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CORPORATE TAX EXHAUSTION AND FINANCIAL POLICY: EVIDENCE ON FINNISH DATA*

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This paper examines in detail the empirical implications concerning taxation and optimal borrowing of the so called tax shelter-bankruptcy cost model. It is shown that in an institutional environment which allows the use of relatively large non-debt related tax shields, it is possible that firms exhaust the tax benefit of debt financing already at riskless debt levels. This, in turn, implies that the relevance of risk factors of debt in explaining optimal financial structure may be related to the firm's expected tax status. Empirical findings on a sample of Finnish manufacturing firms support the hypothesis that there are differences in the borrowing behaviour between tax exhausted and non-tax exhausted firms.

1. Introduction

Since the introduction of the famous financial structure irrelevancy theorem by Franco Modigliani and Merton H. Miller[1] in the late 1950s there has emerged a wide body of literature attempting to explain the observed relevance of corporate financing decisions. The approach most widely adopted in extending the analysis was to retain the assumption of a perfectly competitive capital market and to introduce various institutional market imperfections to make financial policy relevant. The outcome of this line of research has become to be known as the tax shelter-bankruptcy cost (TS-BC) model[2] of optimal financial structure. The TS-BC model states that due to the preferential tax treatment of debt, firms have an incentive to issue it. These tax benefits are then traded off against various costs associated with the issuance of risky debt to determine the optimal level of debt of a firm.

The driving force of this partial equilibrium model is the assumption that the tax system provides an incentive for firms to issue debt. This assumption was challenged by Miller (1977), who argued that, in market equilibrium, any tax advantage of debt at the corporate level has to be exactly offset by a tax disadvantage of debt in the personal taxation of investors. It was soon realised in the literature, however, that Miller's argument rested on the rather unrealistic assumption that firms are homogeneous in their capacity to issue

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[1] *Modigliani & Miller (1958).*

[2] *Among the first to formalise this approach were Kraus & Litzenberger (1973) and Scott (1976).*

debt. By relaxing this assumption and allowing for firm-specific leverage-related costs, various generalisations of the »Miller equilibrium» have shown that there has to be, also in a market equilibrium, a net tax advantage of issuing debt.[3] This, in turn, implies that the TS-BC model ought to have some empirical relevance.

Although the view that taxes are important for corporate financing decisions seems to have been accepted at a theoretical level, empirical evidence on the issue has turned out to be disappointing. Much of this has to do with various technical problems in the empirical work. It also appears that the empirical implications of the theory concerning taxation and financial policy have not always been fully examined.

In this paper a partial equilibrium model of corporate financial policy is constructed and testable implications of the model are derived. The model is essentially a TS-BC model in the spirit of Kraus & Lizenberger (1973), Scott (1976) and Bradley, Jarrell & Kim (1984). Unlike the above mentioned studies, however, this paper pays special attention to the implications of the firm's tax status for financing decisions in the spirit of DeAngelo & Masulis (1980) and Mayer (1986). Finally, panel data on Finnish manufacturing companies is used to test the implications of the model.

2. *The model*

2.1 *Institutional setting*

Consider a one-period model of firm valuation under uncertainty. Investors in this economy are risk neutral and possess homogeneous expectations. It is assumed that the firm's investment and financing decisions are separable and, in order to concentrate on financial policy, the firm's investment decisions are taken as given. At time 0 the firm chooses its financial structure and at time 1, when the true state of nature is revealed, the firm is liquidated and the proceeds are distributed among the various claimants.

The capital market is assumed to be imperfect in the sense that both corporate and personal end-of-period wealth are taxed. The firm faces a constant tax rate τ_c. Furthermore, corporate taxation is assumed to be nonneutral in that all payments to debtholders, as opposed to payments to shareholders, are fully deductible. In calculating the taxable end-of-period wealth the firm can claim an exogenously given amount, Δ, as pure accounting expenses. Δ is henceforth referred to as the non-debt related tax shield since it is a substitute for debt payments in providing tax shield for the firm. Negative taxes are not allowed and unused tax shields are not transferable across firms. Investors' personal tax rates for debt income and equity income are denoted by τ_{pd} and τ_{pe}, respectively. It is assumed that these tax rates may generally differ. From the viewpoint of the firm the relevant tax rates are those of the marginal investor. In the following analysis we interpret τ_{pd} and τ_{pe} as representing the tax rates of the firm's marginal investor.

Moreover, if the firm fails to meet its fixed end-of-period obligations to debtholders it goes bankrupt. In bankruptcy some exogeneously determined costs to third parties are assumed to be incurred. However, even before the firm goes bankrupt risky debt may give rise to agency costs[4] that lower the value of the firm. Let C_{fd} denote all the various costs associated with risky debt financing and refer to it henceforth as the costs of financial distress.

