfg	27.0%	20.8%	23.7%	30.9%
High Tech Mfg	31.1%	28.0%	25.4%	37.2%
Low Tech Services	27.6%	22.3%	24.5%	36.1%
High Tech Services	32.4%	35.0%	33.0%	52.4%

evident in the service sector where micro-companies proliferate and appear to be more financially constrained than their larger counterparts.

High-tech businesses have poor access to loans and subsequently to the deduction of interest charges from taxable profits (the "debt-tax shield"; DeAngelo and Masulis, 1980) when compared with low-tech firms. These findings strongly support the conclusions of other scholars (e.g. Westhead and Storey, 1997).

5.6. *Asset structure*

As can be seen in Table VII above, where we present the results of the OLS regression, asset structure (i.e. the ratio of fixed assets to total

TABLE XV
Gearing in sample firms (weighted averages)[a]

Variable	All other	Manufacturing		Services	
	Low-Tech	Low-Tech	High-Tech	Low-Tech	High-Tech
Gearing	23.7%	25.0%	17.2%	27.9%	13.8%
One-way ANOVA F-Statistic	20.538	Significance		0.000[b]	

Pairwise multiple comparison tests (Bonferroni Test)
Mean difference in gearing ratios between sector type pairs

Pairs (Sectors)		Mean difference (I)–(J)	Std. error	Significance
(I)	(J)			
Low Tech Other	Low Tech Mfg	–0.014	0.007	0.571
	High Tech Mfg	0.065	0.019	0.006[b]
	Low Tech Services	–0.042	0.014	0.027[b]
	High Tech Services	0.099	0.014	0.000[b]
Low Tech Mfg	High Tech Mfg	0.078	0.019	0.000[b]
	Low Tech Services	–0.028	0.014	0.518
	High Tech Services	0.112	0.015	0.000[b]
High Tech Mfg	Low Tech Services	–0.106	0.023	0.000[b]
	High Tech Services	0.034	0.023	1.000
Low Tech Service	High Tech Services	0.141	0.019	0.000[b]

[a] By the distribution of firms in each cell of the database.
[b] The mean difference is significant at the 0.05 level.

assets) exhibits a negative relationship with total tax burden (total taxes to total assets). This suggests that the more fixed assets a company possess the more the depreciation deductions it will be able to use in order to shield income from taxation, and as a result the lower the tax burden it will have to face.

What is of more interest though, is the interaction effect between asset structure and sector type illustrated in Table VIII above. Although, not significant at the 0.05 level, the interaction term is significant at the 0.10 level. This suggests that the effect of asset structure on tax burden differs across industry in a manner related to differences in asset structure across industries.

In fact, we can see in Table XVI that TBSFs exhibit lower asset structure ratios compared to their low-tech counterparts. The financial constraints faced by TBSFs will mean that both high-tech manufacturers and service businesses will have fewer fixed assets to total assets than their low-tech counterparts (OECD, 1993).

Few high-tech small companies have any intangible assets such as patents, licences or accumulated R&D expenditure on their balance sheets, presumably because no tax and accounting advantages arise from capitalising this expenditure. As a result, it is more tax efficient to absorb development costs into operating expenditures that *are* fully deductible in calculating profits for taxation purposes.

5.7. *Directors remuneration*

The results of the OLS regression presented in Table VII above, reveal a positive relationship between directors remuneration and tax burden faced by businesses. This is of course obvious because the higher the remuneration the higher will be the taxes in the form of employers and

TABLE XVI
The asset structure (fixed to total assets) of sample firms (weighted averages)[a]

Variable	All other	Manufacturing		Services	
	Low-Tech	Low-Tech	High-Tech	Low-Tech	High-Tech
Asset structure	34.1%	33.0%	22.4%	29.6%	23.3%
One-way ANOVA F-Statistic	21.205	Significance		0.000[b]	

Pairwise multiple comparison tests (Bonferroni Test)
Mean difference in asset structure ratios between sector type pairs

