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Kimmo Virolainen

Tax Incentives and Corporate Borrowing: Evidence from Finnish Company Panel Data

SUOMEN PANKKI
Bank of Finland



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**Tax Incentives and
Corporate Borrowing:
Evidence from Finnish
Company Panel Data**

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Abstract

This study analyses the relationship between taxes and corporate borrowing decisions, both theoretically and empirically. A dynamic stochastic model that allows for interactions between the firm's investment and financial decisions is constructed and its properties are examined. It is shown that corporate tax exhaustion may yield an internal financial optimum for the firm without the need to resort to institutional borrowing constraints. The comparative static results with respect to the firm's optimal debt level remain mostly indeterminate due to conflicting income and substitution effects, but it is possible to prove analytically that firms' borrowing responses to changes in a key tax incentive variable, the available nondebt tax shields, should vary according to their profitability. This result is also confirmed by a simulation analysis.

In the empirical work, the borrowing behaviour of Finnish companies is analysed, both descriptively and econometrically over the period 1978–1991. The descriptive analysis reports financing and investment patterns of Finnish companies and their tax status, focusing on flows of finance instead of stocks. The econometric analysis is carried out on company-level panel data covering 548 Finnish manufacturing companies. A two-step generalized method of moments estimation procedure is employed to enable consistent estimation in the presence of unobservable firm-specific effects. The results of the econometric analysis are in line with the implications of the theoretical model and provide evidence in favour of the tax incentive effects. The key results are shown to hold for the whole sample period although Finnish firms' adjustment toward a new tax environment already shows up in the weakening of the tax incentive effects in the latter part of the sample period.

Overall, the results of this study provide support for a positive role for taxation in the firm's financial decision-making. They also imply that changes in the tax system may give rise to significant shifts in the financing behaviour of companies.

Keywords: taxation, corporate finance, capital structure

Tiivistelmä

Tutkimuksessa tarkastellaan verotuksen ja yritysten velkaantumisen välistä riippuvuutta teoreettisesti ja empiirisesti. Teoreettinen tarkastelu suoritetaan dynaamisella stokastisella mallilla, jossa otetaan huomioon yrityksen investointi- ja rahoituspäätösten välinen yhteys. Tutkimuksessa osoitetaan, että yritys voi ilman institutionaalisia rajoitteita päätyä velkaantumisessa sisäpisteoptimiin otettaessa huomioon mahdollisuus, että kaikkia kulukirjausmahdollisuuksia ei kyetä käyttämään hyväksi. Vastakkaisten tulo- ja substituutiovaikutusten vuoksi mallin eksogeenisten muuttujien vaikutukset yrityksen optimaaliseen velkaantumiseen jäävät suurimmaksi osaksi epäselviksi. Työssä kyetään kuitenkin analyttisesti osoittamaan, että keskeisen verokiihokemuuttujan, yrityksen käytettävissä olevien korkomenojen verovähennyskorvikkeiden vaikutus velkaantumiseen vaihtelee yrityksen kannattavuuden mukaan. Tulos vahvistetaan myös simulointianalyysillä.

Tutkimuksen empiirisessä osassa tarkastellaan suomalaisten yritysten rahoituskäyttäytymistä vuosina 1978–1991. Kuvailevassa analyysissä luodaan katsaus suomalaisyritysten rahoitus- ja investointikäyttäytymiseen sekä verotukselliseen asemaan keskittyen rahoitusvarantojen sijasta rahoitusvirtoihin. Ekonometrisessa analyysissä hyödynnetään yritystason paneeliaineistoa, joka kattaa 548 suomalaista teollisuusyritystä. Estimoinnissa käytetään kaksivaiheista yleistettyä momenttimenetelmää, GMM-menetelmää, havaitsemattomien yrityskohtaisten tekijöiden vaikutusten eliminoinniseksi. Ekonometriset tulokset tukevat työn teoreettisen mallin implikaatioita ja väitettä verokiihokevaikutusten olemassaolosta. Keskeiset tulokset pätevät estimointien mukaan koko tarkasteluajanjakson ajan, vaikka verokiihokevaikutukset heikkenevät tarkasteluajanjakson jälkimmäisellä puoliskolla yritysten aloitettua sopeutumisen kohti uutta verojärjestelmää.

Kaiken kaikkiaan tutkimuksessa esitetyt tulokset tukevat väitettä, että verotekijöillä on merkittävä vaikutus yritysten rahoituspäätöksiin. Tulosten perusteella voidaan myös päätellä, että verojärjestelmän muutokset voivat huomattavasti muuttaa yritysten rahoituskäyttäytymistä.

Asiasanat: verotus, yritysrahoitus, pääomarakenne

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Helsinki, April 1998

Kimmo Virolainen

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1 Introduction

One of the most contentious issues in the theory of corporate finance has been the question of a firm's optimal financial structure. The first analytical treatment of the issue appeared in the late 1950s by Modigliani & Miller (MM) in their seminal article 'The cost of capital, corporation finance and the theory of investment' (1958). In this article, MM presented their celebrated capital structure irrelevance theorem. Since the introduction of the irrelevance theorem, a vast number of studies have attempted to extend and generalize MM's original analysis.

In the 1960s MM's irrelevance analysis was extended and a role for corporate financial policy was established by taking into account certain institutional market imperfections, taxes and bankruptcy costs in particular (MM 1963, Farrar & Selwyn 1967, Baxter 1967). In the 1970s this line of research was further elaborated and it became a widely held view that the firm's optimal financial policy is determined in a tradeoff between the tax advantages and bankruptcy costs of debt (Kraus & Litzenberger 1973, Scott 1976, 1977). As these models relied crucially on the assumption that the tax position of the firm's investors is such that there initially exists a net tax advantage to debt financing, the demonstration by Miller (1977) that the tax advantage of debt might disappear when one considers the determination of the firm's marginal investor in a more general setting temporarily refuted the tax-based explanation of optimal financial policy. However, Miller's analysis was soon extended by recognizing the role of the tax position of the firm and it was established that a net tax advantage to debt financing is, after all, consistent with a market equilibrium (DeAngelo & Masulis 1980, Kim 1982, Barnea, Haugen & Senbet 1985). Thereafter the tax-based theories of financial policy have been extended to take fuller account of the interactions between the firm's financial and investment decisions (Mayer 1986, Dammon & Senbet 1988).

On the other hand, the fact that firms used both equity and debt financing already long before corporations were taxed at all led some researchers to look for explanations other than in taxes and bankruptcy costs for the relevance of corporate financing decisions. This line of research originated in the 1970s and it has concentrated on the role of financial instruments in resolving various conflicts of interest within a firm that may arise in a world of incomplete contracts (Jensen & Meckling 1976, Barnea, Haugen & Senbet 1985, Myers 1977, Myers & Majluf 1984, Leland & Pyle 1977, Ross 1977). These

considerations have given rise to a multitude of hypotheses about the optimal financial structure of the firm.

More recently, by relaxing the other crucial element of the MM world, namely, the assumption of a perfectly competitive market (atomistic agents), research in the field has proceeded to analyse the capital structure question in the context of various game-theoretic, or industrial organization models (Harris & Raviv 1988, Stulz 1988, Brander & Lewis 1986, Maksimovic 1988, Titman 1984).

Despite the abundance of theoretical research in the field, empirical work on the subject took off rather slowly. The early studies in the 1960s and early 1970s already revealed systematic patterns in corporate debt ratios, with industrial classification and the size of a firm surfacing as the most significant explanatory factors. Along with advances in capital structure theory, empirical studies became more sophisticated. However, it was not until the early 1980s that direct cross-sectional tests of the modern capital structure theories began to emerge. For various reasons, the empirical studies have yielded rather mixed results with regard to the theories. A particularly tough challenge for empirical work has been posed by the tax-based theories of capital structure. Almost everyone agrees that, in theory, taxes play an important role in corporate financing decisions. Uncovering their role empirically has turned out to be rather difficult.

In this study we adopt a rather narrow focus and examine the relationship between taxation and corporate financial policy in detail. In this chapter we first review various capital structure theories, paying particular attention to tax-based theories. In the review, and throughout the study, we consider only models that analyse the determination of the relative amounts of debt and equity, taking the nature of the securities involved as exogenous.¹

¹ Security design models are reviewed eg in Harris & Raviv (1991).

1.1 Modigliani-Miller irrelevance theorem

MM showed in their famous 1958 article that in a perfect capital market a firm's market value is determined solely by its real activities and that it cannot affect its market valuation through financial policy. The logic behind MM's irrelevance proposition is simple. The basic underlying assumption is that investors care only about the direct wealth effects of the actions taken by the firm, ie that the ownership and control of the firm do not as such enter into the investor's utility function. Given that this holds, the other crucial element is the requirement that financial decisions in no way affect the total return stream offered by the firm to its owners, the shareholders. In the MM world, both of these crucial assumptions are captured by the concept of a perfect capital market.²

Generally, a perfect capital market presupposes a number of things. First, no firm can be in a position to exercise monopoly power in the capital market, ie the capital market is assumed to be perfectly competitive.³ MM originally defined a perfectly competitive capital market in terms of there being at least two firms in each 'risk class'. Firms were defined as being in the same risk class if their total return streams were perfectly correlated, ie that the return streams differed at most by a scale factor. The assumption that there are at least two firms in each risk class ensures that the state-space spanned by the existing securities in the market is unaffected by the actions of any individual firm. This rather restrictive assumption has been subsequently generalized.⁴ In a more general setting the MM risk class assumption is equivalent to assuming that the capital market is complete, ie that the number of assets offering linearly independent payoff patterns equals the number of possible states of nature. An important feature of a market that satisfies this 'spanning condition' is value additivity, ie the condition that the value of the whole is equal to the sum of the values of its parts.

Secondly, in a perfect capital market there can be no institutional market imperfections, such as transaction costs, taxes, bankruptcy penalties, or asymmetric information, for which the market cannot

² In fact, it has become common practice to define a perfect capital market as one in which the MM irrelevance proposition holds.

³ Strictly speaking, the absence of monopoly power in the capital market would alone be sufficient for the capital structure irrelevance theorem since in such a market all the financial transactions needed to maximize shareholders' wealth can be accomplished by any capital market participant; it need not be the firm itself. We leave this question aside and simply assume that financial transactions are executed by the firm.

⁴ See eg Ingersoll (1987).

provide perfect and costless monitoring. The absence of institutional market imperfections ensures that no parties other than the firm's shareholders and creditors claim a share of the firm's return stream and that the firm's financial decisions have no effects on its real activities. Under these circumstances, the market value of the firm is completely determined by its real activities and is independent of financial policy.⁵

1.2 Extensions of the irrelevance theorem

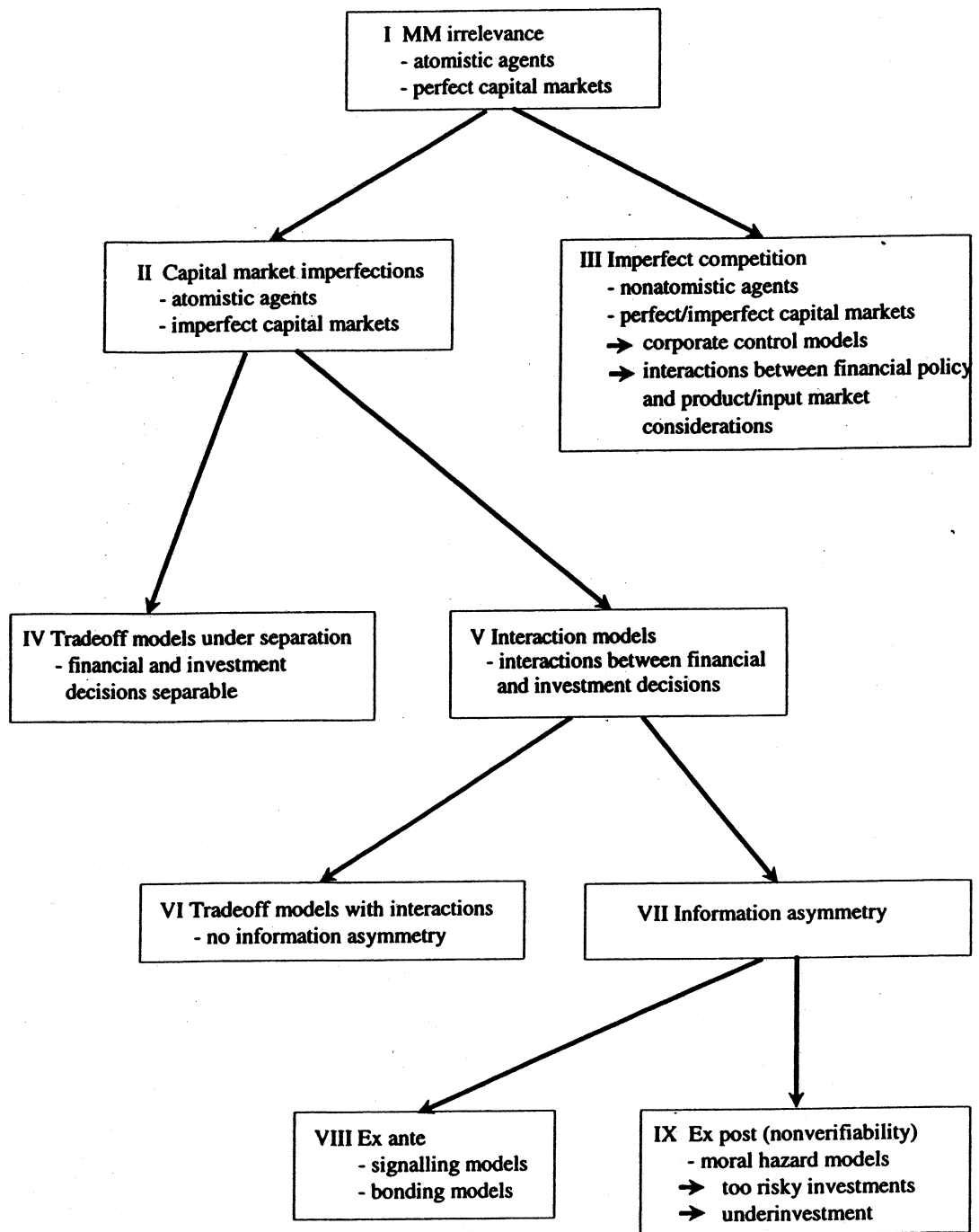
Since the MM irrelevance theorem relies crucially on the assumptions of a perfectly competitive and (institutionally) perfect capital market, the most obvious way to extend the analysis is to relax one or the other of these assumptions. Table 1.1 provides a classification of the extensions to the original MM analysis.

Relaxing the perfectly competitive capital market assumption leads one to consider various industrial organization or game-theoretic corporate control models (case III in table 1.1). Examples of models examining the linkages between the market for corporate control and capital structure are Harris & Raviv (1988) and Stulz (1988). On the other hand, examples of models exploiting the relationship between the firm's capital structure and its product/input market characteristics are Brander & Lewis (1986), Maksimovic (1988) and Titman (1984). However, these models are beyond the scope of this study, and in what follows we consider only models in which the assumption of atomistic agents is maintained but various institutional capital market imperfections are introduced to establish optimal financial structures.

There are basically two strands of models in which capital market imperfections are introduced to create a link between the firm's financial policy and the return stream accruing to the firm's shareholders: tax-based models and models based on informational asymmetries between capital market participants.

⁵ In the one-period models that have been employed especially in the finance literature on optimal capital structure, the objective of maximizing total market value (the sum of the market value of equity and debt) of the firm is equivalent to the objective of maximizing the wealth of the firm's shareholders. This is due to the fact that the market value of debt equals the proceeds to the firm's shareholders of selling the debt claims on the firm.

Table 1.1 Classification of financial structure theories



1.2.1 Tax-based theories of financial policy

Although maintaining the MM assumption that the firm's investment and financial decisions are separable, financial policy may have a role if it affects the institutional sharing rule that determines how the exogenously determined return stream is eventually distributed to the firm's various claimants (case IV in table 1.1).⁶ The institutional sharing rule for the return stream generated by the firm is, firstly, determined by the design of the equity and debt securities. Equity entails the limited liability feature and shareholders are the residual claimants to the firm's return stream. Creditors, on the other hand, have a fixed priority claim on the firm's return stream. In addition to these two groups of security holders, there are various other claimants. The state usually claims part of the return stream through taxation. The existence of taxation is not sufficient for the relevance of financial policy. Taxation must be nonneutral in its treatment of different forms of financing the firm's investment. Most OECD countries have historically shared the same feature of corporate income taxation: tax deductibility of interest income as opposed to dividend payments or capital gains. MM (1958) themselves already analysed the implications of this kind of nonneutral corporate income tax system for optimal financial policy and showed that from a corporate income tax perspective it is optimal for the firm to be 100 per cent debt financed.

Farrar & Selwyn (1967) were the first to include investors' personal taxes in the analysis. Again, a common feature of most OECD countries has been the preferential treatment of equity income (capital gains in particular) as opposed to interest income in personal taxation. The disadvantage of debt financing in respect of investors' personal taxation thus provided an offsetting effect to the tax advantage of debt in respect of corporate taxation. Since tax rates in general differ considerably between different investor groups, the firm's optimal financial policy appeared to depend crucially on the assumption as to who was the firm's marginal investor. Another type of cost of debt issuance that was examined was the increased probability of bankruptcy and potential welfare losses that are incurred in bankruptcy. Baxter (1967) was the first to include costly bankruptcy in capital structure analysis.

The tax shelter - bankruptcy cost (TS-BC) model of the optimal capital structure was further elaborated by Kraus & Litzenberger

⁶ The assumption that the firm's financial and real (ie investment) decisions are separable greatly simplifies the analysis since the technologically generated return stream of the firm can be treated as exogenous when analysing the firm's optimal financial policy.

(1973) and Scott (1976, 1977). Scott extended the analysis from a one-period to a multiperiod framework. The conventional TS-BC models of optimal capital structure, which take the firm's investment policy as exogenously determined, yield rather straightforward implications for empirical testing. However, empirical results have in many cases turned out to be either inconclusive or at variance with the TS-BC hypotheses. In particular, the empirical evidence on the tax effects has remained ambiguous.

The underlying assumption in all tax-based models in a partial equilibrium setting is that the tax system initially provides an incentive for firms to issue debt. A serious threat for these models was presented by Miller (1977). In this insightful paper, Miller examines what the relative values of the tax parameters must be in order to support a market equilibrium. Miller's original analysis, determining the so-called 'Miller equilibrium', was based on assumptions about heterogeneous investor groups, progressive personal income taxation and the absence of firm-specific costs in debt issuance. For simplicity, Miller assumes that the return stream on equity is not subject to personal taxes but is taxed only once at the corporate level. Furthermore, the tax brackets for investor groups must span from below to above the corporate income tax rate.

The logic in Miller's model is that when a market for corporate debt is opened for the first time value-maximizing firms realize that there exist opportunities for tax arbitrage, and they issue debt first to investors belonging to the lowest tax bracket. As more and more debt is issued by all firms so as to reap the tax benefits, the demand attributable to investors in the lowest tax bracket eventually becomes fully satisfied, and any additional debt must be issued to investors in the next tax bracket. As the demands of these investors are fully satisfied, firms must turn to investors in the next tax bracket, and so on. The end result of these activities is a market equilibrium in which all tax arbitrage opportunities are exploited and the marginal investor's marginal tax rate equals the corporate income tax rate. Hence, faced with such a marginal investor, the financing decision of an individual firm is completely irrelevant from a tax perspective.

The crucial factor in Miller's analysis for yielding the irrelevance result is the assumption that there are no costs involved in issuing debt and that the firms are homogeneous in their capacity to issue debt. The equilibrium condition requires that there be no net advantage to debt issuance. Hence, if borrowing is costless but there initially exists a tax advantage to debt issuance, then in equilibrium the tax advantage must completely vanish. On the other hand, if there are some nontax-related costs involved in issuing debt, then a net tax

benefit of debt financing is not at variance with a market equilibrium. This is the idea in 'generalized Miller equilibrium' models in which the existence of firm-specific nontax-related costs on the supply side is explicitly recognized (DeAngelo & Masulis 1980, Kim 1982, Barnea, Haugen & Senbet 1985).⁷ The difference between the equilibrium originally derived by Miller and the generalized equilibrium lies in that if a new firm enters the market in Miller's world it faces only investors who find its financial policy irrelevant, while according to the generalized model a new firm always finds investors initially preferring debt financing. Each firm issues debt until the expected marginal net tax advantage equals the (firm-specific) expected marginal cost of debt financing.

Subsequently, in the tax-based literature the assumption of separability of the firm's real and financial decisions has been relaxed and it has been recognized that the return stream generated to the firm's shareholders is not exogenous to financial decisionmaking (case VI in table 1.1). In most OECD countries, investment affects the effective tax advantage of debt financing by generating tax shield substitutes for interest expenses (accelerated depreciation, investment allowances etc). Discussion then concentrated on the tax position of the companies. The first paper to do this was DeAngelo & Masulis (1980). They incorporate a more detailed treatment of the capital income tax system and allow for the existence of nondebt-related tax shields. DeAngelo & Masulis show that the tax advantage of debt diminishes as the probability of the firm being tax exhausted increases. As a result, an internal optimal financial structure can be determined.

DeAngelo & Masulis (1980) was the first study in the traditional capital structure literature to consider the interrelations between the firm's investment and financial decisions. On the other hand, in the 'cost of capital literature' (see especially King 1974, 1977) the simultaneous determination of the firm's investment and financial policy had already been recognized. However, due to the fact that these models were analysed in the context of perfect certainty, their implications for the firm's optimal financial policy were normally corner solutions and the models put great emphasis on various institutional constraints to limit excessive use of debt financing.