Letting $\tilde{X}$ denote the uncertain end-of-period value of the firm before debt payments and taxes, and B the promised end-of-period payment (interest plus principal) to debtholders we get the following sharing rule, after all taxes, for the end-of-period wealth generated by the firm between the firms's shareholders and debtholders:

$$\text{shareholders get} \begin{cases} 0, & \text{if } \tilde{X} < B \\ (1-\tau_{pe})(\tilde{X}-B), & \text{if } B \leq \tilde{X} < B+\Delta \\ (1-\tau_{pe})[\tilde{X}-B-\tau_c(\tilde{X}-B-\Delta)], & \text{if } \tilde{X} \geq B+\Delta \end{cases}$$

[3] *See e.g. DeAngelo (1980), Kim (1982), and Barnea, Haugen & Senbet (1985).*

[4] *These agency costs are incurred by the risk shifting incentive and the investment disincentive of risky debt financing. See Jensen & Meckling (1976), Myers (1977) and Barnea, Haugen & Senbet (1985).*

debtholders get $\begin{cases}(1-\tau_{pd})(\tilde{X}-C_{fd}), & \text{if } \tilde{X}<B\\(1-\tau_{pd})B, & \text{if } \tilde{X}\geq B\end{cases}$

Thus, there are two cash outflows to third parties. Firstly, the government claims part of the wealth through taxation: in addition to the corporation tax investors are taxed at the rate τ_{pd} for debt income and τ_{pe} for equity income in their personal taxation. Secondly, C_{fd} reflects the decrease in firm value due to risky debt financing, either in the form of welfare losses due to agency problems or direct bankruptcy costs. Since it is possible for the firm to affect these cash outflows through financing choices financial policy is relevant.

Furthermore, assume that $\tilde{X}$ is a continuous random variable with density function $f(\tilde{X})$ and cumulative distribution function $F(\tilde{X})$. To ensure both investor groups' limited liability it is assumed that $f(\tilde{X})=0\ \forall\ \tilde{X}<C_{fd}$. Finally, denoting by r the one-period riskless interest rate we write the equation for the firm's market value at t=0, V, in the following form:[5]

$$(1)\quad V=\frac{1}{1+r}\{(1-\tau_{pe})[\int_{B}^{B+\Delta}(\tilde{X}-B)f(\tilde{X})d\tilde{X} + \int_{B+\Delta}^{\infty}[(\tilde{X}-B)-\tau_c(\tilde{X}-B-\Delta)]f(\tilde{X})d\tilde{X}] + (1-\tau_{pd})[\int_{0}^{B}(\tilde{X}-C_{fd})f(\tilde{X})d\tilde{X} + \int_{B}^{\infty}Bf(\tilde{X})d\tilde{X}]\}$$

2.2 *Determination of optimal financial policy*

Under the assumptions made above the firm's financial policy involves setting the debt level,[6] B, so that the valuation equation (1) is maximised. The first-order condition for a maximum is given by

$$(2)\quad \frac{\partial V}{\partial B}=\frac{1}{1+r}\{[(1-\tau_{pd})-(1-\tau_c)(1-\tau_{pe})][1-F(B+\Delta)]-(\tau_{pd}-\tau_{pe})[F(B+\Delta)-F(B)]-(1-\tau_{pd})C_{fd}f(B)\}=0.$$

The first two terms inside the brackets give us the marginal net tax benefit of debt financing. The last term, on the other hand, tells us the marginal impact of debt on the expected costs of financial distress. Since the sign of the last term is unambiguously negative it must be assumed that at B=0 the net tax advantage of debt is positive in order to have firms issuing any debt at all. Under the plausible assumption that the firm's value if liquidated exceeds the (present) value of non-debt related tax shields $(F(\Delta)=0)$, we must have

$$(3)\quad (1-\tau_{pd})-(1-\tau_c)(1-\tau_{pe})>0.$$

This basically says that an additional unit of wealth generated by the firm must yield a greater after-tax payoff if distributed to the firm's debtholders as opposed to the shareholders. In this partial equilibrium analysis we take the investors' tax characteristics as given and simply assume that equation (3) holds.[7] Hence, the first term in equation (2) is unambiguously positive. The second term, however, is unambiguously nonpositive if $\tau_{pd}\geq\tau_{pe}$, as the tax system in most countries would suggest. The reason is that in the range $B<\tilde{X}<B+\Delta$, where the end-of-period value of the firm exceeds the promised payment to debtholders but is less than the available tax deductions, the marginal tax benefit of debt is zero at the corporate level. Therefore, if debt income is more heavily taxed at the personal level, the effect on firm value through the second term in equation (2) is negative.