Pairs (Sectors)		Mean difference (I)–(J)	Std. error	Significance
(I)	(J)			
Low Tech Other	Low Tech Mfg	0.011	0.008	1.000
	High Tech Mfg	0.117	0.020	0.000[b]
	Low Tech Services	0.045	0.015	0.024[b]
	High Tech Services	0.107	0.015	0.000[b]
Low Tech Mfg	High Tech Mfg	0.106	0.021	0.000[b]
	Low Tech Services	0.034	0.015	0.256
	High Tech Services	0.097	0.016	0.000[b]
High Tech Mfg	Low Tech Services	–0.072	0.024	0.029[b]
	High Tech Services	–0.010	0.024	1.000
Low Tech Service	High Tech Services	0.062	0.020	0.020[b]

[a] By the distribution of firms in each cell of the database.
[b] The mean difference is significant at the 0.05 level.

directors NICs and income tax. What is of interest though, is whether the level of directors' remuneration is related to sector type. The significant interaction between directors' remuneration and sector type presented in Table VIII suggests that the extent to which directors remuneration determines tax burden differs across sectors. This may be the result of systematic remuneration differences across sectors. In fact, as can be seen in Table XVII, remuneration per director is significantly lower in high-tech services compared to their low-tech counterparts.

High-tech services sector is characterised with a proliferation of micro-ventures (with small turnover, asset base) whose working owner/directors perhaps do not get high pay-out packages as they are retaining profits to service business loans and/or finance investment in survival and growth strategies.

It is important to note here that, even though directors of high-tech services earn considerably less, and as a result pay lower taxes when directors taxes are expressed as a proportion of assets, the tax burden as a percentage of total assets is higher in high-tech services when compared to low-tech counterparts (See Table XVIII). This is also true in high-tech manufcaturing firms.

5.8. *Employees remuneration*

As with directors remuneration, employees remuneration can also be expected to have a positive relationship with total tax burden. The results of the OLS regression presented in Table XVII below, reveals that this is the case. Furthermore, the results of the ANCOVA model presented in Table VIII suggest that there is also a significant interaction effect between employees remuneration and sector type in determining tax burden. Given that employees remuneration does affect tax

TABLE XVII
Directrors remuneration in sample firms (weighted averages)[a]

Variable	All other	Manufacturing		Services	
	Low-Tech	Low-Tech	High-Tech	Low-Tech	High-Tech
Directors remuneration	£35,774	£43,690	£45,223	£48,585	£28,544
One-way ANOVA F-Statistic	14.566	Significance		0.000[b]	

Pairwise multiple comparison tests (Bonferroni Test)
Mean difference in directors remuneration between sector type pairs

Pairs (Sectors)		Mean difference (I)–(J)	Std. error	Significance
(I)	(J)			
Low Tech Other	Low Tech Mfg	–7.916	1.483	0.000[b]
	High Tech Mfg	–9.449	3.856	0.143
	Low Tech Services	–12.811	2.870	0.000[b]
	High Tech Services	7.230	2.887	0.123
Low Tech Mfg	High Tech Mfg	–1.533	3.942	1.000
	Low Tech Services	–4.895	2.984	1.000
	High Tech Services	15.146	3.000	0.000[b]
High Tech Mfg	Low Tech Services	–3.362	4.645	1.000
	High Tech Services	16.679	4.655	0.003[b]
Low Tech Service	High Tech Services	20.042	3.878	0.000[b]

[a] By the distribution of firms in each cell of the database.
[b] The mean difference is significant at the 0.05 level.

burden, the interaction between sector type and employees remuneration suggests that there are systematic differences in the way employees are paid across sectors. What is of interest is the direction of these differences. Table XIX points out that employees' remuneration is lower in TBSFs compared to their low-tech counterparts; however, the difference is significant in the services industry only. There is a need for more empirical research into the employment and pay structures of technicians working in high tech business activities (on short-time, part-time contracts and/or on pro-rata basis) as it appears they differ from traditional sectors characterised with more unionised operatives.

The narrow capital asset base of TBSFs, especially in the services sector (referred to above) and the labour intensive nature of TBSF production tasks prevent TBSFs from substituting capital equipment for labour. As a result, it may be expected that employment taxes will represent a larger proportion of the total assets of TBSFs than would be the case for low-tech firms. Table XX reveals that this is the case.