It was not until in Mayer (1986) that a comprehensive modelling of the interactions of corporate financial and investment policies under conditions of uncertainty and in the presence of a nonneutral

⁷ Slightly different modifications to the Miller equilibrium have been presented by Auerbach & King (1983) and Modigliani (1982), who consider the tradeoff between the tax advantage and risk costs of nondiversified portfolios.

tax system was undertaken. In a subsequent paper, Dammon & Senbet (1988) endogenized the firm's investment policy in a one-period TS-BC model of optimal capital structure.

Endogenizing the firm's investment policy revealed important implications for empirical work by uncovering the conflicting income and substitution effects of many exogenous factors on the firm's optimal debt policy. It has by now become evident that a proper understanding of the relationship between taxation and corporate financial policy requires consideration of the simultaneous determination of the firm's investment and financial policies.

1.2.2 Theories of financial policy based on information asymmetry

Another way of creating a link between the firm's real and financial decisions is by allowing for the existence of asymmetric information and recognizing that the capital market cannot provide perfect and costless monitoring of capital market participants (cases VII-IX in table 1.1). This approach leads to models that employ the so-called principal-agent framework and have come to be known collectively as agency cost models of capital structure. An excellent survey of capital structure models exploiting the principal-agent framework is Harris & Raviv (1991). These models can be divided into two categories: ex ante and ex post information asymmetries. Ex ante models are generally built on the fact that due to informational asymmetries the firm's financial policy affects the capital market's perception of the return stream even though the actual stream may remain unaffected. Hence, changes in the firm's financial structure may be used as signals to alter the market value, which is determined by market expectations. Models exploiting these features include the financial structure signalling models of Ross (1977) and Leland & Pyle (1977), and the bonding behaviour model of Grossman & Hart (1982).

Ex post informational asymmetry models⁸ draw on the seminal article by Jensen & Meckling (1977). The basic idea in these models is that in a world of incomplete contracts the method of financing may be used to alleviate incentive problems within the firm or that financial policy may itself give rise to conflicts of interest between investor groups if the capital market fails in its monitoring role. Models in this category differ in their assumption as to the identity of

⁸ Strictly speaking, the principal-agent framework generally relies on the assumption that the agent takes some unobservable (to the principal) and costly (to the agent) action that affects the output to be divided and that the agent's action is not perfectly verifiable afterwards.

the principal and the agent. In the so-called managerial agency cost models, such as that of Jensen & Meckling, it is assumed that the conflict of interest arises between the firm's managers (agent) and shareholders (principal). A problem with these models is that they concentrate mainly on managerial remuneration issues and are not very powerful in generating predictions with regard to the question of an optimal financial structure. As regards empirical financial structure studies, the more useful agency cost models have proved to be those that analyse conflicts of interest between different sources of capital. These models normally assume that the firm's management acts in the interests of the shareholders and that the conflict of interest arises between the shareholders (agent) and the creditors (principal). The two most important hypotheses from these models are the investment disincentive of debt financing by Myers (1977) and the risk incentive of debt financing by Galai & Masulis (1976) and Jensen & Meckling (1977). The former hypothesis involves the idea that risky debt financing creates an incentive for the firm's shareholders to forgo socially profitable investments and, therefore, lowers the value of the firm. The latter hypothesis says that risky debt financing creates an incentive for the firm's shareholders to choose riskier investment projects than would be socially optimal and therefore lowers the value of the firm. As a result, agency costs of debt act to reduce the optimal debt level of the firm.

Finally, the pecking-order hypothesis of Myers & Majluf (1984) combines ingredients from both the ex ante and ex post informational asymmetry models. The basic idea in their model is that, due to informational asymmetries between the firm's insiders and outsiders, all external financing is more costly than internally generated funds. Moreover, using the analogy that the equity of the firm can be interpreted as a call option on the firm's assets, Myers & Majluf are able to prove that, if external finance is really necessary, the firm's shareholders are better off issuing debt rather than new equity. These results are then used as a theoretical justification for the pecking-order hypothesis, which states that firms prefer internal to external financing and, if they must resort to external financing, they prefer debt to outside equity.

It may be noted that a problem with the pecking-order hypothesis and generally with all financial signalling models is that the results are highly sensitive to assumed content of the inside information, ie the expected value or the volatility of the firm's return stream.

1.3 Outline of the study

In this study we concentrate on the relationship between taxes and corporate borrowing decisions. We analyse the issue both theoretically and empirically.

This study consists of five chapters. Chapter 2 analyses a dynamic stochastic model of taxes and corporate financial policy, allowing for interactions between the firm's investment and financial decisions. The analysis follows closely the approach in Mayer (1986) but modifies the framework in order to capture the essential features of the tax environment of Finnish corporations in the 1980s. We deliberately exclude nontax considerations from the model. A crucial ingredient in the theoretical model is the explicit modelling of uncertainty. As a consequence, it is not in general optimal for the firm to pursue an extreme financial policy, and an internal financial optimum may be reached without resorting to institutional constraints. As in Mayer (1986), our model focuses on the influence of corporate tax exhaustion on the firm's financial and investment decisions.

Chapters 3 and 4 contain empirical analyses. Chapter 3 presents a descriptive analysis of the financing and investment patterns of Finnish companies and their tax status in the 1980s. The approach in the descriptive analysis follows Mayer (1988, 1990) in that it focuses on flows of financing instead of stocks and reports financing proportions on a gross as well as a net (of accumulation of equivalent financial assets) funding basis.

The econometric analysis in chapter 4 is carried out on company-level panel data covering Finnish manufacturing companies over the time period 1978-1991. The combined time-series cross-sectional data set provides a number of advantages over the conventional cross-sectional studies of the determinants of corporate financial policy. The most obvious advantages are the improvement in the precision of the estimates and the enabling of consistent estimation in the presence of unobservable firm-specific effects.

Finally, chapter 5 concludes the study with a summary of the main findings and suggestions for further research.

2 A model of tax incentives and corporate borrowing

In this chapter we construct a dynamic model of the investment and financing decisions of a firm in the presence of market imperfections introduced by capital income taxation. Although our main interest lies in analysing the implications for corporate financial policy of the two-rate system of capital income taxation that was operated in Finland in the 1980s, we carry out the theoretical analysis in a general form covering other systems of capital income taxation as well.

2.1 Basic assumptions

The model follows the approach of Mayer (1986). It is a partial equilibrium model in discrete time that allows for uncertainty. The following assumptions are made throughout the theoretical analysis:

- *the firm uses a single input, K , in its production process*
- *the input K depreciates at a constant exponential rate, δ*
- *firms and individual investors can lend and borrow at the riskless rate of interest, r*
- *there are no market imperfections other than those introduced by taxation (no transaction costs, no bankruptcy costs)*
- *investors are risk neutral.*

The firm's operating income (earnings before depreciation, interest and taxes) in period t , $f(K_t, s_t)$, is assumed to be a function of the capital stock at the beginning⁹ of period t , K_t , and of the uncertain state of nature, s_t , at the end of the period. We assume that there exists a continuum of states and that the s_t are i.i.d. with a time-independent probability density function $\phi(s_t)$ with cumulative probability $\Phi(s_t)$. $\phi(s_t)$ is assumed to be correctly perceived by the firm at all dates. For notational convenience, the time subscript t of the state of nature is omitted whenever it is not explicitly required. Furthermore, we assume that operating income is concave in K , ie that $f_K(K, s) > 0$, $f_{KK}(K, s) < 0$.

⁹ Here we follow the notation adopted eg in Mayer (1986): K_t denotes the beginning-of-period capital stock while for all other variables the subscript t denotes end-of-period values.

Cash dividends, C_t , paid out by the firm to its shareholders at the end of period t are given by the following identity for the sources and uses of funds

$$(1) \quad C_t(s) = f(K_t, s) + (B_t - (1+r)B_{t-1}) - I_t - T_t(s),$$

where B_t is the amount of one-period debt issued at t ; I_t is the amount of capital expenditure at t ; T_t is the amount of taxes paid by the firm at t ; and r is the fixed interest rate on borrowing and lending.¹⁰ It is assumed that at time t the firm must choose I_t and B_t before the state of nature s_t is revealed.

2.2 Taxation

The taxation of income from capital in most OECD countries can be broken down into three alternative systems, known as the classical system, the two-rate system and the imputation (or *avoir fiscal*) system.¹¹ The tax systems differ in their treatment of dividend income. As is well known, the classical system of capital income taxation does not provide relief from the double taxation of dividends as opposed to the two-rate system and the imputation system. A classical tax system has been operated eg in the US. The UK also operated a classical tax system up to 1973 but since then an imputation system has been in effect. In Finland we have had a two-rate tax system up to 1989 and an imputation system from 1990 onward.

In our theoretical model, the rate of corporation tax is denoted by τ . It is assumed to be strictly positive, not confiscatory and uniform for all firms. Taxable profits are defined as operating income less current allowances. The tax system is assumed to be asymmetric in that negative tax payments, ie tax rebates, are not allowed. The basic allowances consist of interest payments and book depreciation. For simplicity, neither tax-loss carry-forwards nor carry-backs are assumed to be allowed. The rate of book depreciation for tax

¹⁰ Note that we deliberately abstract from new equity issues as a source of funds and concentrate on the choice between retentions and borrowing. There is, however, a role for equity issues in the model and that will be explained in the context of the formulation of the firm's optimization problem. Note also that the price of capital goods is assumed to be equal to the price of the output of the firm and normalized to unity. The effects of inflation are ignored.

¹¹ See King (1977) for a comprehensive description of the alternative systems of capital income taxation.

purposes, Δ , is assumed to be greater than the rate of economic depreciation, δ . Accelerated book depreciation makes it possible for firms to finance part of their investment by interest-free tax debt. We denote by K the real value of the capital stock of the firm and by K^r the book value of the capital stock that is used in calculating depreciation allowances. The equations of motion for the real and the book value of the capital stock respectively are given by

$$(2) \quad K_{t+1} = (1 - \delta)K_t + I_t$$

$$(3) \quad K_{t+1}^r = (1 - \Delta)K_t^r + I_t$$

The relationship between cash dividends, gross dividends and net dividends is determined by the system of capital income taxation. Gross dividends, G , are defined as dividends after corporate income tax but before deduction of personal income tax. Net dividends, D , are dividends received by the firm's shareholders after payment of all taxes. They are related to gross dividends by the relationship $D = (1 - m_d)G$, where m_d is the shareholder's marginal tax rate on dividend income.

Under the classical system, the firm pays a corporation tax at a rate τ on all taxable profits and the shareholders pay personal income tax on their receipts of cash dividends. The firm's taxable profits equal operating income less basic allowances. Taxes paid by the firm are then given by

$$(4a) \quad T_t(s) = \begin{cases} 0, & \pi_t(s) \leq 0 \\ \tau\pi_t(s), & \pi_t(s) > 0 \end{cases}$$

where

$$(5) \quad \pi_t(s) = f(K_t, s) - rB_{t-1} - \Delta K_t^r$$

is defined as operating income less basic allowances. Ignoring for the moment any legal restrictions on the firm's dividend payments, cash dividends to shareholders are given by

$$(6a) \quad C_t(s) = \begin{cases} X_t(s) & , \pi_t(s) \leq 0 \\ X_t(s) - \tau\pi_t(s) & , \pi_t(s) > 0 \end{cases}$$

where

$$(7) \quad X_t(s) = f(K_t, s) + (B_t - (1+r)B_{t-1}) - I_t$$

is defined as cash flow less current investment. Under the classical system, gross dividends equal cash dividends paid by the firm, ie $G_t = C_t$.

Under the two-rate system, the effective rate of corporation tax on distributed profits is lower than that on retained earnings. In Finland this has been administered by allowing firms to deduct a proportion, v , of current dividends from the corporate income tax base.¹² We then have for the firm's tax payments:

$$(4b) \quad T_t(s) = \begin{cases} 0 & , \pi_t(s) \leq vC_t(s) \\ \tau(\pi_t(s) - vC_t(s)) & , \pi_t(s) > vC_t(s) \end{cases}$$

and for the cash dividends

$$(6b) \quad C_t(s) = \begin{cases} X_t(s) & , \pi_t(s) \leq vC_t(s) \\ \frac{1}{1-v\tau}(X_t(s) - \tau\pi_t(s)) & , \pi_t(s) > vC_t(s) \end{cases}$$

Under the two-rate system, gross dividends equal cash dividends paid by the firm, ie $G_t = C_t$.

Under the imputation system, there is a single rate of corporate tax on both distributed and undistributed profits but credit is given to shareholders for taxes paid by the firm, which may be used to offset their personal tax liability on dividends. In Finland the system has

¹² In 1977-1988 the dividend deduction was 60 per cent (100 per cent on dividends paid on new equity issued less than five years prior to dividend payment) in state taxation. In 1989-1990 the dividend deduction was 40 per cent. No allowance for dividends was made in municipal taxation.

been administered since 1990 as follows. The firm pays a corporate tax at a rate τ on all taxable profits. Any dividends which are then paid are regarded as having borne tax at a rate of imputation u on grossed-up dividends, $G_t = C_t/(1-u)$. The rate of corporate tax, τ , and the rate of imputation, u , need not be the same.¹³ However, if the tax credit to shareholders, $uC_t/(1-u)$, exceeds the current 'mainstream corporate tax', $\tau\pi_t$, a legal restriction comes into play and the firm has to pay the balance as a supplementary tax.¹⁴ Tax payments by the firm are thus given by $T_t = \max [0, uC_t(s)/(1-u), \tau\pi_t(s)]$ which, assuming $C_t \geq 0$ for all t (limited liability of shareholders), can be written as

$$(4c) \quad T_t(s) = \begin{cases} \frac{u}{1-u} C_t(s), & \pi_t(s) \leq \frac{u}{\tau} \frac{C_t(s)}{1-u} \\ \tau\pi_t(s), & \pi_t(s) > \frac{u}{\tau} \frac{C_t(s)}{1-u} \end{cases}$$

It then follows that cash dividends under the imputation system are given by

$$(6c) \quad C_t(s) = \begin{cases} (1-u)X_t(s), & \pi_t(s) \leq \frac{u}{\tau} \frac{C_t(s)}{1-u} \\ X_t(s) - \tau\pi_t(s), & \pi_t(s) > \frac{u}{\tau} \frac{C_t(s)}{1-u} \end{cases}$$

Under the imputation system, gross dividends are related to cash dividends paid by the firm as $G_t = C_t/(1-u)$.

¹³ In most countries using an imputation system, $u < \tau$, which means that the tax paid by the corporation is not fully credited in the shareholders' personal taxation. In Finland, when the imputation system was first introduced in 1990 the rate of imputation could differ between investors and $u \neq \tau$. Since 1993, however, the Finnish imputation system has been designed so that $u = \tau$.

¹⁴ Notice the difference between the Finnish and the UK imputation system, as described eg in Keen & Schiantarelli (1991). In Finland the comparison is made between the tax credit to shareholders and the tax payment by the firm, whereas in the UK the comparison is made between the imputed dividend and the taxable profits of the firm. However, since the Finnish system has been designed s.t. $u = \tau$, both the UK and Finnish systems yield the same end result. Nevertheless, from the fact that $u = \tau$, it follows that a regime in the UK system, 'advanced corporation tax (ACT) exhaustion' appears to be absent from the Finnish system. It may be noted that the description of the Finnish tax code is simplified here in that we ignore the fact that tax surplus, ie current mainstream corporate tax payments, $\tau\pi_t$, less the tax credit to shareholders, $uC_t/(1-u)$, may be carried forward to offset future tax liability.

Let us assume for notational simplicity that the states can be labelled and ordered such that

$$s_t \in [\underline{s}, \bar{s}]$$

and that $f_s(K_t, s_t) > 0 \forall K, t$. The expected¹⁵ gross dividends at time t under alternative tax systems can then be written as follows:

$$(8a) \quad E(G_t) = E(C_t) = \int_{\underline{s}}^{s'} X_t(s) \varphi(s) ds + \int_{s'}^{\bar{s}} (X_t(s) - \tau \pi_t(s)) \varphi(s) ds$$

(classical system) or

$$(8b) \quad E(G_t) = E(C_t) = \int_{\underline{s}}^{s'} X_t(s) \varphi(s) ds + \frac{1}{1 - v\tau_c} \int_{s'}^{\bar{s}} (X_t(s) - \tau \pi_t(s)) \varphi(s) ds$$

(two-rate system) or

$$(8c) \quad E(G_t) = \frac{1}{1 - u} E(C_t) = \int_{\underline{s}}^{s'} X_t(s) \varphi(s) ds + \frac{1}{1 - u} \int_{s'}^{\bar{s}} (X_t(s) - \tau \pi_t(s)) \varphi(s) ds$$

(imputation system),

where s' is defined under the alternative tax systems to be the state in which corporate income taxes just equal zero (under the imputation system the 'mainstream corporate tax' just equals the tax credit to shareholders). That is, s' satisfies the following conditions:

$$(9a) \quad \pi_t(s') \equiv 0 \Leftrightarrow f(K_t, s') \equiv rB_{t-1} + \Delta K_t^r$$

(classical system)

$$(9b) \quad \pi_t(s') \equiv vC_t(s') \Leftrightarrow f(K_t, s') \equiv rB_{t-1} + \Delta K_t^r + \frac{v}{1 - v} [(B_t - B_{t-1}) - I_t + \Delta K_t^r]$$

(two-rate system)

¹⁵ The expectation is conditional on information available at the beginning of period t .

$$(9c) \quad \pi_i(s') \equiv \frac{u}{\tau} \frac{C_i(s')}{1-u} \Leftrightarrow f(K_i, s') \equiv rB_{i-1} + \Delta K_i^\tau + \frac{u}{\tau-u} [(B_i - B_{i-1}) - I_i + \Delta K_i^\tau]$$

(imputation system).

It is assumed in the rest of the analysis that $v < 1$ and that $u < \tau$, ie that, even under the two-rate or imputation system, dividends do not fully escape taxation at the corporate level.¹⁶ Defining before-personal tax dividends obtainable from one unit of operating income, net of taxes paid by the firm, by the symbol $\hat{\theta}$ ¹⁷ and noting that

$$(10a) \quad \hat{\theta} = 1 \quad (\text{classical system})$$

$$(10b) \quad \hat{\theta} = \frac{1}{1-v\tau} \quad (\text{two-rate system})$$

$$(10c) \quad \hat{\theta} = \frac{1}{1-u} \quad (\text{imputation system}),$$

the expression for expected gross dividends can be written in a general form as

$$(11) \quad E_i(G_i) = \int_{\underline{s}}^{\bar{s}} X_i(s) \varphi(s) ds + \hat{\theta} \int_{\underline{s}}^{\bar{s}} (X_i(s) - \tau \pi_i(s)) \varphi(s) ds.$$

¹⁶ In Finland, under the two-rate system in the 1980s, which is the period of interest in this study, $v < 1$ was satisfied. It may be noted that for the analysis to be meaningful under an imputation system in which $u = \tau$, as in Finland since 1993, one would have to model the tax code in more detail, eg by taking into account the fact that mainstream corporate tax payments exceeding the tax credit to shareholders ('tax surplus') may be carried forward to offset future tax liability, and to take into account the effects of inflation.

¹⁷ This symbol was introduced by King (1974, 1977).

2.3 Restrictions on financial policy

In many countries company and tax laws impose restrictions on firms' financial policies. In Finland as well as in most other non-Anglo-Saxon OECD countries operating under the so-called uniform reporting principle, it is required that the firm's taxable profit be the same as its accounting profit.¹⁸ Furthermore, company law in Finland requires that dividends can only be paid out of the firm's free reserves, which are composed of current or accumulated past accounting after-tax profits. In this study we follow the approach in Edwards & Keen (1985) and take these institutional constraints into account by introducing an additional state variable, R_t , reflecting the stock of the firm's free reserves at t (the stock of assets financed by retentions prior to t). It is determined by

$$(12) \quad R_{t+1} = R_t + \pi_t(s) - T_t(s) - C_t(s).$$

Using equations (1) and (5), this can be rewritten as

$$(13) \quad R_{t+1} = R_t - (B_t - B_{t-1}) + I_t - \Delta K_t^f.$$

Finally, the constraint for the firm's financial policy introduced by the above considerations is the nonnegativity of free reserves, ie

$$(14) \quad R_{t+1} \geq 0 \quad \forall t.$$

From (13) and (14) it is apparent that the nonnegativity requirement of free reserves is a constraint on the amount the firm can raise through external financing (borrowing). External financing is constrained by the net (accounting) cost of the firm's current capital expenditure plus the firm's free reserves.

¹⁸ Uniform reporting is required in Germany, France, Italy, Greece, Sweden, Norway, Finland, Spain, Switzerland, Belgium, Portugal, Luxembourg, Japan and Turkey (OECD 1986). Its implications for firms' financial and investment policy have previously been analysed eg in Ylä-Liedenpohja (1983, 1986), Koskenkylä (1985) and more recently in Kanninen & Södersten (1994, 1995).