Equation (2) clearly demonstrates how the firm's optimal financial policy is determined as a trade-off between the expected net tax advantage of debt and the expected costs of financial distress. It is, however, worth noting that the existence of non-debt related tax shields makes it possible in the model that the

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[5] *We also assume that f(X) is continuous and twice continuously differentiable to justify the manipulations which follow.*

[6] *Strictly speaking, B denotes the total promised end-of-period payment to debtholders. However, assuming that the interest rate is exogenously given B is directly related to the firm's debt level.*

[7] *As already mentioned previously, the justification for this assumption comes from the literature extending Miller's (1977) analysis of equilibrium tax rates. See DeAngelo & Masulis (1980), Kim (1982), and Barnea, Haugen & Senbet (1985).*

optimal debt level is reached already before debt becomes risky. Formally, it is possible that for some B both

(4) $f(B)=F(B)=0$ and

(5) $[(1-\tau_{pd})-(1-\tau_c)(1-\tau_{pe})][1-F(B+\Delta)] - (\tau_{pd}-\tau_{pe})F(B+\Delta)=0.$

This is due to the fact that over the relevant range the marginal net tax benefit of debt is itself a decreasing function of the firm's debt level, as given by the first two terms in equation (2).[8] Hence, it is possible that for some firms the factors associated with risky debt play no role in determining the optimal financial structure, and that the optimum is determined by tax factors alone. This is especially likely in an institutional environment which allows the use of relatively large non-debt related tax shields.

In general, V is not everywhere concave in B. However, assuming that the density function $f(X)$ is »bell-shaped» and writing out the second-order condition for a maximum as

(6) $$\frac{\partial^2 V}{\partial B^2} = -\frac{1}{1+r}\{[(1-\tau_{pd})-(1-\tau_c)(1-\tau_{pe})] f(B+\Delta)+(\tau_{pd}-\tau_{pe})[f(B+\Delta)-f(B)] +(1-\tau_{pd})C_{fd}f'(B)\}<0,$$

or, equivalently, as

(7) $$(1-\tau_{pe})\tau_c f(B+\Delta)-(\tau_{pd}-\tau_{pe})f(B) +(1-\tau_{pd})C_{fd}f'(B)>0,$$

and noticing that equation (3) requires that $(1-\tau_{pe})\tau_c>\tau_{pd}-\tau_{pe}$, it can be verified that a sufficient condition for concavity is that $f(B+\Delta)\geq f(B)$.[9] Under reasonable parameter assumptions, it would appear that a unique optimum can be determined over the range where $f'(B)>0$, i.e. over the range where the expected marginal costs of financial distress are increasing.

2.3 *Comparative statics results*

The effects of shifts in the tax parameters, the non-debt tax shields and the costs of financial distress on the optimal level of debt are given by the following cross-partial derivatives:[10]

(8) $$(1+r)\frac{\partial^2 V}{\partial B\partial \tau_c}=(1-\tau_{pe})[1-F(B+\Delta)]>0$$

(9) $$(1+r)\frac{\partial^2 V}{\partial B\partial \tau_{pd}}=-[1-F(B)]+C_{fd}f(B)$$
$$=-[1-F(B)]+\left[1-\frac{(1-\tau_c)(1-\tau_{pe})}{1-\tau_{pd}}\right][1- F(B+\Delta)]-\frac{\tau_{pd}-\tau_{pe}}{1-\tau_{pd}}[F(B+\Delta)-F(B)]<0$$

(10) $$(1+r)\frac{\partial^2 V}{\partial B\partial \tau_{pe}}=(1-\tau_c)[1-F(B+\Delta)] +[F(B+\Delta)-F(B)]>0$$

(11) $$(1+r)\frac{\partial^2 V}{\partial B\partial \Delta}=-f(B+\Delta)(1-\tau_{pe})\tau_c<0$$

(12) $$(1+r)\frac{\partial^2 V}{\partial B\partial C_{fd}}=-(1-\tau_{pd})f(B)<0$$

An increase either in the corporate tax rate or in the personal tax rate on equity income raises the tax incentive of debt financing and, hence, induces the firm to issue more debt. On the other hand, an increase either in the personal tax rate on debt income[11] or in the level of tax shield substitutes for debt lowers the tax incentive of debt financing and, hence, lowers the firm's optimal debt level. Finally, an increase in the costs of financial distress unambiguously reduces the firm's optimal debt level given, of course, that the outstanding debt is risky.

For analytical tractability we only consider two special types of changes in the distribution for the end-of-period value of the firm: a shift in the mean and a shift in the variance.

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[8] *Formally, a decreasing marginal net tax benefit requires that $(1-\tau_{pe})\tau_c f(B+\Delta)<(\tau_{pd}-\tau_{pe})f(B)$. This obviously holds over the range of B for which $f(B)=0$ and $f(B+\Delta)>0$.*

[9] *This is also the sufficient condition for a decreasing marginal net tax benefit in general.*

[10] *By the assumption that the second-order condition for a maximum is satisfied we have that sign $[dB/d\xi]$ = sign $[\partial^2 V/\partial B\partial\xi]$, where ξ denotes some exogenous variable.*

[11] *The sign can unambiguously be determined by solving for $C_{fd}f(B)$ in the first-order condition.*