6. The NatWest MBS tax model for small high-tech companies

There are about 44,400 high-tech small companies in the U.K. economy (DTI, 1997). By combining this information with the sample data in the NatWest MBS Tax Model, it is estimated that incorporated TBSFs will contribute about £2bn of tax revenues to the Exchequer in 1997/98, i.e. less than one per cent of total government taxes revenues. This figure comprises £338 m in corporation tax, £416 m in director's income tax and national insurance contributions, employers contributions to national insurance amount to £441 m, whilst their employees pay another £608 m in

TABLE XVIII
Directors taxes to total assets in sample firms (weighted averages)[a]

Variable	All other	Manufacturing		Services	
	Low-Tech	Low-Tech	High-Tech	Low-Tech	High-Tech
Directors taxes to TA	6.1%	5.6%	13.1%	11.0%	19.0%
One-way ANOVA F-Statistic	46.190	Significance		0.000[b]	

Pairwise multiple comparison tests (Bonferroni Test)
Mean difference in directors taxes to total assets between sector type pairs

Pairs (Sectors)		Mean difference (I)–(J)	Std. error	Significance
(I)	(J)			
Low Tech Other	Low Tech Mfg	0.005	0.006	1.000
	High Tech Mfg	–0.070	0.015	0.000[b]
	Low Tech Services	–0.049	0.011	0.000[b]
	High Tech Services	–0.129	0.011	0.000[b]
Low Tech Mfg	High Tech Mfg	–0.075	0.016	0.000[b]
	Low Tech Services	–0.053	0.012	0.000[b]
	High Tech Services	–0.134	0.011	0.000[b]
High Tech Mfg	Low Tech Services	0.021	0.018	1.000
	High Tech Services	–0.059	0.018	0.010[b]
Low Tech Service	High Tech Services	–0.080	0.015	0.000[b]

[a] By the distribution of firms in each cell of the database.
[b] The mean difference is significant at the 0.05 level.

income tax and £201 m in national insurance contributions. The equivalent 218,655 small low-tech manufacturers and service companies (which are on average larger than their high-tech counterparts – see Table XI) generate an estimated £18 bn of tax revenues equivalent to about 6% of government receipts.

Figure 2 includes these results for TBSFs together with the costs of compliance with tax regulations (primarily for collecting PAYE and VAT on behalf of government). The data is presented in the form of the NatWest MBS Tax Index that shows the major components and the trends in the total tax burden on TBSFs since 1995/96. Since a single generic set of tax rules apply to all small companies, the trends exhibited by the NatWest MBS Tax Index for TBSFs are similar to that of the whole small business economy (see Chittenden et al. 1996, 1998, 1999a, 1999b; Poutziouris et al., 1999). Between 1995/96 and 1997/98 the TBSF index has fallen by 3.6 points. These changes are primarily the result of increased personal allowances for income tax (up from £3,525 to £4,045 per person), together with reductions in the standard rate of income tax and the small companies rate of corporation tax (both down from 25% to 23%).

In addition the budget changes announced in July 1997, introduced in 1998/9, reduce the index by a further 0.7 points 95.7, due to further reductions in the small companies rate of corporation tax. This reduction would have been almost 50% higher (at one index point) if the Chancellor had not used the improving economic position as an opportunity to reduce the carry back of losses for corporation tax from three years to one year, which will result in TBSFs paying an extra £70 m in corporation tax in 1998/99.

Any changes that reduce the burden of taxation on the severely financially constrained TBSF

TABLE XIX
Employees remuneration in sample firms (weighted averages)[a]

Variable	All other	Manufacturing		Services	
	Low-Tech	Low-Tech	High-Tech	Low-Tech	High-Tech
Employees remuneration	£3,449	£14,378	£14,354	£17,083	£12,382
One-way ANOVA F-Statistic	18.611	Significance		0.000[b]	

Pairwise multiple comparison tests (Bonferroni Test)
Mean difference in employees remuneration between sector type pairs