2.4 Optimal financial and investment policy

The firm is assumed to maximize the present value of after-tax cash flow to shareholders. Under the assumption of risk neutrality, equilibrium (the absence of arbitrage) in the capital market requires that

$$(15) \quad (1 - m_b)rV_t = (1 - m_d)E_t(G_t) + (1 - z)(E_t(V_{t+1}) - V_t)$$

where V_t is the value of the firm's equity at the beginning of period t , m_b is the marginal investor's marginal tax rate on interest income, and z is the marginal investor's marginal tax rate on capital gains (accrual basis). Note also that the expectation for gross dividends at the end of period t , E_t , is based on information available at the beginning of period t . Equation (15) can be rewritten as

$$(16) \quad V_t = \frac{1}{1 + \rho} \left\{ \frac{1 - m_d}{1 - z} E_t(G_t) + E_t(V_{t+1}) \right\},$$

where

$$(17) \quad \rho = \frac{1 - m_b}{1 - z} r$$

is the tax adjusted shareholders' discount rate. The firm's optimization problem is to maximize V_t with respect to I_t and B_t before revelation of the period t state of nature. The maximization is performed subject to the financial constraints that the firm's free reserves, debt issues and expected gross dividend must be nonnegative, ie $R_{t+1} \geq 0$ (as stated in equation 14), $B_t \geq 0$ and $E_t(G_t) \geq 0$. Writing the last financial constraint in expected value terms means that we do not rule out the possibility that dividends in some states of the world can be negative. This may be interpreted as giving a residual role to new equity issues in that the firm may have to resort to additional funding from its shareholders in states of the

world in which the firm's cash flow turns out to be exceptionally poor and borrowing is constrained. Associating multipliers λ_t^R , λ_t^B and λ_t^G with the three nonnegativity constraints respectively and multipliers μ_t^K , $\mu_t^{K^r}$ and μ_t^R with the equations of motion for the real capital stock (2), the book value capital stock (3), and the firm's free reserves (13), respectively, and substituting for $E_t(G_t)$ from (11), the following Lagrangian function can be formed:¹⁹

(18)

$$\begin{aligned}
L = \sum_{t=1}^{\infty} \frac{1}{(1+\rho)^t} & \left\{ \frac{1-m_d}{1-z} \left[\int_{\underline{s}}^{\bar{s}} [f(K_t, s) + (B_t - (1+r)B_{t-1}) - I_t] \phi(s) ds \right. \right. \\
& + \hat{\theta} \int_{\underline{s}}^{\bar{s}} [f(K_t, s) + (B_t - (1+r)B_{t-1}) - I_t - \tau[f(K_t, s) - rB_{t-1} - \Delta K_t^r]] \phi(s) ds \Big] \\
& + \lambda_t^G \left[\int_{\underline{s}}^{\bar{s}} [f(K_t, s) + (B_t - (1+r)B_{t-1}) - I_t] \phi(s) ds \right. \\
& + \hat{\theta} \int_{\underline{s}}^{\bar{s}} [f(K_t, s) + (B_t - (1+r)B_{t-1}) - I_t - \tau[f(K_t, s) - rB_{t-1} - \Delta K_t^r]] \phi(s) ds \Big] \\
& + \lambda_t^B B_t \\
& + \lambda_t^R R_{t+1} \\
& - \mu_t^K [K_{t+1} - (1-\delta)K_t - I_t] \\
& - \mu_t^{K^r} [K_{t+1}^r - (1-\Delta)K_t^r - I_t] \\
& \left. - \mu_t^R [R_{t+1} - R_t + (B_t - B_{t-1}) - I_t + \Delta K_t^r] \right\}
\end{aligned}$$

The Kuhn-Tucker conditions for an optimal policy can be written as²⁰

¹⁹ Writing the nonnegativity constraint on dividends in expected value terms results in a significant simplification of the optimization analysis in that uncertainty only pertains to the objective function and the state of the system evolves deterministically over time. It may be noted, however, that allowing for negative dividends implies that we may also have to accept negative taxes in these extreme states of the world. Alternatively, one could impose a nonnegativity constraint on the lower bound for the firm's operating income but this would most likely be a greater violation to reality. The nonnegativity constraints on K_{t+1} and K_{t+1}^r have been omitted for simplicity, but in the analysis that follows we only consider economically feasible solutions with positive capital stock. Disinvestment, ie sales of capital goods, are however allowed.

²⁰ Terms involving induced changes in s' drop out of the calculations. See appendix 1.

$$(19) \quad \frac{\partial L}{\partial I_t} = 0: -\left(\frac{1-m_d}{1-z} + \lambda_t^G\right) [\Phi(s') + \hat{\theta}(1-\Phi(s'))] + \mu_t^K + \mu_t^{K\tau} + \mu_t^R = 0$$

$$\Leftrightarrow -\nabla_t + \mu_t^R + \mu_t^K + \mu_t^{K\tau} = 0$$

$$(20) \quad \frac{\partial L}{\partial B_t} = 0:$$

$$\left(\frac{1-m_d}{1-z} + \lambda_t^G\right) [\Phi(s') + \hat{\theta}(1-\Phi(s'))] + \lambda_t^B - \mu_t^R$$

$$- \frac{1}{1+\rho} \left[\left(\frac{1-m_d}{1-z} + \lambda_{t+1}^G\right) [(1+r)\Phi(s') + \hat{\theta}(1+(1-\tau)r)(1-\Phi(s'))] - \mu_{t+1}^R \right] = 0$$

$$\Leftrightarrow \nabla_t + \lambda_t^B - \mu_t^R - \frac{1}{1+\rho} [\nabla_{t+1} [1 + (1-\tau_{t+1}^*)r] - \mu_{t+1}^R] = 0$$

$$(21) \quad \frac{\partial L}{\partial K_{t+1}} = 0: -\mu_t^K + \frac{1}{1+\rho} \left[\left(\frac{1-m_d}{1-z} + \lambda_{t+1}^G\right) \left[\int_{\underline{s}}^{\bar{s}} f_K(K_{t+1}, s) \varphi(s) ds \right. \right.$$

$$\left. \left. + \hat{\theta}(1-\tau) \int_{\underline{s}}^{\bar{s}} f_K(K_{t+1}, s) \varphi(s) ds \right] + (1-\delta)\mu_{t+1}^K \right] = 0$$

$$(22) \quad \frac{\partial L}{\partial K_{t+1}^\tau} = 0:$$

$$-\mu_t^{K\tau} + \frac{1}{1+\rho} \left[\left(\frac{1-m_d}{1-z} + \lambda_{t+1}^G\right) \hat{\theta}\tau\Delta(1-\Phi(s')) + (1-\Delta)\mu_{t+1}^{K\tau} - \Delta\mu_{t+1}^R \right] = 0$$

$$\Leftrightarrow -\mu_t^{K\tau} + \frac{1}{1+\rho} [\nabla_{t+1}\tau_{t+1}^*\Delta + (1-\Delta)\mu_{t+1}^{K\tau} - \Delta\mu_{t+1}^R] = 0$$

$$(23) \quad \frac{\partial L}{\partial R_{t+1}} = 0: \lambda_t^R - \mu_t^R + \frac{1}{1+\rho} \mu_{t+1}^R = 0$$

There are two new concepts introduced in (19) - (23). First,

$$(24) \quad \nabla_t = \left(\frac{1-m_d}{1-z} + \lambda_t^c \right) \left[\Phi(s') + \hat{\theta}(1 - \Phi(s')) \right]$$

is the expected marginal value of cash dividends (in terms of net capital gains forgone) at time t . In tax exhausted states of the world, the value of one additional unit of cash dividends is $(1-m_d)/(1-z)$ while in nontax exhausted states, the value of one additional unit of cash dividends is $\hat{\theta}(1-m_d)/(1-z)$, plus the shadow price on the minimum constraint on dividends in all states. Since $\hat{\theta} = 1$ for a classical tax system but $\hat{\theta} > 1$ holds for both a two-rate and an imputation system, it can be seen that cash dividends are assigned a greater marginal value under the latter two tax systems than under the classical tax system. This is due to the fact that dividends provide a tax shield in nontax exhausted states under a two-rate or imputation system.²¹ Secondly,

$$(25) \quad \tau_{t+1}^* = \frac{\hat{\theta}(1 - \Phi(s'))}{\Phi(s') + \hat{\theta}(1 - \Phi(s'))} \tau$$

is the expected rate of corporate tax for the next period. The tax shield value of an additional unit of interest expenses is $\hat{\theta}\tau$ in nontax exhausted states. This must be weighted by its corresponding probability and measured against the expected before-personal-tax value of a unit increment to the firm's operating income.²²

In order to rule out explosive paths for the state variables, the following transversality conditions must hold:

$$(26) \quad \lim_{t \rightarrow \infty} \frac{1}{(1+\rho)^t} \mu_t^\Gamma \Gamma_{t+1} = 0 \quad , \quad \Gamma = K, K^r, R.$$

²¹ It is worth noting the difference between the definition of ∇ in this study and that in Mayer (1986). Mayer's analysis implicitly assumes either a classical system of capital income taxation ($\hat{\theta}=1$), or that under a two-rate or imputation system the tax shield of dividend payments can be fully utilized also in tax exhausted states.

²² In Mayer (1986), $\tau_{t+1}^* = (1 - \Phi_{t+1}(s'))\tau$ (ignoring tax-loss carry-forwards). The formulation in our model yields the same result if either a classical tax system is assumed or the tax shield of dividends is allowed to be fully utilized also in tax exhausted states.

That is, the (discounted) shadow value of the stocks must go to zero as the time horizon approaches infinity.

From equation (19) we obtain

$$(27) \quad \mu_t^K + \mu_t^{K\tau} = \nabla_t - \mu_t^R,$$

where the left-hand side is the marginal valuation of a unit increment to the capital stock and the right-hand side is the cost of retained earnings. Furthermore, from equation (20) we obtain

$$(28) \quad \nabla_t - \mu_t^R = \frac{(\nabla_{t+1} - \mu_{t+1}^R) + \nabla_{t+1}(1 - \tau_{t+1}^*)r}{1 + \rho} - \lambda_t^B,$$

where the right-hand side is the cost of debt financing. From (27) and (28) it can be noted that the cost of capital is affected by μ_t^R , the shadow price of the stock of the firm's free reserves. From (23) we can derive the following relationship between μ^R and λ^R :

$$(29) \quad \mu_t^R = \sum_{i=1}^T \frac{1}{(1 + \rho)^{i-1}} \lambda_{t+i-1}^R + \frac{1}{(1 + \rho)^T} \mu_{t+T}^R.$$

Imposing a condition that

$$\lim_{T \rightarrow \infty} (1 + \rho)^{-T} \mu_{t+T}^R \rightarrow 0$$

(this can most easily be accomplished by assuming a fixed date T for which $\mu_T^R = 0$ holds), it follows that the shadow price of the firm's free reserves depends only on the extent to which the firm is constrained now or in the future by the requirement that the reserves be nonnegative. From (13) it can be seen that there are basically two cases in which this constraint is binding: first, there is an opportunity for unlimited tax arbitrage by borrowing and paying the proceeds out as dividends or, second, there is an adverse shock that requires the firm to reduce its capital stock below the level of the initial share capital.

In the model, there are four possible financing regimes for the firm:

(i) Zero borrowing with zero free reserves:

$$\begin{cases} B_t = 0, \lambda_t^B > 0 \\ R_{t+1} = 0, \lambda_t^R > 0 \end{cases}$$

(ii) Zero borrowing with positive free reserves:

$$\begin{cases} B_t = 0, \lambda_t^B > 0 \\ R_{t+1} > 0, \lambda_t^R = 0 \end{cases}$$

(iii) Internal financial optimum (positive borrowing, positive free reserves):

$$\begin{cases} B_t > 0, \lambda_t^B = 0 \\ R_{t+1} > 0, \lambda_t^R = 0 \end{cases}$$

(iv) Binding borrowing constraint (positive borrowing, zero free reserves):

$$\begin{cases} B_t > 0, \lambda_t^B = 0 \\ R_{t+1} = 0, \lambda_t^R > 0 \end{cases}$$

In the first two regimes debt plays no role and the firm finances its investment through retentions. Since borrowing is driven only by tax considerations in the model, these regimes would be feasible if there existed a statutory net tax disadvantage to debt financing. Hence, the first regime is possible only if the firm is hit by an adverse shock that requires the firm to reduce its capital stock below the level of the initial share capital. In this study we abstract from this possibility. The second regime, in which the firm maintains positive free reserves and finances investment through retentions only, would be a feasible steady-state equilibrium if tax parameters made retentions the preferred mode of financing. However, in this study we take the statutory net tax advantage of debt financing as given and concentrate on the latter two regimes with positive borrowing.

Given a statutory net tax advantage to borrowing, it needs to be ascertained whether an internal financial optimum or an all-debt

finance regime or both can be an equilibrium outcome. In a world of perfect certainty, a net tax advantage to debt would immediately imply that it is optimal for the firm to issue debt to the extent that the external constraint on borrowing becomes binding. However, if uncertainty and the existence of tax exhaustion are taken into account, the opportunity for tax arbitrage through borrowing is not unlimited. As can be seen from equation (25), an increase in borrowing lowers the expected rate of corporate tax for the next period, τ_{t+1}^* , and hence the expected net tax advantage of debt financing. Therefore, depending on exogenously given characteristics of the firm, either the expected net tax advantage of debt vanishes before the borrowing constraint becomes binding and the firm ends up in an internal financial optimum or the borrowing constraint becomes binding and the firm ends up being totally debt financed.

As argued in Mayer (1986), the determination of the financial structure of the firm by institutional constraints is both theoretically unappealing and not in accord with observed company behaviour. Firms do not drive their free reserves to zero and finance their investment entirely by borrowing.²³ Therefore, in this study we concentrate on analysing the properties of the model in the absence of constraints and assuming that an internal financial optimum is attainable.

Furthermore, throughout the rest of the analysis it is assumed that the nonnegativity constraint, on expected gross dividends is not binding ($\lambda_t^G = 0 \forall t$) and that no new relevant information about the distribution of returns becomes available. The first assumption is in fact a feasibility condition for the existence of the firm, and the second assumption enables abstraction from unexpected changes in financing regimes.

²³ In practice, firms accumulate free reserves for various nontax reasons also. First, free reserves act as a cushion to absorb operating losses without having to resort to time-consuming court proceedings in order to reduce the restricted share capital of the firm. Secondly, in the case of risk averse shareholders, free reserves have a role in enabling the firm to smooth the dividend stream. Finally, there may be some agency cost explanations for having a positive amount of free reserves. These considerations could be included in the model by introducing an additional term in the maximand to reflect the nontax benefits of free reserves. However, for simplicity these are ignored.

If borrowing constraints are never binding, so that the firm can optimally adjust its debt usage in each period, it follows that the critical state s' as defined by equations (9a-9c) is time invariant.²⁴ This in turn implies that both the marginal value of dividends, ∇_t , and the expected rate of corporate tax, τ_{t+1}^* , are constant and they can be rewritten as

$$(30) \quad \nabla_t = \nabla = \frac{1-m_d}{1-z} [\Phi(s') + \hat{\theta}(1-\Phi(s'))] \quad \forall t$$

and

$$(31) \quad \tau_{t+1}^* = \tau^* = \frac{\hat{\theta}(1-\Phi(s'))}{\Phi(s') + \hat{\theta}(1-\Phi(s'))} \tau \quad \forall t.$$

Noting that at an internal financial optimum $\lambda_t^B = 0$, equation (28) can be rewritten as the following first-order difference equation for the shadow price of the firm's free reserves:

$$(32) \quad \mu_{t+1}^R - (1+\rho)\mu_t^R = \left[(1-\tau^*) - \frac{1-m_b}{1-z} \right] \nabla r.$$

From equation (29) and the fact that at an internal financial optimum $\lambda_t^R = 0$ holds for all t , it follows that $\mu_t^R = 0$ must also hold for all t . This implies that the internal optimum is not constrained by the firm's free reserves. That is, an increase in free reserves does not increase the maximized value of equity.

Since both ∇ and r are assumed to be strictly positive, it can be concluded from equation (32) that an internal financial optimum requires that

²⁴ It may be noted that even if an internal financial optimum is the steady-state regime, it is conceivable that the borrowing constraint is binding in the initial periods of the life of a firm and does not become redundant until later, as the firm's capital stock is built up and its earnings stream strengthened. The following analysis is thus restricted to a steady-state.

$$(33) \quad 1 - \tau^* = \frac{1 - m_b}{1 - z}$$

or equivalently using (25),

$$(34) \quad \frac{\hat{\theta}(1 - \Phi(s'))}{\Phi(s') + \hat{\theta}(1 - \Phi(s'))} \tau = \frac{m_b - z}{1 - z}.$$

If the firm plans to always be a regular taxpayer (ie $\Phi(s') = 0$, which requires zero or very low debt usage), $\tau^* = \tau$ and the condition for an internal financial optimum reduces to the familiar form $1 - m_b = (1 - z)(1 - \tau)$.²⁵ Generally, an increase in borrowing raises the probability of tax exhaustion, $\Phi(s')$, and thus lowers the expected rate of corporate tax, τ^* . Assuming that the borrowing constraint does not become binding before equality (34) is attained, the model yields an internal financial optimum on the basis of tax factors alone.

From equation (34) it can readily be observed that for the internal financial optimum to be feasible, it is necessary that

$$(35) \quad 0 \leq \frac{m_b - z}{1 - z} \leq \tau.$$

This is tantamount to requiring that there is a net tax advantage to borrowing. In Finland, the statutory corporate tax rate in the 1980s was 60 per cent up to 1985, 50 per cent in the years 1986-1989, 42 per cent in 1990, and 40 per cent in 1991. The marginal tax rates on interest income and capital gains respectively for the firm's marginal investor are difficult to identify. For tax-exempt institutional investors, $m_b = z$, and for them the condition has clearly been satisfied. For individual investors, it must be taken into account that in Finland the market for corporate bonds was virtually nonexistent in the 1980s and that loans from households to corporations were channelled almost exclusively through the banking sector.²⁶ Since bank deposits were tax-exempt, effective marginal tax rates on

²⁵ In fact, if this condition on statutory tax rates is satisfied, then the firm's debt policy is irrelevant.

²⁶ It may be noted that a significant proportion of funding from the household sector to the corporate sector has been channelled through pension funds in the 1970s and the 1980s. This funding has been taxfree.

individual investors' interest income have been rather moderate. Therefore, despite the fact that the effective marginal tax rate on capital gains (accrual basis) has been close to zero throughout the 1980s, it is likely that the condition has been satisfied for individual investors too.²⁷

More generally, for an individual firm the existence of a net tax advantage to issuing debt in a market equilibrium can be based on a generalized Miller equilibrium analysis. As opposed to Miller's original analysis in which he assumed that there are no firm-specific costs involved in issuing debt, generalized Miller equilibrium models take such costs into account and are able to establish a market equilibrium in which there initially exists a net tax advantage to issuing debt for each firm.²⁸

The optimal probability of tax exhaustion of the firm consistent with an internal financial optimum can be determined by rewriting (34) as

$$(36) \quad \Phi^*(s') = \frac{[(1 - m_b) - (1 - \tau)(1 - z)]\hat{\theta}}{[(1 - m_b) - (1 - \tau)(1 - z)]\hat{\theta} + (m_b - z)}.$$

It can be verified that under the assumptions of an initial net tax advantage to debt and a heavier tax burden on interest income as opposed to capital gains in personal taxation, the optimal probability of tax exhaustion satisfies $0 < \Phi^*(s') < 1$.

²⁷ Up until 1985 individual investors' capital gains were taxfree provided the holding period was at least five years. If a holding period of less than five years, capital gains were fully taxable at the marginal income tax rate. Since 1986 also the long term capital gains have been partially taxable but at a fairly low effective rate. In 1986-1988, only 20 per cent of capital gains in excess of FIM 1 million were taxable after a five-year holding period. In 1989 the tax exempt amount (for long-term capital gains) was reduced to FIM 200 000, and the proportion of taxable capital gains in excess of FIM 200 000 was increased to 40 per cent. Capital losses were tax deductible only if the holding period was less than five years, and they could be offset only against short-term capital gains. See Kukkonen (1992) and Sorjonen (1995) for a more detailed description of the taxation of capital gains.

²⁸ See eg DeAngelo & Masulis (1980), Kim (1982) and Barnea, Haugen & Senbet (1985) on the intuition behind the generalized Miller equilibrium. Auerbach & King (1983) is one of the few attempts to analyse in a general equilibrium setting the determination of asset prices in the presence of taxation.

Notice also that even without any constraints on borrowing, it would not be optimal for the firm to plan to be tax exhausted with certainty in every period. The result is due to the fact that there are costs associated with borrowing in the model, namely, the tax discrimination in respect of interest income vs capital gains in personal taxation. Hence, the introduction of uncertainty together with preferential tax treatment of capital gains in personal taxation may be sufficient, even without considering tax-loss carry-forwards as in Mayer (1986), to explain why firms eg in the Nordic countries have systematically failed to maximize their interest-free tax debt capacity.²⁹

Let us solve next for the firm's optimal capital stock. In order to keep the analysis tractable, we make the following simplifying assumption:

*Returns on the firm's marginal investment have a distribution independent of the returns on the firm's existing assets.*³⁰

Equation (21) then simplifies to

$$(37) \quad \mu_{t+1}^K - \frac{1+\rho}{1-\delta} \mu_t^K = - \frac{\nabla(1-\tau^*)E(f_K(K_{t+1}))}{1-\delta},$$

which yields the equilibrium shadow price

$$(38) \quad \mu^{K*} = \frac{\nabla(1-\tau^*)E(f_K(K_{t+1}))}{\rho + \delta}.$$

²⁹ Strictly speaking, it is assumed in the model that firms always claim all accounting allowances. One may then ask why some firms fail to take full advantage of all accounting allowances while at the same time they pay taxes. A minimum constraint on dividends together with the requirement that dividends can only be paid out of taxable income can explain this observation. Kanninen & Södersten (1994) have recently explained the apparent failure to maximize tax debt by introducing informational asymmetries in addition to the uniform reporting requirement. However, since K&S assume a world of perfect certainty, in their model all firms end up being debt (dividend) constrained in a steady-state. Moreover, the fact that in the 1970s and 1980s there was always the possibility that the firm was subjected to presumptive income taxation if its taxable profits were too low can also explain the observation that Finnish firms did not maximize their tax debt.