Let us first examine the effect of a shift in the mean which leaves the shape of the distribution unchanged. Define $\tilde{X}' = \tilde{X} + \alpha$, then substitute $\tilde{X}'$ for $\tilde{X}$ in the first-order condition (2). Finally, differentiating the first-order condition with respect to α and evaluating the cross-partial derivative at $\alpha = 0$ yields

$$(13)\quad (1+r)\frac{\partial^2 V}{\partial B \partial \alpha}\bigg|_{\alpha=0} = [(1-\tau_{pd}) - (1-\tau_c)(1-\tau_{pe})]\,f(B+\Delta) + (\tau_{pd}-\tau_{pe})[f(B+\Delta)-f(B)] + (1-\tau_{pd})C_{fd}f'(B) > 0$$

The effect on the optimal debt level of a shift in the expected end-of-period value of the firm appears to be positive.[12] The intuition is that by lowering the probability of financial distress and by raising the probability of the firm being able to utilise the tax shield of debt, an increase in the mean induces the firm to issue additional debt. It may be noted that in this one-period context where $\tilde{X}$ denotes the total net value of the firm at the end of the period, an increase in the mean of $\tilde{X}$ may be interpreted to reflect either an increase in the (collateral) value of its capital stock or an increase in its net operating income, or both. Furthermore, it is also worth noting that the positive relation between net operating income (internal finance) and the firm's debt level in this model runs contrary to the implications of the so called »pecking-order» hypothesis,[13] according to which firms should prefer internal to all external financing.

Finally, let us examine how a shift in the variance of the end-of-period value of the firm which leaves the mean unchanged affects the optimal level of debt financing. Define $\tilde{X}'' = \beta(\tilde{X} - \overline{X}) + \overline{X}$, where $\overline{X}$ denotes the mean of the distribution $f(\tilde{X})$. Substitute then $\tilde{X}''$ for $\tilde{X}$ in the first-order condition (2) and differentiate it with respect to β. Finally, evaluating the cross-partial derivative at $\beta = 1$ yields

$$(14)\quad (1+r)\frac{\partial^2 V}{\partial B \partial \beta}\bigg|_{\beta=1} = [(1-\tau_{pd}) - (1-\tau_c)(1-\tau_{pe})]\,f(B+\Delta)(B+\Delta-\overline{X}) + (\tau_{pd}-\tau_{pe})[f(B+\Delta)(B+\Delta-\overline{X}) - f(B)(B-\overline{X})] + (1-\tau_{pd})C_{fd}f'(B)(B-\overline{X}) \gtreqless 0$$

The variance of the firm's end-of-period value turns out to have an ambiguous effect on the optimal debt level. This has previously been pointed out by Scott (1976), Castanias (1983) and Bradley, Jarrell & Kim (1984). Given the realistic assumption that the probability of bankruptcy is less than 50 % and assuming that the expected marginal costs of financial distress are increasing, the sign of the last term in equation (14) is unambiguously negative. It reflects the effect of a shift in the variance on the optimal debt level through the increased probability of financial distress. The signs of the first two terms, on the other hand, appear to depend on the relative magnitudes of the expected end-of-period value of the firm and the available tax deductions. The first term reflects the effect of a shift in the variance on the probability that the tax shield of debt at the corporate level is useful. This term is negative for firms with less than 50 % probability of tax exhaustion ($\overline{X} > B + \Delta$) and positive for firms with more than 50 % probability of tax exhaustion ($\overline{X} < B + \Delta$).[14] The second term shows how a shift in the variance affects the optimal debt level through its effect on the probability that the firm's end-of-period value falls in the range $B < \tilde{X} < B + \Delta$. Under the usual assumptions about the tax parameters the net tax benefit of debt is negative in this range and, hence, an increase in the probability leads to a reduction in the optimal debt level and vice versa. It turns out that an unambiguous sign for this term can only be determined for ex ante tax exhausted firms, in which case it is positive.

The overall effect remains indeterminate, however, and for an unambiguous result more specific assumptions about the exogenous parameters are needed. It is noteworthy that the ambiguous result derives from the existence of non-debt related tax shields. This can be readily verified by setting $\Delta = 0$, in which case

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[12] *Assuming that the second-order condition for a maximum is satisfied.*

[13] *This hypothesis was based on purely empirical observations until Myers & Majluf (1984) gave a theoretical justification for it. Their reasoning rests on the assumption of informational asymmetry between the firm's insiders and outside investors.*

[14] *These are henceforth referred to as ex ante non-tax exhausted and ex ante tax exhausted firms, respectively.*

the cross-partial $\partial^2V/\partial B\partial\beta$ becomes unambiguously negative. It turns out that the model yields an unambiguously negative relation between the variance of the end-of-period firm value and the optimal debt level only in the special cases that there are no non-debt related tax shields (i.e. $\Delta=0$), or that the firm is ex ante non-tax exhausted and the tax treatment of debt and equity income is symmetric at the personal level (i.e. $\overline{X}>B+\Delta$ and $\tau_{pd}=\tau_{pe}$).[15] For ex ante tax exhausted firms an increase in the variance unambiguously raises the expected net tax advantage of debt (the first two terms in equation (14) are both positive) so it is possible that the overall effect is also positive. Furthermore, the variance effect is unambiguously positive for those ex ante tax exhausted firms whose outstanding debt is riskless since for them the last term in equation (14) plays no role.