Pairs (Sectors)		Mean difference (I)–(J)	Std. error	Significance
(I)	(J)			
Low Tech Other	Low Tech Mfg	–0.929	0.250	0.002[b]
	High Tech Mfg	–0.904	0.650	1.000
	Low Tech Services	–3.633	0.481	0.000[b]
	High Tech Services	1.067	0.487	0.284[b]
Low Tech Mfg	High Tech Mfg	0.024	0.664	1.000
	Low Tech Services	–2.705	0.500	0.000[b]
	High Tech Services	1.995	0.506	0.001[b]
High Tech Mfg	Low Tech Services	–2.729	0.781	0.005[b]
	High Tech Services	1.971	0.785	0.120
Low Tech Service	High Tech Services	4.700	0.652	0.000[b]

[a] By the distribution of firms in each cell of the database.
[b] The mean difference is significant at the 0.05 level.

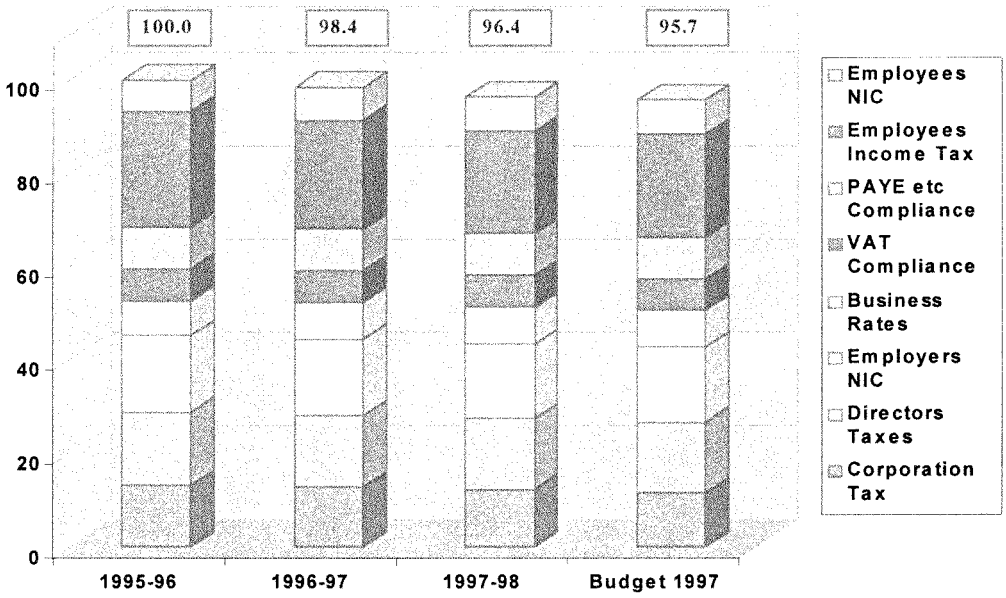


Figure 2. The tax index for high technology small companies.

TABLE XX
Employees taxes to total assets in sample firms (weighted averages)[a]

Variable	All other	Manufacturing		Services	
	Low-Tech	Low-Tech	High-Tech	Low-Tech	High-Tech
Employee taxes to TA	18.1%	19.6%	24.6%	26.2%	32.4%
One-way ANOVA F-Statistic	31.408	Significance		0.000[b]	

Pairwise multiple comparison tests (Bonferroni Test)
Mean difference in employees taxes to total assets between sector type pairs

Pairs (Sectors)		Mean difference (I)–(J)	Std. error	Significance
(I)	(J)			
Low Tech Other	Low Tech Mfg	–0.016	0.008	0.532
	High Tech Mfg	–0.065	0.020	0.014[b]
	Low Tech Services	–0.081	0.015	0.000[b]
	High Tech Services	–0.143	0.014	0.000[b]
Low Tech Mfg	High Tech Mfg	–0.050	0.021	0.177
	Low Tech Services	–0.066	0.016	0.000[b]
	High Tech Services	–0.127	0.015	0.000[b]
High Tech Mfg	Low Tech Services	–0.016	0.025	1.000
	High Tech Services	–0.078	0.024	0.012[b]
Low Tech Service	High Tech Services	–0.062	0.020	0.017[b]

[a] By the distribution of firms in each cell of the database.
[b] The mean difference is significant at the 0.05 level.

sector are helpful (Oakey, 1997) and NatWest MBS Tax Index suggests that any tax allowances will only lead to modest reductions in government tax revenue. Because of the overwhelming support for public policy measures to assist TBSFs (Bank of England, 1997; CBI, 1997) the government is now planning to use fiscal measures to deliver this much needed support, and this paper supports this position.