³⁰ As explained in Mayer (1986), this is a restrictive assumption, but it enables us to separate the effect of tax exhaustion on the cost of capital from that on the marginal return on investment. Mayer shows that the bias introduced by this assumption should be small provided that s' lies in the tail of the distribution $\varphi(s)$.

On the other hand, from (22) we obtain

$$(39) \quad \mu_{t+1}^{K\tau} - \frac{1+\rho}{1-\Delta} \mu_t^{K\tau} = -\frac{\nabla \tau^* \Delta}{1-\Delta},$$

which yields the equilibrium shadow price

$$(40) \quad \mu^{K\tau^*} = \frac{\nabla \tau^* \Delta}{\rho + \Delta}.$$

Finally, inserting μ^{K^*} and $\mu^{K\tau^*}$ into equation (27), we obtain a formula for the steady-state optimal capital stock of the firm:

$$(41) \quad E(f_K(K_{t+1})) = r + \frac{\delta - \frac{(1-\tau^*)r + \delta}{(1-\tau^*)r + \Delta} \Delta \tau^*}{1-\tau^*},$$

where the right-hand side is the effective cost of capital. Taking into account that at an internal financial optimum, $(1-\tau^*)r = \rho$, equation (41) can be rewritten in a more standard way as

$$(42) \quad E(f_K(K_{t+1})) = \frac{1 - \frac{\Delta \tau^*}{\rho + \Delta}}{1-\tau^*} (\rho + \delta).$$

Furthermore, using the fact that at an internal optimum $\tau^* = (m_b - z)/(1-z)$ the condition for the optimal capital stock can be rewritten as

$$(43) \quad E(f_K(K_{t+1})) = \delta + r \left[1 - \frac{\frac{m_b - z}{1 - z} (\Delta - \delta)}{\frac{1 - m_b}{1 - z} r + \Delta} \right].$$

It can be seen that the firm's optimal investment policy is independent of financial policy. The tax system affects the firm's investment decision through the interactions of excess accounting depreciation allowances and the unequal treatment of interest income vs capital gains in personal taxation. From (43) one sees that neutrality of the tax system with respect to investment policy can be achieved by either setting $\delta = \Delta$ (no tax debt), or $m_b = z$ (no tax cost to issuing debt). The former case is the familiar result that the tax system is neutral with respect to investment policy if interest expenses are fully tax deductible but only economic depreciation is allowed for tax purposes. In the latter case, the tax cost associated with borrowing vanishes, and it is optimal for the firm to issue debt until $\tau^* = 0$, ie until it is permanently tax exhausted. Permanent tax exhaustion explains why excess accounting depreciation has no effect on marginal investment in the latter case.³¹

³¹ However, it may be noted that this result is dependent on the way accelerated depreciation is modelled. In our model, accounting depreciation is determined only by the book value of the capital stock and no tax allowance is made for current capital expenditure. If investment allowances are made, then accounting depreciation enters into the cost of capital formula and influences the firm's investment policy (see eg Mayer 1986). The result that investment policy is independent of financial policy, however, remains intact.

2.5 Comparative static properties

At an internal financial optimum, the optimal financial and investment policy of the firm are determined by the two equations (36) and (43) respectively. The fact that the firm's optimal capital stock is determined independently of its financial policy greatly simplifies the comparative static analysis. Once the optimal capital stock is determined by (43), the optimal level of debt is chosen such that the probability of tax exhaustion equals the right-hand side of (36). Inverting (36) at the optimum, we can write

$$(44) \quad s' = \Phi^{*-1}(\eta) \quad , \quad \eta = \frac{[(1 - m_b) - (1 - \tau)(1 - z)]\hat{\theta}}{[(1 - m_b) - (1 - \tau)(1 - z)]\hat{\theta} + (m_b - z)}$$

Ignoring dynamic effects and possible shifts between financing regimes, we are interested in the impact of changes in the exogenous variables on the steady-state values of the capital stock and the debt level. In a steady-state $B_t^* = B_{t-1}^* = B^*$ and $K_{t+1}^* = K_t^* = K^*$, and the equations defining the critical state (9a-c) all reduce to $f(K^*, s') = rB^* + \Delta K^*$. Recalling that $K^{r*} = (\delta / \Delta)K^*$, this can be rewritten as

$$(45) \quad f(K^*, \Phi^{*-1}(\eta)) = rB^* + \delta K^*$$

We can then define the two-equation system

$$(46) \quad \begin{cases} G^1(K^*, B^*; \gamma) = E(f_K(K^*)) - \delta - r \left[1 - \frac{\frac{m_b - z}{1 - z}(\Delta - \delta)}{\frac{1 - m_b}{1 - z}r + \Delta} \right] = 0 \\ G^2(K^*, B^*; \gamma) = f(K^*, \Phi^{*-1}(\eta)) - rB^* - \delta K^* = 0 \end{cases}$$

The Jacobian of the system is given by

$$(47) \quad |J| = \begin{vmatrix} G_{K^*}^1 & G_{B^*}^1 \\ G_{K^*}^2 & G_{B^*}^2 \end{vmatrix} = \begin{vmatrix} E(f_{KK}(K^*)) & 0 \\ f_K(K^*, s') - \delta & -r \end{vmatrix} = -rE(f_{KK}(K^*)) > 0$$

and the comparative static properties can be derived applying Cramer's rule as³²

$$(48) \quad \begin{cases} \frac{\partial B^*}{\partial \gamma} = \frac{G_{\gamma}^1 G_{K^*}^2 - G_{K^*}^1 G_{\gamma}^2}{|J|} \\ \frac{\partial K^*}{\partial \gamma} = \frac{G_{B^*}^1 G_{\gamma}^2 - G_{\gamma}^1 G_{B^*}^2}{|J|} \end{cases}$$

The results are presented in table 2.1.³³ It turns out that most of the effects on the firm's optimal debt level cannot be determined analytically without further assumptions about the parameters. If both the financial and investment policy of the firm are treated as endogenous, then following a change in an exogenous variable, there are two effects at play, a direct effect and an indirect effect (via investment), which explain why the analytical results with respect to the firm's optimal financial policy remain mostly indeterminate.³⁴ In our model, the problem stems from the ambiguous partial derivative $G_{K^*}^2 = f_K(K^*, s') - \delta$.³⁵ In table 2.1, in cases where two alternative results are shown, the first result is valid for a 'profitable' firm in the sense that $f_K(K^*, s') > \delta$, and the second result is valid for a 'nonprofitable' firm in the sense that $f_K(K^*, s') < \delta$.³⁶

³² In fact, as there is no feedback from the optimal financial policy to the optimal investment policy, the comparative static results with respect to the optimal capital stock could be derived directly from (43).

³³ Details of the calculations are presented in appendix 2.

³⁴ In this model, the direct effect reflects potential rivalry between the exogenous variable and debt in shielding income from taxation (substitution effect), and the indirect effect reflects the influence of the exogenous variable on the optimal capital stock and hence on the firm's income stream and the optimal total amount of tax allowances (income effect).

³⁵ Only in the special case where the marginal returns on investment are state-independent (pure 'demand-quantity uncertainty') and either $\delta = \Delta$, or $m_b = z$, can it be shown that $G_{K^*}^2 > 0$.

³⁶ Since profitability is here defined by the firm's marginal return on capital, one may also think of these two groups of firms as 'growth' firms and 'mature' firms, respectively.

Table 2.1 Comparative static properties of the model

γ	$\text{sgn}\left(\frac{\partial B^*}{\partial \gamma}\right)$	$\text{sgn}\left(\frac{\partial K^*}{\partial \gamma}\right)$	$\text{sgn}\left(\frac{\partial (B/K)^*}{\partial \gamma}\right)$
τ	> 0	0	> 0
m_b	$? / < 0$	> 0	< 0
z	$? / > 0$	< 0	> 0
r	$< 0 / ?$	< 0	$?$
δ	$< 0 / ?$	< 0	$?$
Δ	$> 0 / < 0$	> 0	< 0
v	> 0	0	> 0
u	> 0	0	> 0

The model possesses the familiar feature that the firm's optimal debt level is an increasing function of the corporate tax rate.³⁷ The effects of other tax parameters on borrowing remain ambiguous in general. For 'nonprofitable' firms, the relationship between the optimal debt level and investors' personal tax rates is in line with the results obtained in models in which the firm's investment policy is treated as exogenous, ie the tax rate on interest income is negatively related to borrowing and the tax rate on capital gains is positively related to borrowing. For 'profitable' firms, it is not possible to determine analytically which of the conflicting income and substitution effects dominates.

It also turns out that a change in either the rate of interest or in the rate of economic depreciation of the firm's capital stock has an unambiguous negative effect on the firm's optimal debt level only for 'profitable' firms. For 'nonprofitable' firms, these effects remain ambiguous in general. Intuitively, an increase in either the rate of interest or in the rate of economic depreciation will increase the firm's cost of capital and thus lower its optimal capital stock. Optimal borrowing is determined by the optimal probability of tax exhaustion. The critical state in which the firm is just tax exhausted (the firm's tax

³⁷ This is true regardless of the assumed tax system as shown in the appendix 2. Under a two-rate system changes in τ have an effect through the tax discrimination variable also.

credit equals its tax payment under the imputation system) is determined by the equality of the firm's operating income and basic tax allowances, ie interest expenses plus the accounting depreciation (which equals economic depreciation in the steady-state). For firms with a high marginal return on capital, a reduction in the capital stock has a large negative impact on the firm's operating income, and it follows that the firm must reduce borrowing in order to satisfy the optimal probability of being tax exhausted. For a firm with only a moderate marginal return on capital, a reduction in its capital stock has such a small effect on its operating income relative to the effect on depreciation allowances that it may be necessary for the firm to increase its borrowing to reach an optimal probability of tax exhaustion.

A particularly interesting result is the sensitivity of the effect of the amount of nondebt tax shields (*NDTS*) on borrowing to the firm's investment opportunity set. For 'profitable' firms, it turns out that the relationship between *NDTS* and the debt level is unambiguously positive while for 'nonprofitable' firms the opposite holds. The intuition behind the former result is that an increase in *NDTS* lowers the firm's effective cost of capital and thus raises its optimal capital stock. If the marginal return on the new capital is high enough (in the state in which the firm is just tax exhausted) to exceed the extra allowances, the firm will have to issue more debt in order to satisfy the optimality condition for the probability of tax exhaustion.³⁸ The latter result is familiar from the traditional tax-based models in which the firm's investment policy is assumed to be exogenously determined. The hypothesis that the firms' responses to shifts in *NDTS* should vary according to their financial status is not new.³⁹ However, it has not been previously proved analytically that such systematic variation should exist. In general, *NDTS* may differ across firms eg because of differences in asset composition (depreciable vs nondepreciable) and depreciation methods (accelerated vs straight-line).

Finally, an increase in either the dividend deduction rate (under the two-rate system) or in the rate of imputation (under the imputation system) unambiguously raises the optimal debt level in the model. An increase in either the dividend deduction rate or in the rate of imputation raises the value of $\hat{\theta}$, the amount of before-personal-tax dividends obtainable from a unit of the firm's operating income net of corporate taxes. From (36), conditional on the assumption that $m_b > z$,

³⁸ Dynamic aspects of adjustment are, of course, missed by analysing only changes in steady-state values.

³⁹ See especially MacKie-Mason (1990) and Graham (1996).

it can be seen that an increase in $\hat{\theta}$ raises the optimal probability of tax exhaustion. This is due to the fact that a larger $\hat{\theta}$ implies a higher marginal value of tax shields in nontax exhausted states while the 'tax cost of tax exhaustion' (ie the heavier tax burden on interest income as opposed to capital gains in personal taxation without any interest tax shield in corporate taxation) remains the same. Hence an increase in the optimal probability of tax exhaustion requires that the firm increases its borrowing.

An examination of the effects on borrowing of shocks to the probability distribution of the firm's operating income would require assumptions about their influence on the marginal productivity of capital. These effects will be analysed under the simplifying assumption of a normal distribution in the simulation analysis that follows.

The effects of the exogenous variables on the firm's optimal capital stock turn out to be unambiguous in the model. The capital stock is unaffected by changes in the statutory rate of corporate tax, whereas the investors' personal tax rates play a role in determining the firm's optimal investment policy. An increase in the personal tax rate on interest income reduces the effective cost of capital and hence raises the optimal capital stock, while an increase in the personal tax rate on capital gains increases the effective cost of capital and hence lowers the optimal capital stock. An increase in either the interest rate or in the economic rate of depreciation of the capital will raise the effective cost of capital and thus lower the optimal capital stock. As noted above, an increase in *NDTS* raises the optimal capital stock by lowering the effective cost of capital. Finally, since the optimal capital stock of the firm is unaffected by the tax discrimination variable, $\hat{\theta}$, neither changes in the dividend deduction rate nor in the rate of imputation affect the optimal capital stock.⁴⁰ However, since the interactions of the tax parameters and corporate investment decisions are somewhat simplified in our model, no firm conclusions about these effects should be drawn.

Interestingly, even though the relationship between *NDTS* and the firm's debt level remains ambiguous in general, it is possible to show that an increase in *NDTS* has an unambiguously negative impact on the firm's optimal debt/capital ratio, as indicated in the last column of table 2.1. The same holds true for the personal tax rates as well: the tax rate on interest income can be shown to be negatively related and the tax rate on capital gains can be shown to be positively related to the firm's debt/capital ratio.

⁴⁰ See also King (1974) and Ylä-Liedenpohja (1978).

To obtain more definitive results of the model with respect to the firm's optimal financial policy, it is necessary to resort to a simulation analysis.⁴¹ We specify a production function (determining the firm's operating income) that consists of a nonstochastic and a stochastic component and that satisfies the concavity assumption of the theoretical model. Uncertainty is captured by introducing a normally distributed random variable, $\tilde{\alpha}$, in the production function. In order to shed light on the financing behaviour of Finnish companies in the 1980s, the simulation analysis assumes a two-rate system of capital income taxation. Let us first consider a 'nonprofitable' firm with a relatively low marginal return on capital. The numerical values assumed for the base case simulation are presented in table 2.2.

Table 2.2 Parameter values assumed for a 'nonprofitable' firm in the simulations

$f(K)$	$0.05K + \tilde{\alpha} \ln(K+1)$
$f_K(K)$	$0.05 + \tilde{\alpha} / (K+1)$
$f_{KK}(K)$	$-\tilde{\alpha} / (K+1)^2$
α	$\tilde{\alpha} \sim N(1.1, 1)$
r	0.1
τ	0.4
m_b	0.5
z	0.25
m_d	0.5
δ	0.1
Δ	0.3
v	0.5

⁴¹ For previous simulation analyses concerning the firm's financial policy, see eg Bradley, Jarrell & Kim (1984).

For a 'nonprofitable' firm, the nonstochastic component of the return on capital is assumed to be 5 per cent.⁴² The tax parameters are chosen so that a net tax advantage to debt financing exists, ie $(1 - m_b) - (1 - \tau)(1 - z) = 0.05 > 0$. The assumed value for accounting depreciation, $\Delta = 0.3$, is rather high, but it may be noted that the Finnish tax laws allowed rather liberal free depreciation in the 1980s. The value $v = 0.5$ is an estimate of the effective dividend deduction rate.

Results of the simulation are depicted in figures 2.1(a-i). They are obtained by first determining the optimal debt level and the optimal capital stock for the parameter values specified in table 2.2. After that, the assumed value for one parameter at a time is systematically changed and the corresponding new optimal values for the firm's debt level and capital stock are determined.

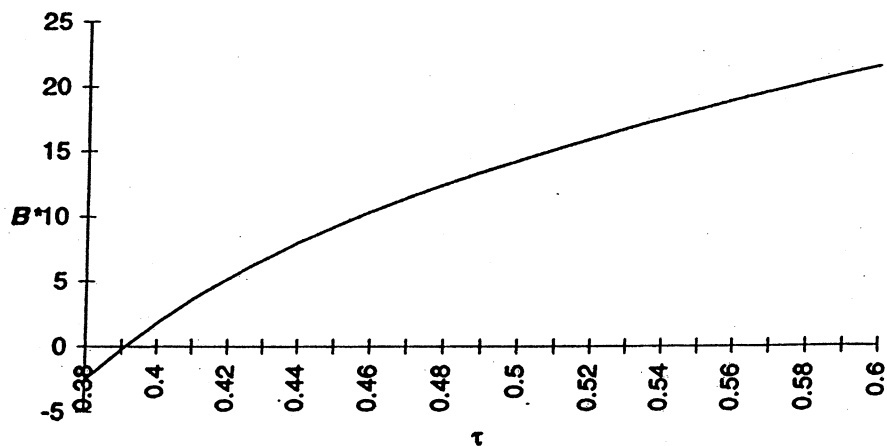
The results in figures 2.1(a-i) confirm our analytical results for a 'nonprofitable' firm. An increase either in the corporate tax rate or in the personal tax rate on capital gains raises the optimal debt level while an increase in the personal tax rate on interest income lowers the optimal debt level. The effect of *NDTS* on borrowing is unambiguously negative, as expected. It also appears from figure 2.1(f) that the relationship is not linear and that the higher the initial level of *NDTS*, the smaller its effect on the debt level.

The relationship between the interest rate and the optimal debt level of a 'nonprofitable' firm turns out to be somewhat surprising. It appears that at a low initial interest rate an increase in the rate actually induces the firm to increase its borrowing while at a relatively high initial interest rate the more familiar negative relationship holds. The intuition behind the former result is that for a 'nonprofitable' firm, the negative relationship between the interest rate and the optimal capital stock is not linear. Therefore, at a low initial interest rate, the effect of an interest rate increase on the firm's operating income may be so small and the effect on the firm's depreciation allowances so large that it is necessary for the firm to issue additional debt to satisfy the condition for the optimal probability of tax exhaustion. Finally, an increase in the rate of economic depreciation appears to unambiguously lower the optimal debt level of a 'nonprofitable' firm.

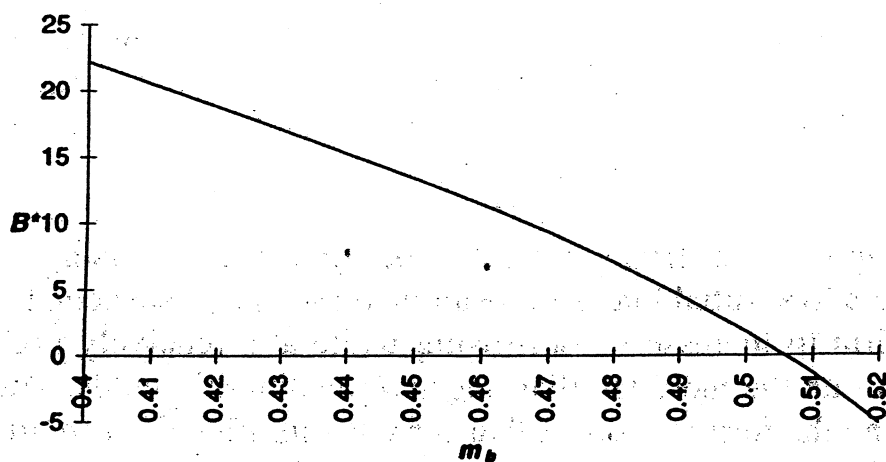
⁴² It may be of interest to note that the optimal probability of tax exhaustion implied by the assumed parameter values is 20 per cent, ie a firm should on average be tax exhausted once in every five years. The parameters also imply that the steady-state debt-to-firm-value ratio is about 74 per cent in book value terms but only about 25 per cent in real value terms.