In sum, the model implies that the firm's debt level ought to be positively related to the corporate tax rate, the personal tax rate on equity income, the (collateral) value of the capital stock and the net operating income of the firm. The model also implies a negative relation between the debt level and the personal tax rate on debt income, and the magnitude of the costs of financial distress. The effect of the variance of the value of the firm turns out to be ambiguous in general but it is possible that firms differ with respect to this effect according to their tax status: for non-tax exhausted firms the effect is likely to be negative while for tax exhausted firms the ambiguity of this effect is more pronounced, and it may even be positive. Finally, the model also suggests that if the tax system allows the use of relatively large non-debt related tax shields, it is possible that a firm exhausts the tax benefit of debt already at some riskless debt level and that the factors associated with risky debt may thus be irrelevant for the financing decision.

[15] *Bradley, Jarrell & Kim (1984), after noting the ambiguity of the volatility effect in general, show by performing simulations of the firm's leverage decision that under a wide range of plausible parameter values the overall effect is negative. It is worth noting that the hypothetical firm in their simulations is ex ante non-tax exhausted under every parameter constellation.*

3. Empirical evidence

In this section a standard cross-sectional regression method is employed to analyse the variations in the borrowing of a sample of Finnish metal and engineering companies. Before proceeding to empirical work, though, it is worth noting a few words about the institutional setting in the Finnish capital market. In Finland, like in most other western countries, interest payments are tax deductible as opposed to dividend payments in corporate taxation.[16] On the other hand, the Finnish tax laws generally permit the use of relatively large non-debt related tax shields, which is likely to lower the effective tax shield of debt financing. At the personal level capital gains have been tax free after a 5-year holding period but dividends have been taxed at the marginal income tax rate. Due to the fact that the borrowing of the Finnish corporate sector is channelled through banks and other financial intermediaries with little direct borrowing from the public and that interest on bank deposits has been tax free to investors, the effective personal tax rate on interest income has been moderate. Furthermore, banks have been significant shareholders[17] in large Finnish companies and there has traditionally existed a close relationship between a firm and its »own» bank. Although the banks' control has loosened somewhat throughout the 1980s, it is doubtful whether the various bankruptcy and agency type costs have such a big role in the financing behaviour of Finnish companies as they appear to have, for example, in the US.

The results in previous empirical studies[18] on the determinants of corporate financial policy have turned out to be rather inconclusive. The strongest evidence thus far appears

[16] *To be precise, it has also been possible for Finnish companies to deduct a fraction of their dividend payments if they have equity outstanding which has been issued less than five years before the dividend payment.*

[17] *Although for legal restrictions the commercial banks' direct shareholdings in Finnish companies are small, they indirectly hold a controlling stake in many companies.*

[18] *These include Williamson (1981), Bradley, Jarrell & Kim (1984), Auerbach (1985), Long & Malitz (1985), Titman & Wessels (1988), and MacKie-Mason (1990) on US data; Kester (1986) and Allen & Mizuno (1989) on Japanese data. A study by Kanniainen & Airaksinen (1989) reports some findings on Finnish data.*

to be for the bankruptcy/agency cost hypotheses, and for the pecking-order hypothesis. It is particularly puzzling that there is an almost complete lack of evidence for the effects of tax factors on financing decisions. There is only one study, by MacKie-Mason (1990),[19] which is able to find direct evidence that non-debt related tax shields crowd out interest deductibility.

A problem with the cross-sectional regression analyses of the determinants of corporate financial policy is that the results appear to be highly sensitive to the way in which the empirical model is specified and in which the variables are measured. In some cases, at least, the fact that the dependent variable in the regressions (the firm's debt level) has been scaled[20] by some market value measure of size (total value of the firm, or the value of the firm's equity) may have resulted in biased estimates, since these market value measures are themselves endogenous. In general, it may be noted that differences in the empirical model specification and in the measurement of the variables make direct comparisons between the results obtained in different studies very difficult.

3.1 Model specification

The theoretical model highlighted the role of tax factors in determining the firm's debt level. In a cross-sectional study the corporate income tax rate is typically constant across the sample and there are seldom data on the investors' personal tax rates that are sufficiently detailed for inclusion in the empirical model. This is also the case in the present study. Although in a cross-section of firms it is not possible to test the effects of the tax parameters directly some new evidence of tax effects may be obtained by explicitly accounting for the firms' tax status in the estimation.