7. Conclusions and recommendations

This study shows that small high technology companies pay proportionately higher taxes (as a percentage of total assets) than their low technology counterparts. In absolute figures average tax bills are higher for the relatively larger low-tech firms, but when taxes paid are expressed as a proportion of firm size, the impact of taxation on high-tech companies is much greater (Figure 3). Thus it may be argued that the tax system disproportionately affects the financial development of such "survivor" high-tech firms and hampers their growth potential.

The results presented in this paper suggest that, even when controlling for other variables that could determine the tax burden incurred by small firms (e.g. size, age, profitability, asset and liability structure), there are significant sector influences affecting tax burden. Very interestingly we also found significant interaction effects between sector type and the control variables. Firstly, it was shown that age is negatively related to tax burden, and because high-tech firms are on average younger than their low-tech counterparts, tax burdens falls more heavily on high-tech business.

Secondly, firm size was found to be negatively related to tax burden as well. This suggests that the tax burden is regressive falling more heavily

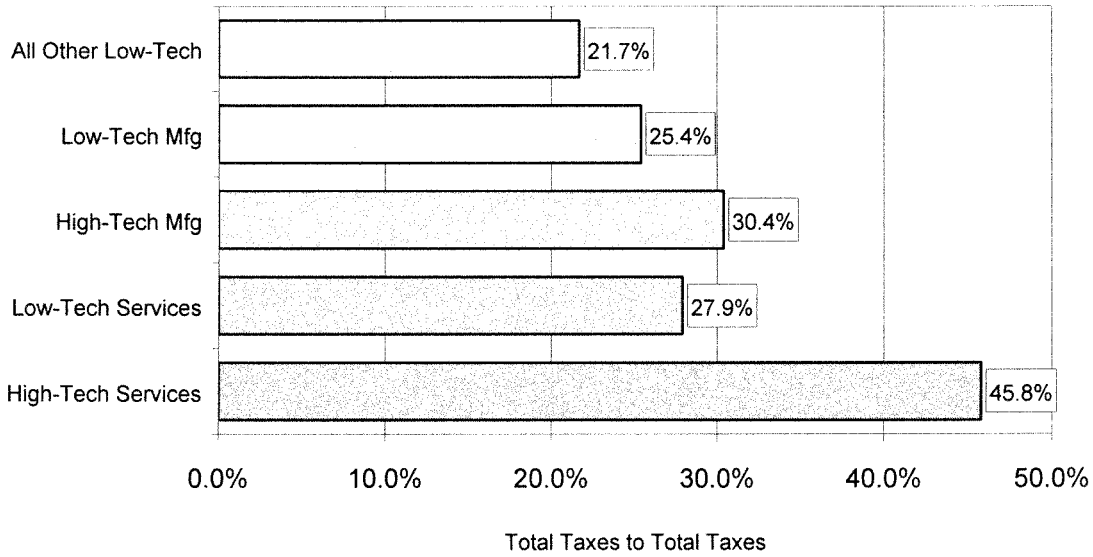


Figure 3. The real cost of tax payments (taxes to total asset).

on smaller firms. The results also suggest that the distribution of firm size across sectors is also such, that there are differences in the tax burden incurred by firms in different sectors. TBSFs are on average smaller than low-tech counterparts and as a result incur higher taxes relative to their size.

However, size is not the only reason TBSFs face higher tax burden. Profitability has a significant effect on tax burden. Obviously more profitable firms pay proportionately more taxes. Furthermore, our results suggest that profitability and sector type interact in their effect on tax burden. TBSFs are significantly more profitable than their low-tech counterparts and as a result incur a higher tax burden.