Figure 2.1 (a-c) Simulation results for a 'nonprofitable' firm

(a) Corporate income tax rate



(b) Personal tax rate on interest income



(c) Personal tax rate on capital gains

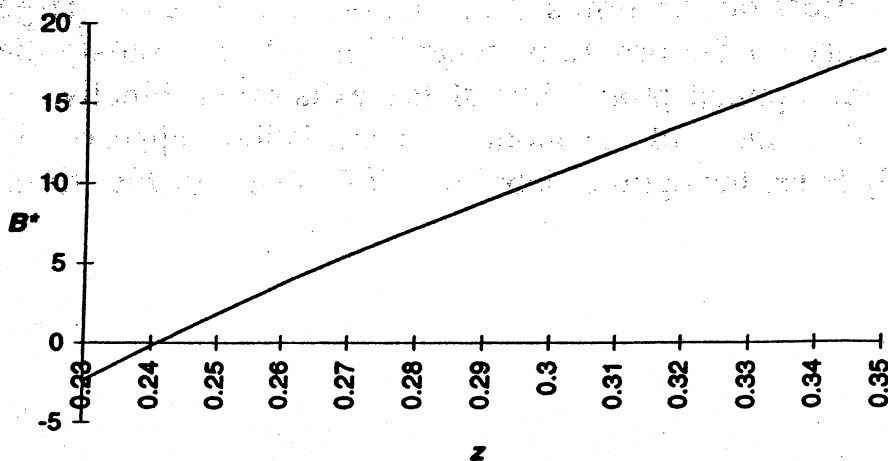
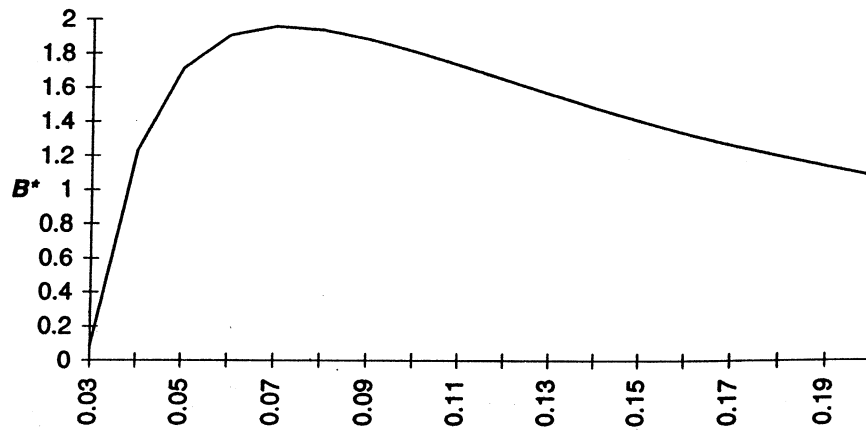
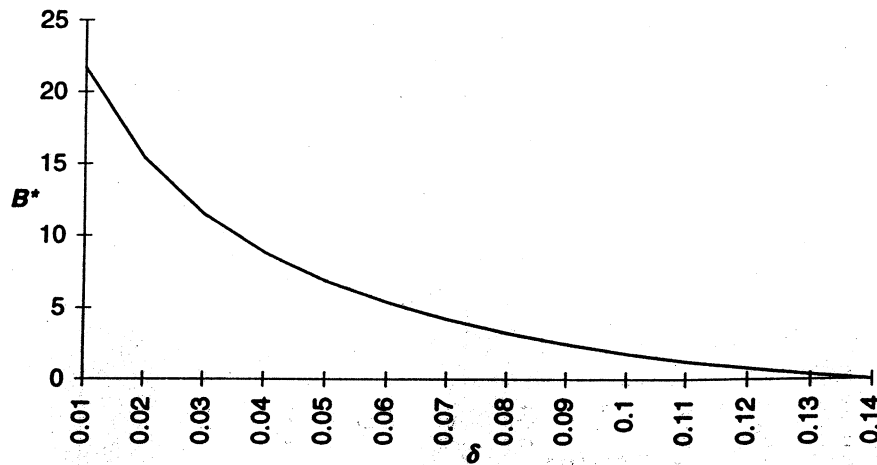


Figure 2.1 (d-f) Simulation results for a 'nonprofitable' firm

(d) Interest rate



(e) Rate of economic depreciation



(f) Nondebt tax shields

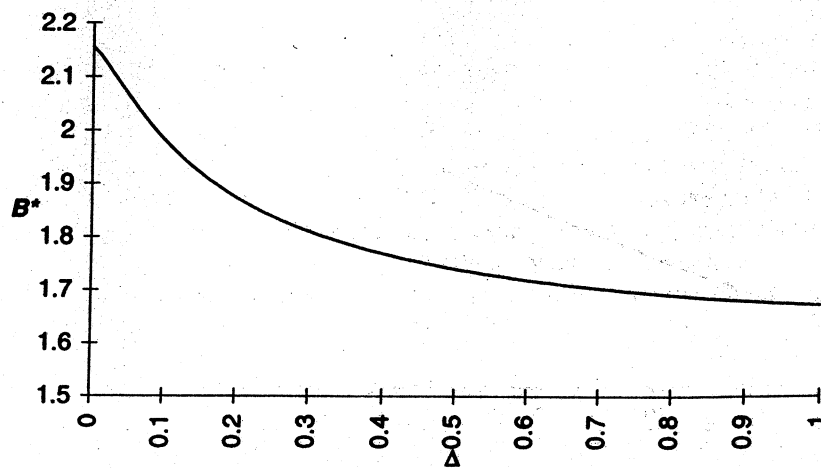
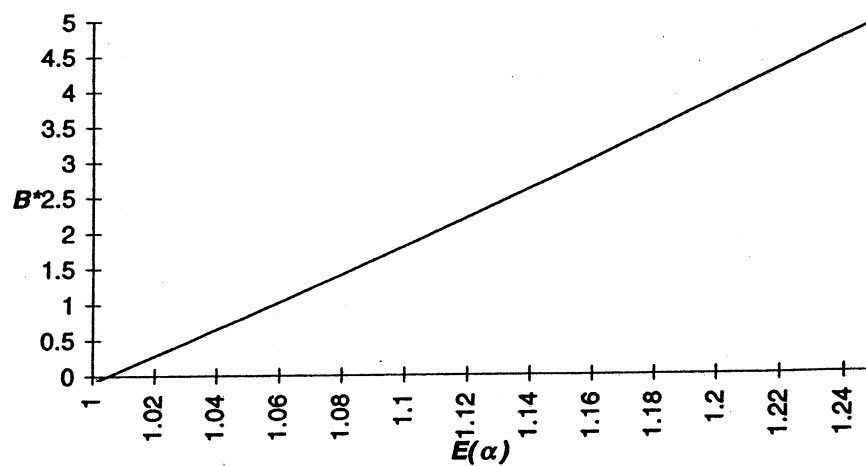
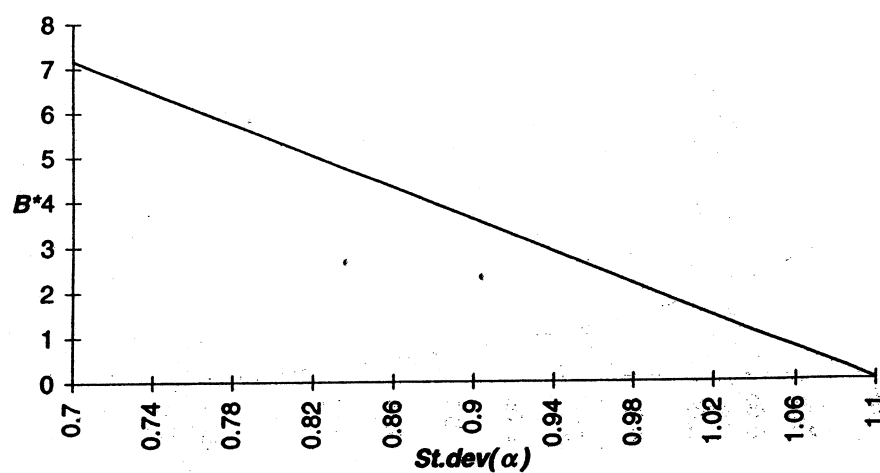


Figure 2.1 (g-i) Simulation results for a 'nonprofitable' firm

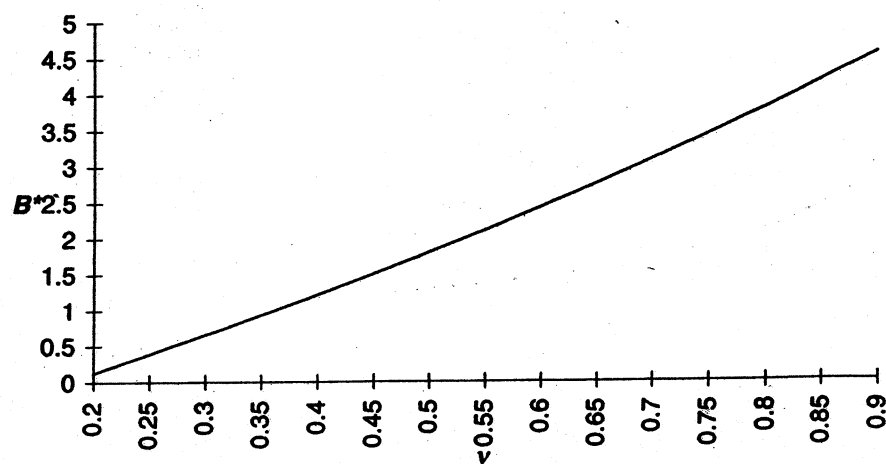
(g) Mean of distribution for operating income



(h) St. deviation of distribution for operating income



(i) Rate of dividend deduction



Figures 2.1 (g-h) depict the relationship between the optimal debt level and, respectively, the first two moments of the probability distribution for the firm's operating income. It turns out that in this model, under the particular assumption of a normal distribution, an increase in the expected cash flow raises the optimal debt level. This is consistent with the results obtained in models taking the firm's investment policy as fixed. The intuition is that positive shocks to the firm's operating income require that larger sums be shielded from tax authorities. Other things being equal, the firm then must issue more debt.⁴³

Let us next consider a 'profitable' firm with a relatively high marginal return on capital. The parameters are otherwise identical to the base case simulation except for the random operating income of the firm (table 2.3). The nonstochastic component of the rate of return on investment for a 'profitable' firm is assumed to be 10 per cent as opposed to 5 per cent for a 'nonprofitable' firm.⁴⁴

⁴³ Recently Unni (1994) has shown that the relationship between cash flow improvements and optimal borrowing is in fact not that straightforward in tax models. The sign of the relationship depends on the exact form of the probability distribution and the way in which the distribution is altered. By defining a class of probability distribution shifts, Unni is able to establish an unambiguously positive relationship between current cash flow and current borrowing. However, Unni demonstrates further that when tax-loss carry-forwards are allowed the relationship between future cash flow and current borrowing is negative. The intuition is that when the firm anticipates an improvement in future cash flow, it rationally also anticipates an increase in future borrowing. In this case, the probability of the firm being able to utilize the tax shield of current interest payments in the event that these payments must be carried forward is lowered, thus reducing the optimal current borrowing.

⁴⁴ Due to the fact that the nonstochastic rate of return is increased as compared with the 'nonprofitable' firm, a small technical adjustment is also made in the mean of the distribution (α is reduced from 1.1 to 1). In this case, the optimal probability of tax exhaustion implied by the assumed parameter values is about 19 per cent. The parameters also imply that the steady-state debt-to-firm-value ratio is about 87 per cent in book value terms but only about 29 per cent in real value terms.

Table 2.3. Parameter values assumed for a 'profitable' firm in the simulations

$f(K)$	$0.1K + \tilde{\alpha} \ln(K+1)$
$f_K(K)$	$0.1 + \tilde{\alpha} / (K+1)$
$f_{KK}(K)$	$-\tilde{\alpha} / (K+1)^2$
α	$\tilde{\alpha} \sim N(1, 1)$
r	0.1
τ	0.4
m_b	0.5
z	0.25
m_d	0.5
δ	0.1
Δ	0.3
v	0.5

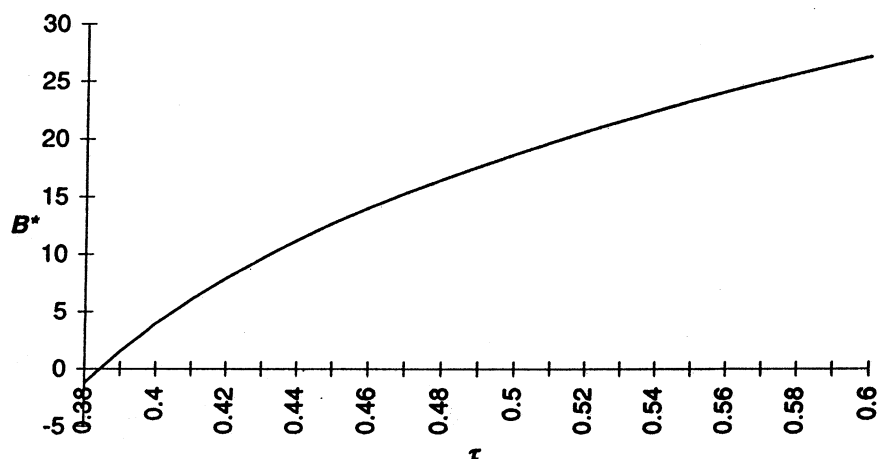
Results of the simulation are depicted in figures 2.2(a-i). Figure 2.2(f) confirms that the optimal debt level is now unambiguously an increasing function of *NDTS*. Furthermore, as depicted in figure 2.2(d), the relationship between the interest rate and the optimal debt level turn out to be more in line with the conventional wisdom in the case of a 'profitable' firm than in the case of a 'nonprofitable' firm.

The effects of the other exogenous variables on the debt level with an indeterminate sign in table 2.1 turn out to be the same for 'profitable' as for 'nonprofitable' firms. These results appear to be quite robust to the assumed parameter values and to assumptions about the firm's technology.⁴⁵

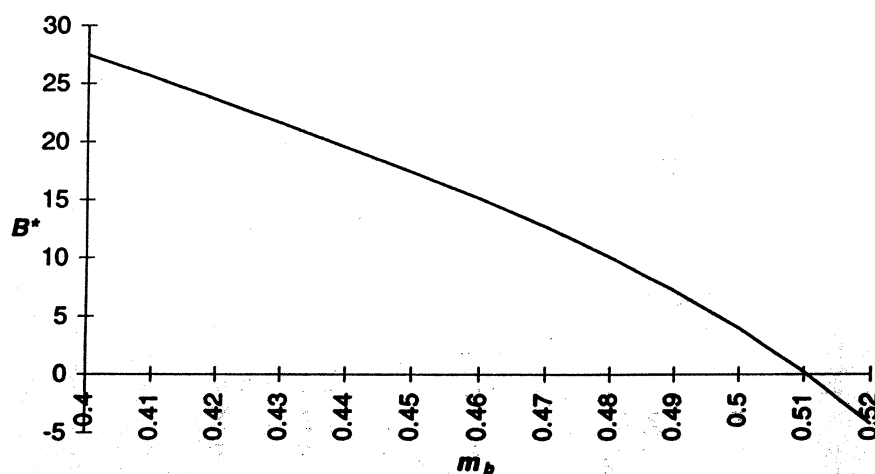
⁴⁵ Robustness of the results has been verified by employing a number of different functional forms for the firm's technology.

Figure 2.2 (a-c) Simulation results for a 'profitable' firm

(a) Corporate income tax rate



(b) Personal tax rate on interest income



(c) Personal tax rate on capital gains

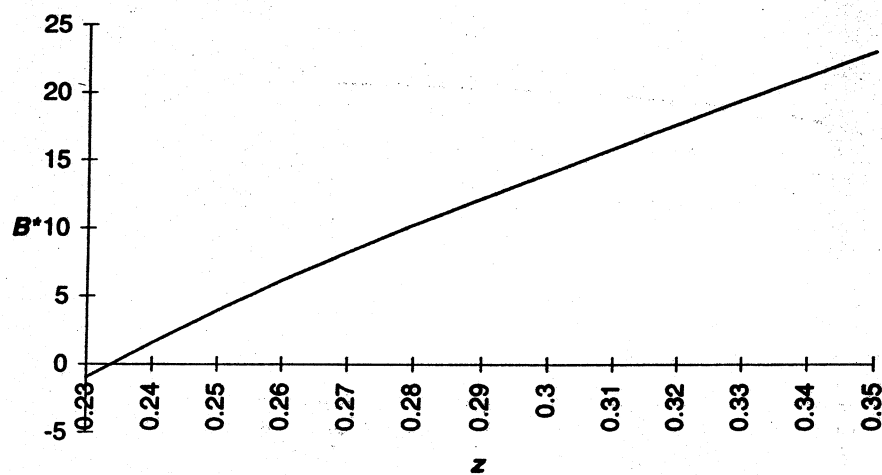
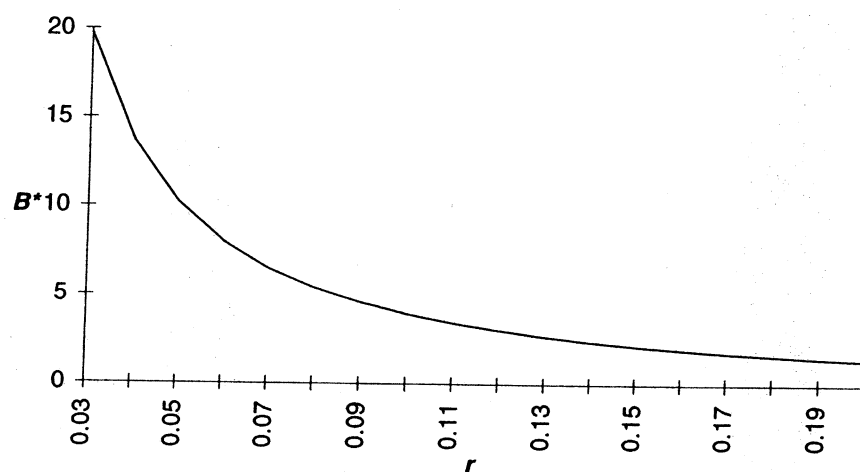
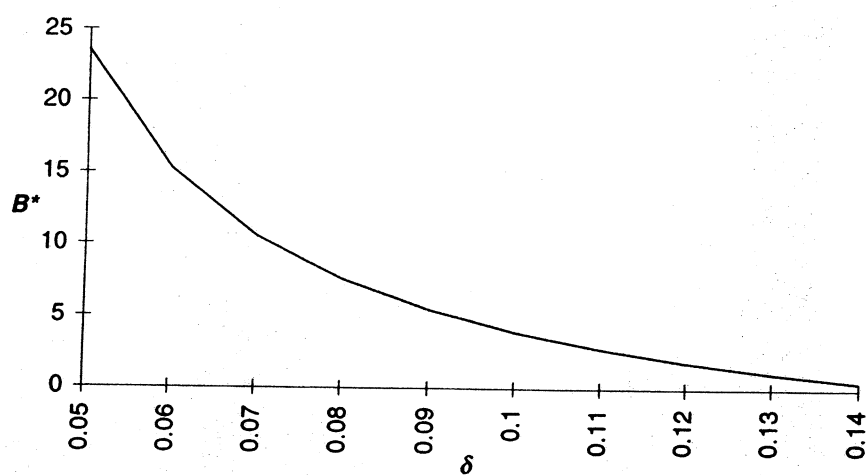


Figure 2.2 (d-f) Simulation results for a 'profitable' firm

(d) Interest rate



(e) Rate of economic depreciation



(f) Nondebt tax shields

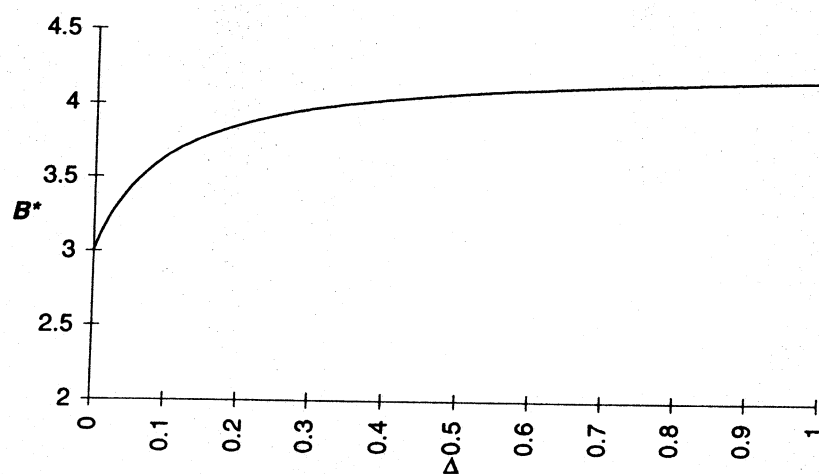
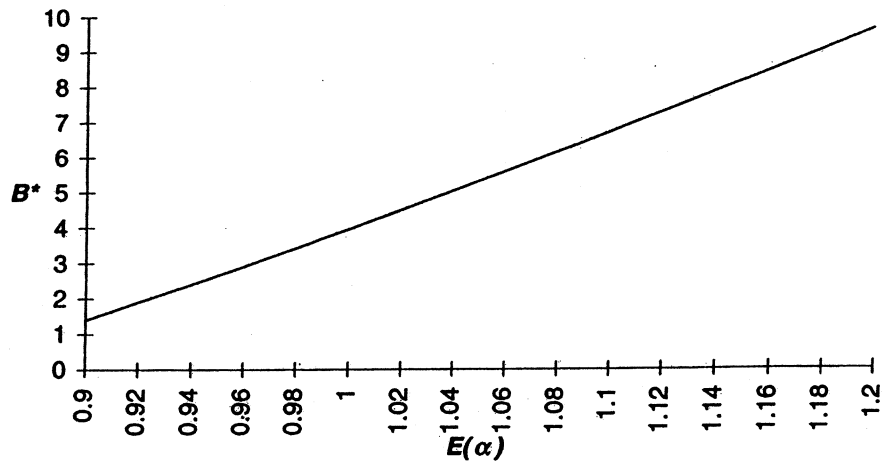
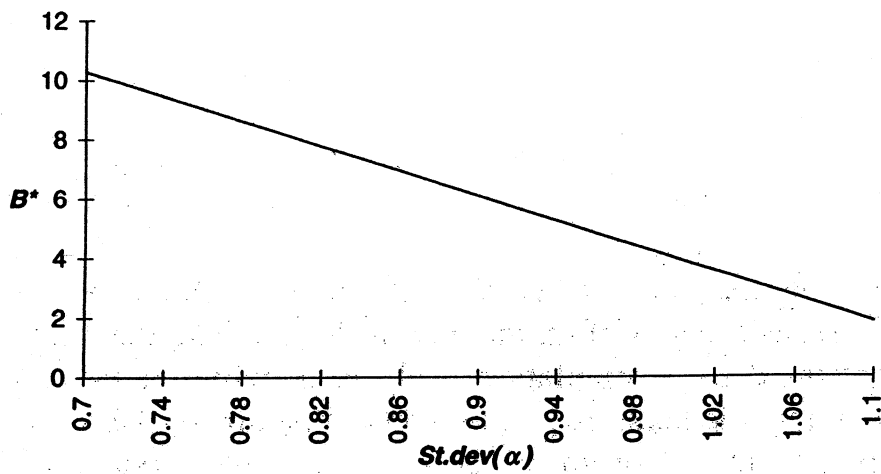


Figure 2.2 (g-i) Simulation results for a 'profitable' firm

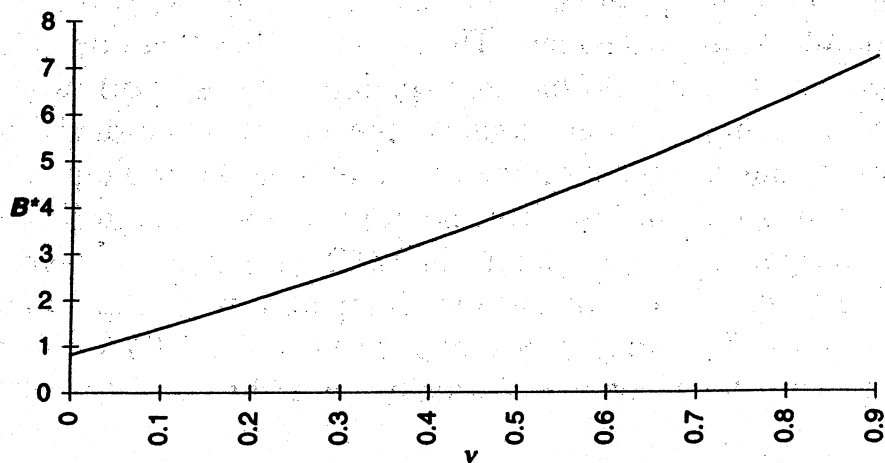
(g) Mean of distribution for operating income



(h) St. deviation of distribution for operating income



(i) Rate of dividend deduction



2.6 Summary of theoretical analysis

In this chapter we have analysed a dynamic model of the firm's investment and financial policy under uncertainty. The theoretical analysis has shown that by allowing for uncertainty and the existence of tax exhaustion, an internal financial optimum for a firm may be established by tax considerations alone, without having to resort to institutional constraints. In the model, the firm uses financial policy to establish an expected corporate tax rate that is equal to exogenously determined parameters.