A cross-sectionally testable linear empirical model appears then as

$$(15)\quad DEBT_i = \beta_0 + \beta_1\, PROFI_i + \beta_2\, SIGMA_i + \beta_3\, NDTS_i + \beta_4\, FDCOST_i + \beta_5\, VTA_i + e_i$$

where PROFI denotes the firm's operating income, SIGMA stands for income variability, NDTS for the level of available non-debt related tax shields, FDCOST for the firm's potential costs of financial distress in a generic sense, i.e. including both the bankruptcy costs and the agency costs of risky debt financing, and VTA denotes the value of the firm's collateralisable capital.

Furthermore, two control variables are included as additional explanatory variables in the empirical model. Firstly, since the theory is concerned only with the determinants of the firm's long-term target debt level, a variable for investment activity is included to control for short-term deviations in financial policy. The main source of external finance for Finnish companies is borrowing from a bank, so big investments may require them to borrow excessively in the short run as compared with the long-run optimum. Moreover, investments in tangible capital increase the firm's debt capacity. Therefore, a positive effect of investment activity on the debt level is expected. Secondly, in order to allow for nonlinearity in the size effect the squared value of the firm's capital stock is included. The relation may be nonlinear if, in addition to the collateral effect, there are economies of scale in financing.[21] The estimable model then appears as

$$(16)\quad DEBT_i = \beta_0 + \beta_1\, PROFI_i + \beta_2\, SIGMA_i + \beta_3\, NDTS_i + \beta_4\, FDCOST_i + \beta_5\, VTA_i + \beta_6\, (VTA_i)^2 + \beta_7\, INVEST_i + e_i$$

Due to wide variations in scale between the cross-sectional units the regression error term in equation (16) is bound to be related to the size of the firm. The consequence of heteroskedastic errors is inefficient OLS estimates since the results would be dominated by a handful of large firms. To tackle this problem, a weighted least squares method is applied un-

[19] It may be noted that MacKie-Mason employs a somewhat different estimation method from the other studies by analysing the incremental financing choices of firms using a Probit model.

[20] Although theoretical models determine the firm's optimal level of debt financing empirical models are usually stated in terms of ratios to get rid of heteroskedasticity.

[21] The nonlinear size term may thus be taken as a proxy for the omitted interest rate effect: large companies are charged lower interest rates and, hence, they borrow proportionately more to achieve their target level of interest expenses.

der the assumption that the standard deviation of the error term is directly related to the value of the firm's tangible assets, as $\sigma_i = \sigma VTA_i$. In this case the estimator can be found by applying the least squares method to a transformed model where all the variables, both dependent and independent, are divided by the value of the firm's tangible capital stock.[22] A measure of the firm's tangible assets is used in weighting instead of any market value measure to mitigate the endogeneity problem.

The expected signs of the coefficients can be summarised as follows:

$$\beta_1 > 0,\ \ \underset{(?)}{\beta_2 < 0},\ \ \beta_3 < 0,\ \ \beta_4 < 0,\ \ \beta_5 > 0,$$
$$\beta_6 > 0,\ \beta_7 > 0.$$

3.2 *The sample*

The sample consists of Finnish companies drawn from the metal and engineering industry.[23] Most of the firms in the sample are medium-sized and nonlisted. The variables included in the analysis were analysed over the 1981–85 time period and all the observations that did not have a complete record on the relevant variables were deleted from the sample. In total, 70 firms were available. Sample averages of the variables were calculated to mitigate the effects of random year-to-year fluctuations. In an attempt to avoid simultaneity the dependent variable is measured as an average over 1984–85 and the explanatory variables as averages over 1981–83, with the exception of SIGMA, for which the whole five-year period was used. In order to remove the effect of inflation the consumer price index was used to deflate the data series.

The dependent variable in the regressions, the firm's debt level (DEBT), is measured by the book value of the firm's interest-bearing debt. The value of the firm's collateralisable capital stock (VTA) is measured by the current (replacement) value of land, equipment and inventories. Operating income (PROFI) is calculated as the firm's earnings before depreciation, interest and taxes. Measuring this variable before interest and tax expenses avoids reverse causality problems in the estimation. As a measure of the variability of earnings (SIGMA) we use the standard deviation of the firm's earnings before depreciation, interest and taxes over the period 1981–85.

The Finnish companies main tools to modify their income for tax purposes consist of two items, accounting depreciation and inventory undervaluation. Therefore, the sum of their maximum allowed values could be thought of as a proxy for the available non-debt related tax shields. It is obvious, however, that this measure is strongly correlated with the firm's capital stock. In order to separate the two effects we regressed the sum of available accounting depreciation and inventory undervaluation on the capital stock (and a constant), and use the residual term of this auxiliary regression as the explanatory variable (NDTS) in our main equation.

The magnitude of potential bankruptcy/agency costs (FDCOST) is proxied by the firm's expenditure on research & development. This measure is widely used also in the other studies as a proxy for the costs of financial distress, and the intuition behind it is that the higher the proportion of human capital in a firm, the greater the expected welfare losses are in default. Moreover, it is the firm's investments in intangible capital in particular that give rise to various moral hazard problems within the firm.[24] The firm's investment activity (INVEST) is measured as the yearly net change in the firm's tangible capital. Descriptive statistics on the variables are reported in table 1.