Liability structure (gearing) also affects tax burden in negative manner, due to tax allowances in interest payments. What is even interesting, is the significant interaction between gearing (liability structure) and sector type. Apparently, TBSFs appear to be more financially constrained than low-tech counterparts and have to rely on lower gearing ratios. As such, they fail to utilise tax allowances on interest payments to reduce their tax bills, to the extent their low-tech counterparts can, and as a result incur a higher tax burden. This is particularly evident in the service sector where micro-companies proliferate and appear to be more financially contrasted than larger counterparts.

OECD (1993) point out that the financial constraints faced by TBSFs will mean that both high-tech manufacturers and service businesses will have fewer fixed assets to total assets than their low-tech counterparts. In fact, the results presented in this paper suggest that TBSFs exhibit low asset structure ratios than low-tech businesses. Furthermore, it is shown that asset structure is negatively related to tax burden due to tax allowances on depreciation changes. It is also shown that asset structure and sector type interact in their effect on tax burden. The result is that, because TBSFs exhibit lower asset structure ratios they fail to utilise tax allowances on depreciation charges, and hence face a higher tax burden.

As one would expect, companies paying higher salaries will incur higher taxes. In fact, the results presented in this paper illustrate a positive relationship between directors and employees remuneration and tax burden. It was also shown that directors and employees remuneration interacts in their effect on tax burden. TBSFs pay lower directors and employees remuneration than low-tech counterparts. Yet, because of the relatively small asset base of TBSFs, taxed paid on employees and directors earnings represent a larger proportion of the businesses' resources than is the case for low-tech firms.

Reiterating from the above, it can be argued that small TBSFs pay more tax as a proportion of

their asset base, even when adjusting for other variable that are thought to determine tax burden. Yet, these variables are significant enough and they appear to interact with sector type in their effect on tax burden. The results presented in this paper suggest that TBSFs face a higher tax burden than low-tech counterparts partly because they are younger, smaller and more profitable, but also because they are more financially constrained and fail to utilise valuable interest and depreciation tax allowances.

It could, therefore, be argued that because TBSFs are financially constrained, the generation of taxable profits is essential in order to sustain the business and offer the prospect of growth. Yet, in all companies, but to a proportionately larger extent on high-tech business (which incur a higher tax burden than low-tech counterparts), taxation of retained profits is a severe drain on productive resources. From a public policy perspective this situation is perverse because the value of owners' taxes collected from the sector (estimated at about £705 m) represents a tiny proportion of government revenues. In addition, with the small company corporation tax rate set at 20% for every additional £ of corporation tax foregone – £5 would be retained for re-investment in the TBSF companies, a fivefold marginal re-investment rate on every £ of corporation tax foregone by the Treasury. Whilst the arguments against the taxation of retained profits for small companies are compelling for all sectors of the economy (Chittenden et al., 1996, 1998, 1999a, 1999b; Poutziouris et al., 1999), for the TBSF sector which is a strong health, employment and export generator the arguments are surely overwhelming.

Acknolwedgements

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Notes

[1] The NatWest MBS tax models were developed using data from almost 10,000 real businesses to track the effects of taxation on small limited companies (i.e. those employing less than 100 people) and unincorporated businesses (i.e. sole traders and partnerships employing less than 20 people) in Britain as well as quantifying the tax contribution of the small business sector to the U.K. economy as a whole. The models examine not just the monetary level of taxes (income, corporation, national insurance taxes and uniform business rates) but also the cost to a business of compliance with the tax system: in other words the estimated cost to a small business of acting as a collector of PAYE and VAT on Government's behalf and of administering their own tax and legal affairs. Taxes deducted from employees earnings i.e. income tax and national insurance contributions are also included as these increase the costs of employing staff. Through workshops of SME tax specialists the Models have been refined and this work is now regarded as the leading tax benchmark for the small business sector. A series of reports under the heading "Taxing Expansion" have been issued which have focused on the impact that taxation policy has on small businesses. Alternative practical cost efficient tax policies to stimulate long-term sustainable small business expansion have been outlined (Chittenden et al., 1996, 1998, 1999a, 1999b; Poutziouris et al., 1999).

[2] Pairwise multiple comparisons, such as the Bonferroni test used in this study, test the difference between each pair of means, and yield a matrix where significantly different group means are specified.

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