The comparative static properties of the model were analysed assuming that an internal financial optimum is attainable. Due to endogeneity of both the financial and investment policy of the firm, there were conflicting substitution and income effects at play and the analytical results with respect to the firm's optimal debt level remained mostly indeterminate. However, it was possible to prove analytically that firms' borrowing responses to changes in the available nondebt tax shields (*NDTS*) should vary according to their (marginal) profitability. In particular, it was shown that a 'nonprofitable' firm (in the sense that its expected return on marginal investment is relatively low) should lower its debt level as a result of an increase in *NDTS*, while a 'profitable' firm (in the sense that its expected return on marginal investment is relatively high) should raise its debt level as a result of an increase in *NDTS*. The theoretical result was confirmed by a simulation analysis in which a two-rate system of capital income taxation and two sets of parameter values for the firm's investment opportunity set were assumed: one for a 'nonprofitable' firm and the other for a 'profitable' firm.

The simulation analysis revealed several interesting side results. First, corporate borrowing turned out to be highly sensitive to variations in statutory tax parameters. The result implies that clientele effects may play a significant role in explaining firms' borrowing decisions. Secondly, the rate of economic depreciation also turned out to have a relatively large impact on the firm's optimal borrowing and hence the asset type (more or less depreciable) may have a significant impact on debt usage. Finally, variations in *NDTS* turned out to have a relatively modest impact on borrowing compared with the other exogenous variables. This may partly explain why the *NDTS* effect has been so difficult to uncover empirically, in addition to the fact that the sign of this effect should vary according to the profitability of the firm.

3 Financing of Finnish companies

It is a well-known fact that there are differences in the structure of different countries' financial systems. According to the conventional wisdom, banks have played a central role in the financing of companies in the continental European countries and Japan, while in Anglo-Saxon countries securities markets have been relatively more important in allocating financing to the corporate sector.

However, a recent comparative study of the industry financing of eight developed countries⁴⁶ by Mayer (1990) revealed the following stylized facts. Retentions are the dominant source of financing in all the countries, but there are nevertheless significant cross-country differences in retention rates. The role of retentions is greatest in the UK and US. On a net basis, the role of securities markets in allocating financing to the corporate sector is small in every country. Securities markets have the greatest role in Canada and the US. Bank loans are the dominant source of external financing in all countries. Bank financing plays the greatest role in France, Italy and Japan, but its role is surprisingly small in Germany.⁴⁷

For Finland, Mayer's analysis reports figures calculated over the period 1975-1984. Mayer's results place Finland in the same category as France, Italy and Japan with a relatively large role for external financing, and loans especially. According to the company accounts data employed by Mayer, the average financing proportions for Finnish nonfinancial corporations over the period 1975-1984 were approximately: retentions 42 per cent, debt 55 per cent and equity 4 per cent on a gross basis, and retentions 68 per cent, debt 36 per cent and equity -2 per cent on a net (of equivalent financial assets) basis.⁴⁸

Another recent study that examines corporate financing patterns in Finland is Kanninen (1991a). Kanninen employs company accounts data on a total of 46 listed nonfinancial companies over the years 1983-1987. The reported average gross financing proportions are approximately retentions 60 per cent, debt 30 per cent and equity 10 per cent. In comparing these results with those obtained by Mayer, Kanninen's results thus imply that listed companies are more highly self-financed than Finnish nonfinancial corporations on average.

⁴⁶ Canada, Finland, France, Germany, Italy, Japan, the UK and the US.

⁴⁷ Similar conclusions about the insignificance of bank loans in the financing of German industry have subsequently been drawn by Edwards & Fischer (1994). Nevertheless, banks do have a great influence in the German corporate sector.

⁴⁸ Due to statistical adjustments of -1 per cent and -2 per cent, respectively, the gross and net financing proportions do not add up to 100 per cent.

However, it should be noted that the difference may be entirely due to the fact that Kanninen's sample period coincides with a relatively favourable business cycle in Finland.

In analysing corporate financing patterns there are basically two sources of data available, national flow-of-funds statistics and company accounts data. The merits and shortcomings of these sources are analysed in detail in Mayer (1990). National flow-of-funds statistics describe flows of capital between different sectors of the economy, netting out intracorporate sector flows but excluding cross-border capital flows. Their coverage is basically comprehensive, but due to the fact that they are collected from a number of different sources, a statistical adjustment is normally required to reconcile entries. Company accounts data, on the other hand, describe all flows to and from individual companies, including cross-border capital flows. However, consistent company accounts data are usually only available for a limited number of firms and over a limited time period. Therefore, the netting of intracorporate sector flows may be inadequate when company accounts are employed. In this study we employ both the flow-of-funds statistics and company accounts data in analysing the financing patterns of Finnish corporations. The company accounts data used here pertain to the manufacturing sector and they are constructed by Statistics Finland.⁴⁹

Furthermore, most traditional studies analysing corporate financing patterns use stock data from company accounts. A problem with this approach is that the book values of both physical capital stock and equity may substantially underestimate their true values. The magnitude of the problem depends on accounting conventions. It may be noted that the problem is especially severe in Finland where tax legislation has been rather liberal in allowing accelerated depreciation schedules. In this chapter we focus on financing flows instead of stocks in order to mitigate these problems.

3.1 Institutional background

The financial system in Finland is similar to those in continental Europe and Japan in that banks have traditionally played a significant role in companies' financing. This is largely because bank intermediation has been subsidized through tax exemption of deposit interest income. Moreover, a high degree of regulation in the form of

⁴⁹ Financial statements statistics. Details of the data collection procedure applied by Statistics Finland in constructing the financial statements statistics are explained in appendix 3.

credit and interest rate rationing was a dominant feature of the Finnish financial markets until the early 1980s. It may be noted, however, that during this period the manufacturing sector, and the export sector in particular, was in a better position than the other sectors of the economy. Public authorities explicitly favoured manufacturing companies in their regulations concerning both the allocation of scarce capital and interest rates.⁵⁰ Furthermore, it may be added that in the corporate sector regulation hit most severely small and medium-sized companies whereas large companies having close relationships with one or more of the largest banks did not find it so difficult to obtain low-cost financing for their investments.

In Finland as well as in many other western countries, financial markets were deregulated in the 1980s.⁵¹ Deregulation brought about an abundance of capital but also higher interest rates. Regulations concerning banks' average lending rates were gradually eased from 1982 onward, and in 1986 they were abolished altogether. Restrictions on short-term foreign borrowing were also eased, for the banking sector in 1980 and then gradually for the corporate sector. In 1987 the restrictions on firms' long-term borrowing (maturity at least five years) in foreign currency were abolished. In 1989 the minimum maturity of foreign currency loans was shortened to one year and in 1991 the remaining restrictions on short-term cross-border capital movements were abolished.

As a result of the liberalization of cross-border capital flows, a large amount of foreign capital was imported into Finland in the latter half of the 1980s. Later on, the active borrowing in foreign currency led to severe problems in the domestic corporate sector when the Finnish markka had to be devalued by 12.6 per cent in November 1991. The cost of domestic borrowing was gradually increased already in the late 1980s in an attempt to slow down the accelerating growth. Furthermore, in 1991-1992 domestic interest rates had to be raised to record high levels to defend the markka in repeated speculative attacks. Finally, in September 1992 the Finnish markka was floated, after which it initially depreciated further, exacerbating the situation in the domestic sector.

During the rationing period, possibilities for short-term financial investments were virtually nonexistent and therefore firms' cash reserves were mainly placed in bank current accounts paying zero interest. With negative real interest rates, it was not surprising that an intracorporate sector 'grey money market' emerged around the end of

⁵⁰ Regulated interest rates were allowed to vary across industries.

⁵¹ More comprehensive descriptions of the deregulation of financial markets in Finland can be found eg in Vesala (1995) and Vihriälä (1997).

the 1970s. Securities markets, being highly illiquid, played only a marginal role in Finland until 1987. Short-term funds gradually found their way into banks' balance sheets and in 1987 a functioning short-term money market was finally established. In contrast to most other western countries, the Finnish short-term money market was based on certificates of deposit (CDs) issued by banks. For nonfinancial corporations, the short- and medium-term securities market still provided little funding.

The role of the stock market was moderate throughout the 1970s and early 1980s. Fast growth and the large amounts of foreign capital that were imported into Finland in the latter half of the 1980s resulted in accelerating increases in the values of all assets, including shares, and in 1987-1990 the stock market experienced a short but vigorous boom. The increased activity in the stock market encouraged companies to acquire more funding through new equity issues. However, it may be noted that the most active equity issuers were the two major commercial banks operating in Finland at the time, Kansallis-Osake-Pankki and Union Bank of Finland. The stock market boom ended with the halving of the market capitalization of the Helsinki Stock Exchange in 1991-1992 when the Finnish economy was hit by the recession.

Although the basic structure of the system of capital income taxation remained the same throughout the 1980s (the two-rate dividend deduction system), some adjustments were made in connection with deregulation of the financial markets. In particular, in 1986 the rate of corporate tax was lowered (from 60 per cent to 50 per cent) but at the same time reserve practices were tightened and the effective capital gains tax rate was increased. These were the first measures that were taken with the aim of reducing statutory tax rates and broadening the tax base. In 1990 a major tax reform was undertaken in which the old two-rate system was abandoned and a new imputation, or *avoir fiscal*, system was introduced.⁵² The statutory rate of corporate tax was further lowered, in 1990 to 42 per cent, in 1991 to 40 per cent and in 1992 to 36 per cent. One of the main objectives of the 1990 tax reform was to eliminate the double-taxation of dividends but at the same time to ensure that all dividend income would be taxed at least once. In 1990-1992 dividends were subject to the marginal income tax rate of the investor.

Later on, in 1993 a new reform was undertaken in which Finland switched to a dual income tax system and income was divided into

⁵² Since the focus of this study is on the period prior to the major tax reform, we do not present a detailed description of the reform. A comprehensive analysis of the tax reform can be found in Myrman, Kröger, Rauhanen, Junka, Kari & Koskenkylä (1995).

capital income and earned income. The capital income tax system was greatly simplified in that all tax rates on capital income as well as the corporate income tax rate were set at the same level, 25 per cent.⁵³ Furthermore, corporations were no longer subject to municipal income tax. On the other hand, almost all reserve provisions that could be used to adjust corporations' taxable income were abolished.

Work on the 1990 tax reform was carried on throughout the late 1980s and the legislation in which the details of the reform were finally approved was passed by Parliament in December 1988. Thus it may be argued that Finnish companies started adjusting to the new institutional environment already in the late 1980s. However, due to the simultaneous deregulation of the financial markets and the exceptionally strong boom-bust cycle of the Finnish economy, it is unlikely that the effects of the tax reform can be separated in aggregated data over this period.

The analysis in this study is restricted to the ten-year period 1982-1991. Therefore it includes the period of financial market deregulation and the rapid credit expansion in the late 1980s but excludes the years of severe recession that followed in the early 1990s. Signs of the forthcoming recession are however reflected in the figures for 1990 and 1991.

3.2 Financing patterns in the nonfinancial corporate sector

Let us first take a look at the aggregate financing patterns of the Finnish nonfinancial corporate sector by analysing the national flow-of-funds statements over the ten-year period 1982-1991.⁵⁴ These data describe financing flows to and from the nonfinancial enterprise sector of the economy and hence present a picture of the different means employed in the sector as a whole in the financing of investments. The figures are recorded on a gross as well as net (of accumulation of equivalent financial assets) funding basis. Net financing proportions are the relevant figures in describing how the nonfinancial corporate sector as a whole has raised financing.

⁵³ There were some transitional provisions for the taxation of interest income. The new system finally went into effect in 1994 when the withholding tax on interest income was raised to 25 per cent.

⁵⁴ The time period was chosen to coincide with that for the company accounts data employed in the econometric analysis in this study.

The financing proportions are aggregated over different time periods using a weighted average of proportions for individual years. Simple averages of individual-year proportions do not take into account the amounts of financing raised and thus put too much emphasis on years with only small amounts of total funds raised. Weighted averages have been created by revaluing flows of different classes of financing at constant (1980) prices and then aggregating these flows before calculating ratios. The producer price index was used as the deflator.⁵⁵ Results are reported in tables 3.1 and 3.2.

On a gross funding basis, debt is the dominant source of financing with a proportion of some 50 per cent of total funds raised over the period 1982-1991. Retentions make up some 35 per cent and new equity some 15 per cent of total funds. The role of securities markets appears to be small. In total, only some 6 per cent of debt financing has been raised via securities markets. On a net funding basis, retentions appear to be the most preferred form of financing for the Finnish nonfinancial corporate sector, with some 60 per cent of fixed investment being self-financed. The proportion of debt financing is some 40 per cent and new equity issues have played only a marginal role.

Loans from financial intermediaries and pension funds are the dominant source of external financing. On a net basis, half of all fixed investment in the latter part of the 1980s was financed by loans. This figure is very large indeed and compares well with the proportion of bank loans in the financing of the nonfinancial sector in Japan.⁵⁶ It should however be noted that in Finland loans from pension funds have traditionally played a big role in the financing of companies and these loans are likely to make up a significant proportion of this figure. Moreover, the large inflow of foreign capital into Finland that followed the deregulation of the late 1980s was primarily channelled through the banking sector to the Finnish corporate sector. This explains why the role of the banking sector may have increased initially after deregulation.

⁵⁵ The capital goods price index and the consumer price index were used as alternative deflators. The choice of a deflator had a negligible effect on the results.

⁵⁶ See Mayer (1990).

Table 3.1 Weighted average gross financing of the nonfinancial corporate sector, 1982-1991, proportion of total funds

	1982-1991	1982-1986	1987-1991
Retentions	36.5	41.4	33.5
New equity	14.7	12.4	16.1
Debt	53.3	51.0	54.6
Loans	40.1	33.1	44.3
Bonds	4.2	5.8	3.3
Short-term securities	1.9	1.9	1.8
Trade credit	5.1	9.9	2.3
Other	2.0	0.4	3.0
Statistical adjustment	-4.5	-4.8	-4.2
Total	100.0	100.0	100.0

Notes: Numbers are percentages. Capital transfers are included in retentions. Loans include loans from financial intermediaries (banks, insurance companies) as well as loans from pension funds.

Source: National Accounts, flow-of-funds statistics.

Table 3.2 Weighted average net financing of the nonfinancial corporate sector, 1982-1991, proportion of capital expenditures and stock building

	1982-1991	1982-1986	1987-1991
Retentions	60.1	68.8	54.6
New equity	3.2	4.8	2.1
Debt	42.3	34.0	47.5
Loans	48.9	39.9	54.6
Bonds	5.1	9.5	2.3
Short-term securities	-2.5	-0.1	-4.0
Trade credit	-0.4	-2.3	0.8
Other	-8.8	-13.1	-6.1
Statistical adjustment	-7.7	-8.1	-7.4
Total	97.8	99.5	96.8

Notes: Numbers are percentages. Capital transfers are included in retentions. Loans include loans from financial intermediaries (banks, insurance companies) as well as loans from pension funds.

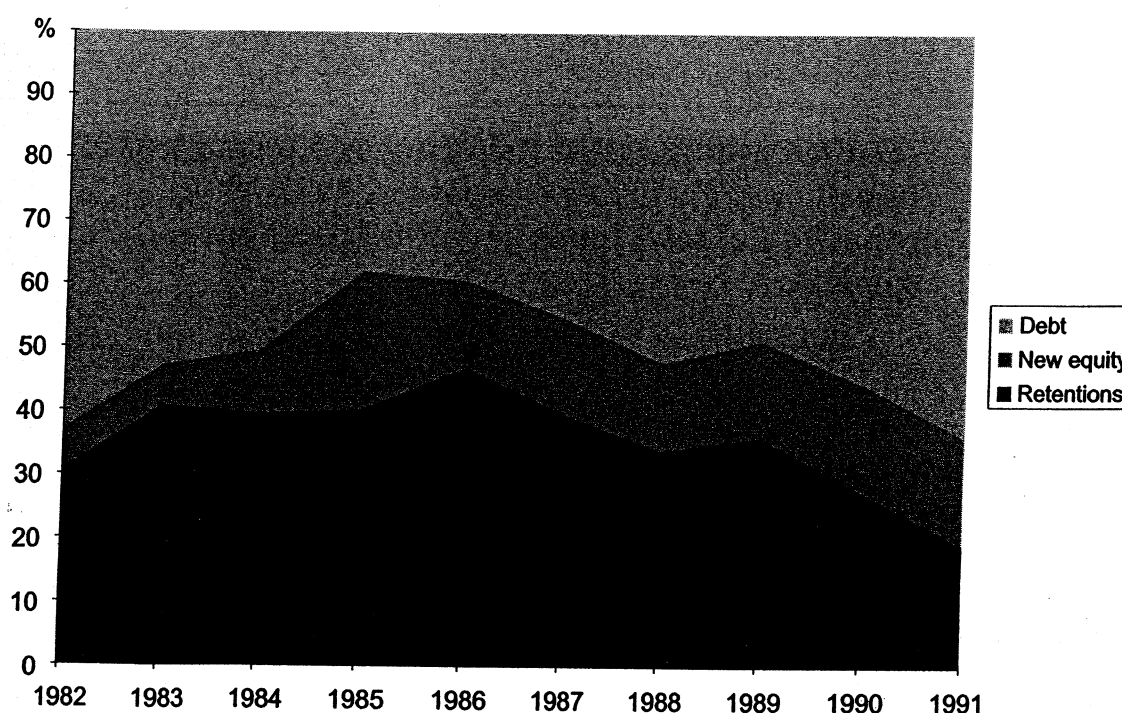
Source: National Accounts, flow-of-funds statistics.

Results in tables 3.1 and 3.2 are in line with those reported for Finland in Mayer (1990). The financing proportions, especially in the first half of the 1980s, appear to be very similar to Mayer's results. The most notable difference is in the role of new equity issues. Our results suggest that new equity issues play a greater role than suggested by the findings of Mayer. This is intuitively acceptable, taking into account the difference in the sample periods. The role played by the equity market increased throughout the 1980s. It is interesting to note, however, that although in the latter part of the sample period the proportion of new equity issues increases on a gross funding basis, on a net basis the contribution of new equity issues actually decreases. There are two explanations for this result. First, it is apparent that the Finnish nonfinancial corporations increased their cross-holdings in the late 1980s. Secondly, the most active equity issuers were the major commercial banks and, due to the Finnish tradition of collecting a group of companies from various industries under the influence of one of the largest banks, the companies in the group may have been more or less obliged to invest in the equity issues of banks.

Figure 3.1 reports gross financing proportions for individual years over the sample period.⁵⁷ As shown in the figure, there is some variation in the individual-year proportions. Following the economic cycle, debt usage is the highest at the beginning and end of the sample period. Interestingly, the proportion of new equity financing increases significantly already in 1985 and remains at roughly the same level throughout the rest of the sample period. Signs of the forthcoming recession are clearly visible in the decline of self-financing proportions in 1990 and 1991. Although not reported here, it might be noted that the net contribution of debt financing ranges from just 20 per cent in 1988 to about 80 per cent in 1990.

⁵⁷ Due to wide year-to-year variation, the calculation of net financing proportions is meaningful only over a number of years. Therefore, we only report individual-year figures on a gross funding basis. Note that the financing proportions in the graph have been corrected by the statistical adjustment so that their sum equals 100 per cent in each year.