3.3 *Results*

Table 2 reports the results of estimating equation (16) on the total sample. As it appears in the table, these estimates provide somewhat mixed evidence on the TS-BC model. The positive and significant coefficients for the firm's operating income and capital stock, and the

[22] *Deflating the variables by some measure of firm size has the additional advantage of mitigating the strong multicollinearity between the variables. A disadvantage of the transformation is that it may create spurious correlations.*

[23] *This data set has been provided by the Federation of Finnish Metal and Engineering Industries.*

[24] *This argument rests on the fact that investments in intangible capital are less observable to outsiders, and hence more costly to monitor, than investments in tangible capital. For a discussion about this issue see e.g. Long & Malitz (1985).*

Table 1. Descriptive statistics. N = 70.

Variable	Mean	Std.dev.	Min	Max
DEBT	27.4	80.2	.086	449.6
PROFI	3.19	8.25	.007	44.6
SIGMA	1.43	3.59	.015	20.4
NDTS	0.00	7.28	−26.5	37.6
FDCOST	.770	2.03	.003	11.9
VTA	41.5	126.5	.199	705.3
INVEST	2.40	6.40	−1.88	33.2
DEBT/VTA	.674	.382	.127	2.16
PROFI/VTA	.128	.081	.0003	.423
SIGMA/VTA	.064	.052	.009	.363
NDTS/VTA	−.570	1.07	−6.32	.134
FDCOST/VTA	.036	.061	.002	.304
INVEST/VTA	.086	.107	−.465	.472

negative (but only marginally significant) coefficient for R & D expenditure are consistent with the theory. On the other hand, the perverse and statistically highly significant effect of the non-debt related tax shields on borrowing, even after removing the indirect effect of the capital stock contained in it, is negative evidence for the model.

Furthermore, the positive and well determined coefficient for earnings variability is somewhat surprising and suggests that tax exhaustion is a dominant feature of Finnish metal and engineering companies. The positive effect of the investment variable supports the presumption that, in the short run, companies have to finance their investments mainly by borrowing and, finally, the nonlinear capital stock term appears to lend (weak) support for the hypothesis that there are economies of scale in the financing of Finnish companies.

The last row in table 2 reports the F statistic for the Goldfeld-Quandt test for heteroskedasticity. In carrying out this test the observations were ordered according to the value of their capital stock (VTA) and ten central observations were omitted. As the test statistic shows, the weighted least squares method appears to be successful in eliminating heteroskedasticity.[25]

Table 2. WLS regression results, total sample. Dependent variable: DEBT. N = 70.

Independent variables	
Constant	2.48 (3.57)
PROFI	1.54 (3.05)
SIGMA	2.36 (3.13)
NDTS	2.03 (3.71)
FDCOST	−1.04 (1.61)
VTA	.190 (2.61)
$(VTA)^2$	.0005 (1.68)
INVEST	.671 (2.15)
SEE	.268
$\bar{R}^2$	.508
Joint significance of regressors	11.2 $F_{0.05}(7,62) = 2.17$
Goldfeld-Quandt test for heteroskedasticity	1.70 $F_{0.05}(22,22) = 2.05$

Note: (i) absolute t statistics in parentheses
(ii) estimation carried out by applying OLS to a transformed model where all the variables are divided by VTA

[25] *Although the nonweighted OLS regression results are not reported here, it may be noted that the error term in these estimations was extremely heteroskedastic.*

Table 3. WLS regression results, sample partitioned according to tax status. Dependent variable: DEBT.

Independent variables	Non-tax exhausted firms N=20 (1)	Tax exhausted firms N=50 (2)
Constant	1.50	2.47
	(1.44)	(2.88)
PROFI	5.02	1.37
	(3.77)	(2.42)
SIGMA	−.827	1.96
	(.434)	(2.07)
NDTS	1.35	2.03
	(1.63)	(3.01)
FDCOST	−2.13	.503
	(2.56)	(.446)
VTA	−.347	.247
	(1.93)	(3.49)
$(VTA)^2$	.0017	.0002
	(2.94)	(.816)
INVEST	1.99	.528
	(2.25)	(1.71)
SEE	.228	.242
$\bar{R}^2$	.641	.607
Joint significance of regressors	5.84	11.8
	$F_{0.05}(7,12)=2.91$	$F_{0.05}(7,42)=2.24$

Note: (i) absolute t statistics in parentheses
(ii) estimations carried out by applying OLS to a transformed model where all the variables are divided by VTA

In order to examine the role of the firm's taxable capacity in the financial decision-making we then partitioned the sample according to the firm's tax status and ran separate regressions for these subsamples. In dividing the sample into two subsamples we calculated for each firm the ratio of actual accounting depreciation plus inventory undervaluation to the sum of their maximum allowed values as stipulated in the Finnish tax laws, averaged over 1981–85. All those firms with a value of this ratio less than 0.85 were classified as tax exhausted.[26] This left us with 50 observations in the subsample of tax exhausted firms and 20 observations in the subsample of non-tax exhausted firms. The results of running separate regressions for the subsamples are reported in table 3.