Figure 3.1 Gross financing proportions for the nonfinancial sector, 1982-1991



3.3 Financing patterns in the manufacturing sector

Let us next employ company accounts data to shed additional light on the financing behaviour of Finnish manufacturing companies over the period 1982-1991.⁵⁸ The company accounts data that we employ are constructed by Statistics Finland on an individual firm basis and are extrapolated to industry levels. The data collection procedure applied by Statistics Finland as well as details of the construction of the variables are presented in appendix 3.

As in the previous section, the figures are recorded on a gross as well as net (of accumulation of equivalent financial assets) funding basis and the financing proportions are aggregated over different time periods using a weighted average of individual-year proportions. Weighted averages have been calculated by revaluing flows of different classes of financing to constant (1980) prices and then aggregating these flows before calculating ratios. The producer price

⁵⁸ Notice that the flow-of-funds statistics pertain to the whole nonfinancial sector whereas the company accounting data employed in this study pertain to the manufacturing sector alone.

index is used as the deflator. Results are reported in tables 3.3 and 3.4.

Table 3.3 Weighted average gross financing and investment of Finnish manufacturing companies, 1982-1991, proportion of total funds and of total capital expenditure respectively

	1982-1991	1982-1986	1987-1991
Retentions	43.7	55.2	37.9
New equity	11.4	6.4	13.9
Debt	45.0	38.4	48.2
Short-term debt	16.2	9.1	19.7
Long-term debt	28.8	29.3	28.5
Interest-bearing debt	38.3	35.6	39.6
Bank loans	18.7	19.1	18.4
Trade credit	-1.1	-2.2	-0.5
Total	100.0	100.0	100.0
Fixed investment	69.4	76.7	65.5
Stock building	-2.5	-4.3	-1.6
Financial investment	33.2	27.6	36.1
Total	100.0	100.0	100.0

Notes: Numbers are percentages. Bank loans include loans from banks and insurance companies (excl. pension funds). Fixed investment is measured net of sales (including capital gains) of fixed assets. Accordingly, capital gains from sales of fixed assets are not included in retentions.

Source: Statistics Finland, the financial statements statistics.

Table 3.4 Weighted average net financing of Finnish manufacturing companies 1982-1991, proportion of capital expenditures and stock building

	1982-1991	1982-1986	1987-1991
Retentions	65.4	74.4	60.2
New equity	16.9	8.5	21.9
Debt	17.9	13.8	20.3
Short-term debt	6.7	-8.4	15.5
Long-term debt	11.2	22.2	4.8
Interest-bearing debt	21.7	20.9	22.2
Bank loans	19.0	11.7	23.2
Trade credit	-2.5	-6.6	-0.1
Total	100.2	96.6	102.3

Notes: Numbers are percentages.

Source: Statistics Finland, the financial statements statistics.

Gross financing figures give a similar picture to that obtained from the flow-of-funds statistics with the exception that retentions appear to play a greater role in the manufacturing sector than in the other nonfinancial sectors. The proportion of retentions is almost equal to the proportion of debt financing on a gross funding basis, both being approximately 45 per cent. New equity appears to have contributed some 10 per cent of total funds raised by the manufacturing sector in the 1980s.

On a net funding basis, retentions are clearly the dominant source. The net financing proportions show a considerable difference in the role that debt has played in the financing of the manufacturing sector as compared with the nonfinancial sector as a whole. The results suggest that there are significant differences in financing behaviour between different industries. In particular, the manufacturing sector appears to be more self-financed and to employ less debt than the other nonfinancial sectors — construction, trade and services. The difference is more pronounced on a net funding basis, reflecting in part the fact that the manufacturing sector is a supplier of credit to the other industries in the nonfinancial sector.

Company accounts also enable a more detailed breakdown of debt into its components. On a gross funding basis, both the proportion of

long-term debt and loans from financial intermediaries appear to be quite robust throughout the sample period. The share of loans from financial intermediaries is approximately half of all interest-bearing debt on a gross funding basis, although the share decreases significantly in the latter half of the sample period. The increase in debt usage in the latter half of the 1980s appears to be due to an increase in short-term debt only.

On a net funding basis, firms in the manufacturing sector appear to have first increased their cash holdings in the growth period of the early 1980s and subsequently reduced them and resorted to short-term borrowing in the latter half of the 1980s. Moreover, an interesting point is that in the latter half of the 1980s, the period of financial market deregulation in Finland, the importance of loans from financial intermediaries in fact increased as a source of financing. A similar result is obtained from the flow-of-funds statistics. However, it may be noted that the proportions of loans as reported in tables 3.3 and 3.4 are not directly comparable with those obtained from the flow-of-funds statistics in tables 3.1 and 3.2 because of differences in the construction of the variables. In the flow-of-funds statistics, loans from pension funds cannot be distinguished from loans from financial intermediaries. Therefore company accounts data, by excluding loans from pension funds, provide stronger evidence of a stable role of financial intermediaries. Since many foreign currency loans to Finnish companies were channelled through the banking sector, the results suggest that currency loans intermediated by banks were used mainly to substitute for existing markka-denominated bank loans.

Tables 3.3 and 3.4 reveal a strikingly high proportion of new equity issues, both on a gross as well as net funding basis in the latter half of the sample period. The figures reflect the fact that the latter half of the 1980s was an active period of mergers and acquisitions in Finland. Furthermore, around the turn of the decade there was a 'restructuring boom' among the large manufacturing companies. In the balance sheets of the acquiring companies, the shares of acquired firms are included in fixed assets and hence they are not netted out against new equity issues in the figures reported in table 3.4.⁵⁹

⁵⁹ In 1987-1991, the weighted average proportion of investment in 'shares and holdings' of total fixed investment was as high as 40 per cent in the manufacturing sector. If one were willing to treat these as financial investments and net them out against corresponding issues of new equity over the period, then the weighted average net financing proportions of the manufacturing sector over the period 1987-1991 would be as follows: retentions 103 per cent, new equity -33 per cent, debt 35 per cent. A large part of this is explained by the 'restructuring boom' around the turn of the decade, during which a number of large manufacturing companies restructured themselves into separate smaller companies, many of which were classified into sectors other than the manufacturing sector. In addition, the figures may also reflect the fact that manufacturing companies were active acquirers of companies in other sectors.

The more detailed breakdown of net financing figures ought to be interpreted with caution. On the basis of the available data, it is difficult to separate eg interest-bearing financial assets from noninterest-bearing financial assets.

Figure 3.2 Gross financing proportions for the manufacturing sector, 1982-1991

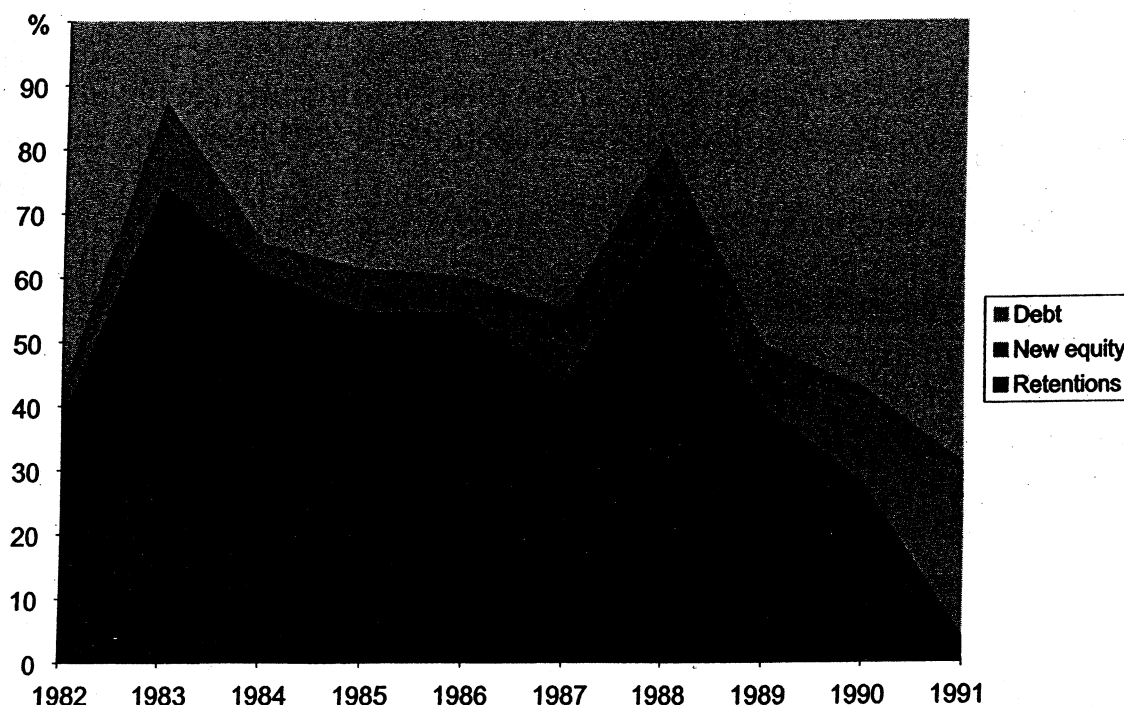


Figure 3.2 reports individual-year gross financing proportions for the manufacturing sector over the sample period. The volatile nature of the Finnish manufacturing sector is clearly visible in the figure when compared with the individual-year gross financing proportions for the whole nonfinancial sector in figure 3.1. In 1991 the decline in the proportion of internally generated funds is extremely steep and falls to close to zero. On the other hand, both in 1983 and 1988 the proportion of retentions was as high as some 70 per cent of total funds raised by the manufacturing sector. It is also interesting to note that the proportion of new equity issues is relatively steady throughout the 1980s and does not increase until in 1990 and 1991.

3.4 Interfirm differences in financing and investment in the Finnish manufacturing sector

In this section we provide somewhat more detailed descriptive evidence of the financing and investment behaviour of Finnish manufacturing companies. In particular, we examine how financing, investment and other characteristics vary across different types of companies according to size, use of nondebt tax shields and industry. The results are based on a sample of individual company accounts from the financial statements statistics collected by Statistics Finland. The same sample is employed in the econometric analysis in the next chapter of the study.

The raw sample is composed of company accounting records of a total of 623 Finnish manufacturing companies over the time period 1978-1991. Due to the estimation method in the econometric analysis, the basic criterion for including observations in the raw sample was that at least five years of consecutive data should be available. Because of this requirement, it is likely that our sample includes a disproportionate number of large companies. Moreover, observations with exceptionally large annual changes in total assets or sales were excluded from the final sample. The data and the sampling procedure are explained in more detail in appendix 3.

Statistics Finland classifies companies into manufacturing subsectors according to the activity for which the aggregate value added is the greatest. The financial statement statistics use a 3-digit application of the industrial classification. For the purposes of our study, the companies were reallocated into nine subsectors of manufacturing. Table A3.2 in appendix 3 shows how the companies are distributed across different manufacturing subsectors.

Table 3.5 presents summary statistics for the sample. Results are reported for years 1982-1991 in order to coincide with the time period of the econometric analysis in the next chapter.⁶⁰ As in the previous sections of this chapter, the reported figures are constructed by first aggregating the flows (in 1980 prices) across all sample firms before calculating ratios. Therefore the figures must be interpreted as telling us how the sample firms as a consolidated company would have

⁶⁰ In the econometric analysis the first four years of data are lost due to use of a one-period lagged scaling variable, taking first differences and using a minimum lag of order two for the instruments in the estimation. In the descriptive analysis dropping the first four years of data provides the advantage that the estimated real value of the firms' capital stock is more accurate.

raised and used financing. It is obvious that the results in column 1 (full sample) reflect primarily the characteristics of the largest companies in the sample, but this method of calculation enables a direct comparison between the results obtained from the sample firms and those obtained from the manufacturing sector as a whole.

An alternative approach would be to calculate the figures as simple averages of individual firm-year ratios, thus giving each observation equal weight. However, the volatile nature of our sample period combined with our aim to focus on flows instead of stocks make this approach questionable. For example, on a gross funding basis the simple average across all observations of the percentage of retentions (debt) is 87.4 per cent (6.0 per cent) with a standard deviation of 2276 per cent (2268 per cent). Still another approach would be to construct the statistics by first aggregating the flows across all observations pertaining to a single firm, then calculating firm-specific ratios and finally taking the simple average of these firm-specific ratios. This method mitigates the problem caused by the high volatility in individual-year flows and it also gives equal weight to each firm in the sample. However, it turns out that there remains too much variation also in these figures for them to be useful in giving a sufficiently reliable picture of the average characteristics of the sample firms. Calculated this way, the percentage of retentions (debt) of total funds is 16.3 per cent (79.4 per cent) but with a standard deviation of 973 per cent (973 per cent). Therefore, in this section interfirm differences are examined by calculating weighted averages over various subsamples of the data set.

Comparing the summary statistics of column 1 (full sample) in table 3.5 with the descriptive statistics in tables 3.3 and 3.4, concerning financing and investment for the whole population of Finnish manufacturing companies (as extrapolated by Statistics Finland), we note the following. On both a gross and net funding basis, the proportion of retentions is higher among the sample firms than among Finnish manufacturing companies on average. On the other hand, the sample firms appear to have issued considerably less new equity than the manufacturing sector as a whole. Furthermore, the sample firms appear to have invested a higher proportion of funds in fixed assets than the manufacturing companies as a whole. These results probably derive from our sampling procedure: the minimum requirement of five years of consecutive data biases our sample toward larger and financially healthier companies, and the exclusion of observations with large annual changes in total assets or sales removes from our sample those cases in which a firm is engaged in a major takeover or in large-scale restructuring.

Table 3.5 Weighted average summary statistics; full sample and sample split by size and tax exhaustion, 1982-1991

	Full sample	Small firms	Med. firms	Large firms	Tax exh.	Slightly tax exh.	Nontax exh.
Number of observations	3478	1079	1451	948	940	1347	1191
GROSS FINANCING:							
Retentions	58.9	52.5	64.1	58.5	18.9	68.9	73.8
Tax debt	8.2	23.8	14.2	7.2	1.7	10.4	10.2
New equity	6.2	3.6	5.5	6.3	8.3	6.6	4.4
Total debt	34.9	44.0	30.4	35.2	72.8	24.5	21.8
Short-term debt	12.7	20.8	11.5	12.7	19.7	8.4	12.6
Long-term debt	22.2	23.2	18.9	22.6	53.1	16.1	9.1
Interest-bearing debt	31.9	37.3	27.5	32.2	72.7	23.5	15.0
Bank loans	16.4	22.9	15.0	16.4	46.5	11	3.1
Trade credit	-0.7	2.8	-0.5	-0.8	-2.2	-2.9	2.3
NET FINANCING:							
Retentions	81.4	75.8	85.8	81.1	29.4	96.2	94.7
Tax debt	11.4	34.4	19.0	9.9	2.6	14.5	13.1
New equity	8.51	5.1	7.3	8.7	12.9	9.2	5.7
Total debt	10.4	29.7	8.3	10.2	64.5	-5.6	-2.9
Short-term debt	-2.4	31.1	9.4	-4.6	-18.1	-13.0	14.7
Long-term debt	12.8	-1.3	-1.1	14.8	82.6	7.4	-17.6
Interest-bearing debt	26.2	19.1	10.4	28.2	112.9	17.6	-10.1
Bank loans	18.7	33.3	19.8	18.3	69.1	0.5	9.3
Trade credit	-14.1	2.8	-6.7	-15.4	-46.2	-8.4	-3.0
Fixed investment	77.0	69.9	74.5	77.4	75.0	74.8	80.2
Stock building	-4.5	4.9	1.1	-5.3	-7.7	-3.3	-3.7
Financial investment	27.5	25.2	24.4	27.9	32.7	28.5	23.6
NDTS utilization rate	71.6	65.6	71.3	71.9	27.6	71.9	107.5
Taxes / (taxes + dividends)	43.3	47.3	43.1	43.2	30.6	41.3	50.3
Effective tax rate	19.3	25.1	20.8	18.8	-17.4	13.8	15.7
Total debt / BVA	68.2	70.1	67.7	68.2	75.6	67.0	63.6
Long-term debt / BVA	39.1	29.0	29.8	40.2	47.0	39.0	32.9
Short-term debt / BVA	29.1	41.2	38.0	28.0	28.6	28.1	30.7
Total debt / RVA	55.8	58.5	53.3	56.0	68.4	55.1	48.0
Long-term debt / RVA	32.0	24.2	23.4	33.0	42.5	32.1	24.9
Short-term debt / RVA	23.8	34.3	29.9	23.0	25.9	23.1	23.2
Fixed investment / K(t-1)	12.8	16.6	15.3	12.5	10.8	12.9	14.1
Cash flow (BT) / K(t-1)	13.0	20.5	17.3	12.5	7.7	15.4	14.4
Cash flow (AT) / K(t-1)	12.0	18.0	15.3	11.6	7.2	14.4	13.0
Payout ratio	11.9	17.1	16.7	11.1	27.4	11.1	9.5
Freq. of dividend payments	59.0	47.3	61.5	68.6	37.0	66.4	68.1
Freq. of new equity issues	10.2	4.7	8.2	19.5	11.4	10.5	9.0

Notes: Numbers are percentages.

BVA equals book value of total assets. RVA equals the replacement value of fixed assets plus book value of current assets. K(t-1) equals the beginning-of-period replacement value of fixed assets. Cash flow (BT) equals retentions plus dividends plus taxes plus interest expenses less estimated economic depreciation. Cash flow (AT) equals cash flow (BT) less taxes. Payout ratio equals the ratio of dividends to the sum of dividends and retentions. Effective tax rate equals the ratio of taxes to the sum of retentions, dividends and taxes less estimated economic depreciation.

In addition to the sources and uses of funds figures, table 3.5 also reports a number of other summary statistics calculated from the sample firms. First, the proportions of the firms' usage of tax debt are calculated. Tax debt equals the change in total reserves plus book depreciation less estimated economic depreciation, multiplied by the corporate tax rate.⁶¹ It should be noted that tax debt is included in retentions. On a gross funding basis, the estimated percentage of tax debt is 8.2 per cent; on a net funding basis 11.4 per cent. There are also three statistics in the table describing the sample firms' tax status. First, the utilization rate of nondebt tax shields (*NDTS*) equals the percentage of actually claimed book depreciation plus inventory undervaluation of their legally specified maxima. Thus the *NDTS* utilization rate reflects the degree of tax exhaustion of the sample firms: the lower the utilization rate, the more tax exhausted the company. Secondly, the proportion of taxes in the sum of taxes and dividends is a measure of the effective tax burden of the sample firms. Roughly speaking, under a uniform reporting requirement and for a given dividend policy, a tax-minimizing borrowing policy requires that this ratio be equal to the statutory corporate income tax rate.⁶² Thirdly, a measure of the sample firms' effective tax rate is calculated. This equals the ratio of current tax payments to the current economic profit. The economic profit is defined as retentions plus dividends plus taxes less estimated economic depreciation.

Moreover, several traditional stock measures of the firms' indebtedness are included in table 3.5. The stock of debt is given in relation to both the book value of total assets and the estimated replacement cost value of fixed assets plus the book value of current assets. It appears from the figures that while the book measure of leverage is nearly 70 per cent the leverage ratio drops to some 55 per cent when the undervaluation of the firms' capital stock is accounted for.⁶³ It may also be noted that even this latter figure is bound to overestimate the true leverage ratio for Finnish manufacturing companies since the sample period is not long enough to enable a truly accurate approximation of the replacement cost value of the firms' capital stock.

The weighted average investment rate of the sample firms is given by the ratio of fixed investment to beginning-of-period real capital stock. The next two statistics in the table are included to measure the rate of return on the firms' fixed investment, both before-

⁶¹ The applied economic depreciation rates are explained in appendix 3 in the description of the construction of the replacement cost value of the capital stock series.

⁶² Strictly speaking, the fact that firms can also pay dividends out of past accumulated accounting profits makes this a rather rough measure of the firm's effective tax burden.

⁶³ The figure is in line with that obtained in Lahdenperä (1983).

tax and after-tax. Total cash flow before taxes equals retentions plus dividends plus taxes plus interest expenses less estimated economic depreciation. Finally, three statistics concerning the firms' dividend and new equity policy are reported. The payout ratio is dividends divided by the sum of retentions and dividends, while the frequency of dividend payments and new equity issues equal the number of observations with positive values for dividends or new equity issues, respectively, divided by the number of total observations.

In order to shed some light on interfirm differences, we present the weighted average summary statistics based on various subsamples of the data. In columns 2-4 in table 3.5 the summary statistics are reported for the subsamples of small, medium-sized and large firms, respectively. Each observation on each firm is classified into one of the three size categories according to the estimated real value of the capital stock (1980 prices) at the beginning of the period. The observation is classified as small if the beginning-of-period real capital stock (K) is less than FIM 20 million, medium if K lies between FIM 20 million and FIM 100 million, and large if K is above FIM 100 million. It should be noted that a firm can move from one group to another as a result of changes in its capital stock.

Examining the summary statistics for the three different size categories of companies reveals the following stylized facts. The percentage of self-financing is highest among the medium-sized companies while small firms appear to resort most often to debt financing. Furthermore, the smaller the firm, the higher the proportion of short-term debt in total debt financing. The proportion of tax debt is relatively high among the small firms and, not surprisingly, its role appears to diminish with the size of the firm. It is in the beginning of the firm's life-cycle that tax debt is normally accumulated; in later periods it is repaid. Bank loans, especially on a net funding basis, appear to play an important role for small companies. The figures also reveal that on a net basis trade credit makes a slightly positive contribution to the financing of small companies whereas the net proportion of trade credit is significantly negative for large firms. This is likely to reflect the fact that a large proportion of small firms in the manufacturing sector operate mainly as subcontractors for larger companies. Therefore the large companies supply trade credit to smaller companies as well as to their customers in the other sectors of the economy.