An examination of the results in table 3 suggests that there are indeed significant structural differences between the two groups. As implied by the model, the main differences lie in the effects of earnings variability and R & D expenditure. For tax exhausted firms an increase in the earnings variability appears to increase the debt level — recall that for these firms the expected value of the interest tax shield is unambiguously increased by greater earnings variance and, hence, a positive sign is consistent with the model. For non-tax exhausted firms this coefficient, although very poorly determined, is negatively signed and thus more in line with the conventional wisdom.

The fact that the proxy for the costs of financial distress attracts a negative and significant coefficient in the subsample of non-tax exhausted firms while it plays no role at

[26] *That is, the closer to unity this ratio is, the better the firm has been able to utilise all available tax deductions. 0.85 was chosen as the threshold in order to retain a sufficient number of observations in the subsample of non-tax exhausted firms.*

all in the subsample of tax exhausted firms, is also consistent with our theoretical analysis. This implies that the majority of the firms in the sample have exhausted the tax benefit of debt financing within their riskless debt capacities. In fact, taking into account the banks' close control over the firms and the generous corporate tax laws in Finland, the above result should not come as a big surprise. A further difference between the two subsamples can be found in the relation between the debt level and company size. For non-tax exhausted firms this relationship appears to be nonlinear: initially the debt level diminishes with firm size and then increases, implying some economies of scale in he borrowing. For tax exhausted firms the relationship turns out to be rather more linear.[27]

Unfortunately, the effect of non-debt related tax shields remains at variance with the theory in both subsamples. A positive and significant coefficient for this term has also been found in Bradley, Jarrell & Kim (1984). In their study the results has been explained by the strong collinearity between the amount of non-debt related tax shields and the firm's investments and capital stock. Here, however, we have tried to eliminate this problem by separating the effect of the capital stock from our measure of non-debt related tax shields. Hence, either the relationship truly is positive and the DeAngelo & Masulis' (1980) argument is empirically refuted or, more likely, there just is not enough information contained in the cross-sectional data set to separate this effect from other underlying effects.

In general, the empirical results obtained in this study clearly show that a firm's tax status and financial policy are interrelated. Furthermore, unlike in most other studies, these results suggest that the positive tax incentive effect of operating income on the debt level dominates the negative »pecking order» effect. This is not surprising, however, taking into account the institutional differences between the Finnish and the US capital markets — informational asymmetries are likely to have a much smaller role in the Finnish system of borrowing from the banks.

4. Conclusions

The major finding of the paper is that there appear to be significant differences in the financing behaviour of Finnish companies according to their tax status. In particular, the risk factors of debt turned out to have a negative and significant effect on the borrowing of non-tax exhausted firms, while they had no role at all in tax exhausted firms. Another major difference was found in the relation between borrowing and earnings variance: in tax exhausted firms this relation is positive and significant, while in non-tax exhausted firms the relation is negatively signed but practically nonexistent. The borrowing of non-tax exhausted firms thus seems to be broadly in line with the conventional view of the TS-BC theory. As the analysis in Chapter 2 shows, however, the behaviour of tax exhausted firms also fits into the TS-BC framework — one only has to allow for the possibility that some firms exhaust the tax benefit of debt financing within their safe debt capacities.

Furthermore, the data set in this study appears to suggest that the proportion of tax exhausted firms is quite large in Finland. This raises a question whether the results obtained here are specific to the Finnish institutional environment. Recent evidence[28] suggests, however, that tax exhaustion is an important feature of corporate tax systems also in the other western countries, so it is likely that these results have wider relevance.

By explicitly accounting for the firm's taxable capacity this paper is able to provide some new evidence on the controversial issue of taxation and corporate financial policy. For more definite results concerning the interactions of taxes and corporate financing decisions more empirical work is needed. In particular, as it appears that a cross-sectional data set does not

[27] *It may be noted that the positive linear relationship also conforms well with Scott's (1977) »secured debt» hypothesis. This hypothesis states that, even in the absence of any tax incentives, all firms should optimally issue debt up to the point where the last unit of debt is just fully secured. This result is due to the fact that in bankruptcy, secured debt holders rank ahead of many third parties also claiming part of the wealth generated by the firm, while shareholders do not. Since total firm value consists of the proportion of this wealth that accrues to either shareholders or debtholders, an increase in the amount of secured debt increases total firm value. See Scott (1977).*

[28] *Mayer (1986) cites some evidence concerning the UK and the US.*

provide enough information to separate the effects of all the underlying factors, studies employing different estimation techniques and larger data sets could yield new and interesting results. Finally, for a more thorough understanding of the tax interactions with financial policy the theoretical model ought to be extended to a dynamic multiperiod framework. Some attempts to this direction have already been made, see e.g. Mayer (1986) and Auerbach (1985).

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