There do not appear to be significant differences in the utilization rate of the nondebt tax shields between different sizes of firms. On the other hand, the two other tax status measures suggest that the effective tax burden is heavier for the small firms than for the

medium-sized and large firms. This is not surprising considering the fact that small firms are more likely to be in the early periods of their life-cycle and to have less freedom to manipulate the accounting profit than their more mature counterparts.

Neither the book measures nor corrected measures of leverage exhibit wide variation across different size categories of companies. The investment rate appears to be highest for the small companies and they also appear to yield the best return on investments. Interestingly, the frequency of dividend payments is lowest among the small firms and yet they have the highest payout ratio. Finally, the last row in table 3.5 reveals the expected result that the frequency of new equity issues increases with the size of the firm.

Finally, in columns 5-7 the summary statistics are reported for the subsamples of tax exhausted, slightly tax exhausted, and nontax exhausted companies, respectively. An observation is classified as tax exhausted if the ratio of currently claimed inventory undervaluation and book depreciation to their maximum allowed values (*URNDTS*) is less than 0.5, slightly tax exhausted if *URNDTS* lies between 0.5 and 0.9, and nontax exhausted if *URNDTS* is above 0.9. Here also, a firm may move from one group to another as a result of changes in its tax status.

The last three columns in table 3.5 reveal significant differences in the financing of companies with different tax status. In particular, the tax exhausted firms appear to rely very heavily on debt financing whereas on a net basis the slightly tax exhausted and non-tax exhausted firms appear to generate almost all financing internally. Furthermore, virtually all debt financing of tax exhausted firms appears to consist of interest-bearing debt. There are two possible explanations for this observation. First, the optimal probability of tax exhaustion may be firm-specific, due either to factors that are ignored in our theoretical model or to clientele effects that imply that different firms face marginal investors in different tax brackets. Secondly, the optimal probability of tax exhaustion may be uniform across firms, but due to the highly volatile nature of our sample period, shocks to the firms' cash flow require them to adjust borrowing over relatively long periods. This latter explanation refers to a feature of debt financing ignored in our theoretical model, namely its short-term role in absorbing shocks to the firm's cash flow.⁶⁴

The utilization rate of the nondebt tax shields for the tax exhausted firms is less than 30 per cent, suggesting that they have on

⁶⁴ It follows from the fact that firms are committed to their chosen investment programmes, together with the notion that new equity issues are seldom used as a source of funds, that retentions and debt as a proportion of total funds are almost perfectly negatively correlated.

average an extremely large 'expense stock'. Both the ratio of taxes to taxes plus dividends and the effective tax rate indicate that the effective tax burden is heavier among firms that do not have such a large 'expense stock'. The reported negative effective tax rate for tax exhausted firms does not indicate that the firms on average receive tax rebates during the periods of tax exhaustion. Rather, it is due to the fact that the financial performance of tax exhausted firms is so poor that the estimated economic profit is on average negative. It is also noteworthy that the ratio of taxes to taxes plus dividends for the tax exhausted firms appears to be lower than the statutory corporate income tax rate. This implies, not surprisingly, that tax exhausted firms that have to pay dividends pay them out of accumulated past accounting profits.

Both the investment rate and the return on investment for tax exhausted companies are considerably lower than those for the nontax exhausted companies. Furthermore, the percentage of financial investment is higher for tax exhausted companies than among nontax exhausted companies. Taken together, these figures suggest that tax exhausted companies have fewer profitable real investment opportunities and therefore invest relatively more in financial assets. Of course, it is difficult to say whether the tax exhausted companies have been financially constrained and whether this explains their low investment rate. The high proportion of financial investment suggests that financing constraints have not generally been binding.

In table 3.6 we report summary statistics for which each observation has been classified into one of nine manufacturing subsectors. There appear to be some interesting differences in financing behaviour as between industries. The subsector 'Pulp, paper and paper products' (IND4) appears to have the highest debt usage, on both gross and net funding bases. On the other hand, the category Other (IND9), which includes 'Mining and quarrying', 'Basic metal industries', 'Other manufacturing industries' and 'Electricity supply', appears to be the most self-financed on a gross funding basis.

Table 3.6 Weighted average summary statistics; sample split by industry, 1982-91

	IND1	IND2	IND3	IND4	IND5	IND6	IND7	IND8	IND9
Number of observations	597	444	283	185	421	282	103	785	378
GROSS FINANCING:									
Retentions	68.3	51.5	48.7	37.1	69.7	59.1	55.1	62.8	82.7
Tax debt	6.6	28.0	5.7	5.1	17.0	7.0	-1.5	13.9	9.0
New equity	4.2	6.3	8.9	7.7	2.2	3.7	6.6	12.3	3.4
Total debt	27.6	42.1	42.4	55.2	28.1	37.2	38.3	24.9	13.9
Short-term debt	12.7	2.8	13.9	13.5	10.8	24.6	21.1	6.5	0.9
Long-term debt	14.8	39.4	28.5	41.8	17.4	12.5	17.2	18.4	13.0
Interest-bearing debt	25.8	48.8	38.2	54.1	23.7	22.6	36.7	32.1	10.7
Bank loans	16.6	23.0	25.4	36.8	12.0	3.1	23.8	14.9	-2.9
Trade credit	1.5	-7.9	0.9	-2.5	0.8	11.6	7.0	-17.8	-1.2
NET FINANCING:									
Retentions	126.6	131.5	58.3	51.1	95.7	80.0	101.5	94.1	81.5
Tax debt	12.3	71.5	6.8	7.0	23.3	9.5	-2.8	20.8	8.8
New equity	7.7	16.1	10.6	10.5	3.0	5.1	12.2	18.5	3.3
Total debt	11.9	-3.4	24.6	30.7	0.0	16.1	-6.7	-18.6	-0.5
Short-term debt	15.3	-6.8	13.5	-14.6	-13.7	31.0	-29.0	-40.7	-3.9
Long-term debt	-3.4	3.4	11.1	45.3	13.7	-14.9	22.3	22.2	3.4
Interest-bearing debt	17.0	27.5	22.7	62.3	22.4	-1.3	58.2	42.7	1.1
Bank loans	30.3	44.4	31.5	45.2	8.9	10.8	46.0	-2.2	-3.8
Trade credit	-5.3	-20.1	-4.0	-27.6	-20.5	6.6	-55.9	-35.9	-4.9
Fixed investment	72.7	61.5	82.3	73.0	72.9	76.4	58.1	77.6	91.1
Stock building	-0.9	-14.0	-3.0	-4.2	-0.8	-1.9	-1.7	-13.4	-3.6
Financial investment	28.2	52.6	20.7	31.2	27.9	25.5	43.6	35.8	12.5
NDTS utilization rate	81.8	55.8	43.6	49.8	87.9	102.5	82.1	62.2	81.5
Taxes / (taxes + dividends)	38.2	46.8	34.4	31.0	60.0	54.3	46.3	37.7	54.1
Effective tax rate	10.0	34.5	29.8	34.3	19.4	15.9	20.9	18.8	22.4
Total debt / BVA	64.6	62.6	71.5	72.3	59.8	68.2	56.9	66.6	71.1
Long-term debt / BVA	26.7	32.0	36.6	48.3	31.2	35.6	24.5	36.3	49.5
Short-term debt / BVA	37.9	30.6	34.9	24.0	28.6	32.6	32.5	30.2	21.5
Total debt / RVA	52.8	53.0	62.1	63.1	44.5	54.0	43.5	59.0	47.9
Long-term debt / RVA	21.8	27.1	31.8	42.2	23.2	28.2	18.7	32.2	33.4
Short-term debt / RVA	31.0	25.9	30.3	20.9	21.2	25.8	24.8	26.8	14.5
Fixed investment / K(t-1)	14.8	6.4	12.2	12.8	15.0	17.0	10.0	10.4	11.5
Cash flow (BT) / K(t-1)	23.1	11.8	11.0	8.8	14.7	15.8	12.2	16.2	8.6
Cash flow (AT) / K(t-1)	21.8	10.3	10.3	8.3	12.8	14.3	10.6	14.9	7.8
Payout ratio	10.1	21.4	15.4	13.4	8.2	8.7	16.0	20.4	6.9
Freq. of dividend payments	60.0	46.6	56.2	55.7	73.9	73.4	68.9	58.7	46.6
Freq. of new equity issues	7.2	6.1	10.2	24.3	7.6	15.2	4.9	11.7	10.3

Notes: See table 3.5.

The maturity breakdown of industry debt is also of some interest. On a gross funding basis, the subsectors 'Chemicals and man-made fibres' (IND6) and 'Other minerals and mineral products' (IND7) appear to rely heavily on short-term debt financing. On the other hand, the latter of these industries is actually a net short-term creditor whereas the former appears to be a net short-term debtor. The percentages of long-term debt and bank loans are strikingly high for 'Pulp, paper and paper products' (IND4) on both gross and net bases. The Finnish tradition of collecting the major paper and pulp companies under the influence of a 'financial conglomerate' led by one or the other of the then-existing two major Finnish commercial banks is clearly reflected in these figures.

The net financing proportions show that in some cases the aggregate amount of the sources of funds deviates significantly from the aggregate amount of the uses of funds. Part of the discrepancy can be explained by the low number of observations in some subsamples and part by intragroup contributions between firms in different industries, which make it possible that the sources and uses of funds do not match at the industry level.

There appears to be some variation in the *NDTS* utilization rate across industries. In particular, firms in 'Timber and wooden furniture' (IND3) and 'Pulp, paper and paper products' (IND4) industries appear to be on average more tax exhausted than firms in the other industries. On the other hand, firms in 'Chemicals and man made fibres' (IND6) appear never to be tax exhausted in the sample period. Of course, these results reflect in large part the financial performance of the various industries over the sample period and it may be difficult to label some industries as tax exhausted and others as nontax exhausted on the basis of a relatively short sample period only.

Moreover, there appears to be quite a lot of variation in effective tax rates as between the industries. A comparison of the ratio of taxes to taxes plus dividends and the effective tax rate reveals how different a picture one can obtain from these figures. The 'Pulp, paper and paper products' industry (IND4) is a case in point. The effective tax rate for firms in this industry is the highest while the other two measures of the tax status both suggest that the effective tax burden need not be that heavy. It is apparent that, despite the fact that the financial performance of the paper industry companies has been poor over the sample period, they have had to pay dividends, presumably to meet a given target level of dividend payments. Although a large proportion of these dividends has been paid out of the firms' past accumulated profits, as evidenced by the low ratio of taxes to taxes

plus dividends, they have also been forced to show a certain amount of current taxable profit to meet the dividend target. This has resulted in a relatively high value for the effective tax rate. On the other hand, firms in the 'Food, drink and tobacco' industry (IND1) appear to have been the most effective in shielding income from the tax authorities.

It must, of course, be kept in mind that these figures relate to a rather exceptional period in Finnish economic history and that they are affected by the situation in which the individual companies and the industries found themselves in 1982. For example, the extremely low effective tax rate on food, drink and tobacco companies may be due to an exceptionally large amount of accumulated tax losses in the beginning of our sample period.⁶⁵

Despite the significant differences in financing flows, there appears to be relatively little variation in the traditional stock measures of indebtedness as between the industries. The 'Pulp, paper and paper products' industry (IND4) stands out as the heaviest borrower, also according to the stock measures, especially when the outstanding debt is measured against the estimated real value of the capital stock.

3.5 Summary of descriptive analysis

The descriptive analysis of this chapter revealed a number of stylized facts about the financing patterns of Finnish corporations. On a gross funding basis, debt financing is the dominant source of funds in the nonfinancial corporate sector. On the other hand, on a net funding basis retentions are the preferred form of financing of Finnish nonfinancial corporations. However, there are significant differences between the various sectors in the use of debt. In particular, the manufacturing sector appears to be more self-financed than the other nonfinancial sectors over the sample period. The result may be due to the time period of the analysis, which for the most part coincided with a relatively strong boom; it is a well-known fact that the Finnish manufacturing sector is more cyclical than the other sectors.

Furthermore, as a proportion of total debt usage, the role of loans from financial intermediaries has diminished in the latter half of the 1980s although their share of total gross funding has remained fairly steady. The greatest increase in debt usage in the latter half of the

⁶⁵ Furthermore, Finnish companies received relatively large tax-free capital gains, mainly from sales of buildings after a ten-year holding period, in the 1980s. These tax-free gains could be used to pay dividends which, in the two-rate system, could be used to reduce a firm's tax liability.

sample period is in short-term debt, which is intuitively acceptable considering the abrupt descent into recession of the Finnish manufacturing sector.

The descriptive analysis of interfirm differences revealed the following facts. First, there appear to be significant differences in the degree of tax exhaustion across companies. Secondly, tax exhaustion and poor performance by the firm are highly positively correlated. As a potential explanation for this finding, it was suggested that the optimal probability of tax exhaustion may be firm-specific. Alternatively, it is possible that the state of extreme tax exhaustion is not an objective but is rather caused by unexpected negative shocks to the firm's cash flows, while the long-run desired state is more moderate tax exhaustion with a slow adjustment toward the optimum.

In interpreting the results it must be borne in mind that they are sample-specific. In particular, the results in this section are likely to be biased toward describing financing patterns of large companies although the examination of various subsamples of data provided some information on interfirm differences.

Mayer (1990) concludes in his comparative study of the financing of industry in eight developed countries that taxation cannot provide a credible explanation for observed financing behaviour. His conclusions are based on a comparison of ranking of countries' tax incentives to employ different forms of financing with average financing ratios over the period 1970-1985. However, as noted by Mayer, there are several objections to this type of comparison. It is difficult to compare tax incentives across countries. They have been shown to be very sensitive to the assumed tax rates of investors (MM, Miller or generalized Miller equilibrium).

It is obvious that taxation alone cannot completely explain the observed financing behaviour of corporations. The relevant question then is: Does taxation play any role in the financial decision-making of corporations? Due to the problems involved in analysing the role of taxation with aggregated data, it is necessary to employ micro-level data in order to properly analyse the relationship between tax incentives and corporate borrowing. This is the task to which we turn in the next chapter.

4 Econometric analysis of tax incentives and corporate borrowing

In this chapter we carry out econometric analyses to examine the relationship between tax incentives and corporate borrowing decisions in a sample of Finnish manufacturing companies. Section 4.1 presents a review of previous empirical research on corporate financial policy. Section 4.2 contains an overview of the estimation method and model specification. Data and construction of the variables is presented in section 4.3 and results of the estimations are presented in section 4.4. Finally, section 4.5 contains a summary of empirical findings.

4.1 Previous research

Baxter & Cragg (1970), Martin & Scott (1974) and Taub (1975) were among the first to study empirically firms' financing decisions. However, the first empirical tests of the modern capital structure theories, including tax incentive effects, did not appear in the literature until the 1980s. These include Bradley, Jarrell & Kim (1984), Auerbach (1985), Long & Malitz (1985), Kester (1986) and Titman & Wessels (1988). More recent empirical evidence has been provided by MacKie-Mason (1990), Trezevant (1992), Kale, Noe & Ramirez (1991), Givoly, Hahn, Ofer & Sarig (1992), Smith & Watts (1992), Gaver & Gaver (1993), Homaifar, Zietz & Benkato (1994), Shenoy & Koch (1996) and Graham (1996). With few exceptions, all of the published studies have been carried out using data on US companies. The results have generally turned out to be rather inconclusive.

Bradley, Jarrell & Kim (1984) test for the effects of earnings variability, nondebt tax shields and the costs of financial distress on the firm's debt ratio. They employ a sample covering 857 US firms over the period 1962-1981 and run cross-sectional regressions with the variables measured as averages over the sample period. Their results confirm the negative effects of earnings volatility and the costs of financial distress (as proxied by advertising and R & D expenditure) on borrowing, but the nondebt tax shield effect turns out to be positive. Bradley, Jarrell & Kim's *NDTS* measure is the actually

claimed nondebt tax shields by a firm. According to the theory, the right measure is the level of available nondebt tax shields.⁶⁶

In an attempt to mitigate the measurement problem encountered when working with proxy variables, Titman & Wessels (1988) apply a combined factor analytic and regression technique, LISREL, which enables them to use more than just one observable variable to proxy latent firm characteristics that are of interest from the theoretical viewpoint. They employ a sample covering 469 US firms over the time period 1974-1982, dividing the sample period into three subperiods over which sample averages of the variables are calculated. Cross-sectional regressions are then run with the dependent and the explanatory variables being measured in separate periods to mitigate the simultaneity problem. Furthermore, they estimate separate models for different maturities of corporate debt. Their results for the determinants of the firm's long-term debt ratio generally suggest only one statistically significant explanatory variable that is robust to the definition of the debt ratio, a negative effect of the 'uniqueness' of the firm. As observable uniqueness attributes of the firm, Titman & Wessels use the firm's R & D and selling expenditure and the turnover of the workforce. Their result is thus consistent with the bankruptcy/agency cost explanations for corporate borrowing. Furthermore, depending on the definition of the debt ratio, they also find negative profitability and size effects and a positive growth effect. They also find that the attributes representing nondebt tax shields generally have a negative but statistically insignificant relationship with leverage.

Auerbach (1985) employs a sample covering 143 US firms over the period 1969-1977. He finds generally rather negative evidence with respect to various theories attempting to explain cross-sectional differences in firm leverage. However, he finds some evidence in favour of the tax incentive effect: a negative relationship between tax-loss carry-forwards and borrowing. His other findings include a positive and significant growth effect and also a positive effect of earnings volatility on the firm's desired debt ratio.

Long & Malitz (1985) run cross-sectional regressions on a sample covering 545 US companies over the period 1978-1980. The variables are measured as averages over the three-year period. Using the firm's R & D and advertising expenditures as proxies for firm-specific, intangible investments, they find strong evidence that the agency costs of debt reduce the firm's optimal borrowing. They also find a

⁶⁶ This distinction may not be particularly important for data collected from the US. However, in countries where the tax laws have been quite generous in providing *NDTS*, as is the case in Finland, it is important to use the level of available *NDTS* as the explanatory variable to avoid reverse causality problems.

negative and significant effect of profitability on the debt/assets ratio, which is taken as evidence for the pecking-order hypothesis of corporate financing. Other variables, such as tax shield substitutes for debt and firm-specific risk measures turn out to be insignificant. However, the authors are careful to point out that the insignificance of the tax effect may well be due to strong multicollinearity between the firm's capital expenditure and the level of available nondebt (investment-related) tax shields.

Kester (1986) analyses the determinants of Japanese corporate capital structures and compares them with those of US corporations. He employs cross-sectional data for 344 Japanese companies and 452 US companies from the 1982 fiscal year. The results show that, on a market value basis, there are no significant country differences in leverage between the US and Japan beyond those which can be explained by variation in such factors as growth, profitability, risk, size and industry classification. However, in addition to industry dummies, only profitability and growth turn out to have statistically significant effects on the debt ratio in both countries, the former with a negative sign and the latter with a positive sign. Kester omits *NDTS* from his analysis. A subsequent cross-sectional regression analysis of the determinants of the debt ratios of a sample of Japanese companies by Allen & Mizuno (1989) reports results that are consistent with those in Kester (1986). Allen & Mizuno employ a sample of 125 Japanese companies covering the time period 1980-1983 and measure the variables as averages over the sample period. Based on their findings, Allen & Mizuno suggest that profitability and industry effects are the major determinants of Japanese company debt ratios. The negative sign of the profitability measure is taken as evidence for the pecking-order hypothesis. Allen & Mizuno include an *NDTS* measure in their analysis. The coefficient estimate for *NDTS* is negative as hypothesized but statistically insignificant.

MacKie-Mason (1990) is the first to provide clear evidence that nondebt tax shields crowd out interest deductibility. He employs a data set of 1747 registrations of securities for public offering in the US over the period 1977-1987 and uses a discrete choice (probit) analysis. He argues that other studies have ignored the fact that most tax shields have only a negligible effect on the marginal tax rate for most firms and that only by analysing the firms' incremental financing choices is one able to obtain positive results for the tax hypothesis. In particular, without deriving the result from a theoretical model, MacKie-Mason argues that an extra dollar of *NDTS* does not crowd out interest deductibility in profitable firms and that therefore *NDTS* should have a negative effect on borrowing only for less

profitable firms. MacKie-Mason separates the profitability (income) and substitution aspects of nondebt tax shields by using *NDTS* and *NDTS* interacted with a variant of Altman's (1968) *ZPROB*⁶⁷ measure as two separate explanatory variables. His results confirm the positive relationship of the income effect of *NDTS* and the negative relationship of the substitution effect of *NDTS* to debt usage.

Trezevant (1992) also focuses on the *NDTS* substitution effect in examining firms' responses to the Economic Recovery Tax Act of 1981. His sample includes 836 US firms over the period 1979-1982. He divides firms into two groups based on the probability of losing the deductibility of tax shields. Firms paying little or no taxes are assumed to have a high probability of losing tax shield deductibility. He uses a dummy variable to separate the two subsamples and interprets the negative coefficient for the *NDTS* variable interacted with the 'high probability' dummy as evidence for the substitution effect. However, strictly interpreted, Trezevant is not able to provide evidence of a negative relationship between *NDTS* and corporate borrowing. His results show that the effect of *NDTS* on borrowing is positive for all firms but smaller in magnitude in the subsample of firms paying little or no taxes than in the subsample of firms paying taxes at a high rate.

Homaifar, Zietz & Benkato (1994) extend the empirical work of Bradley, Jarrell & Kim (1984) and Titman & Wessels (1988) by including a proxy for the corporate tax rate, which was omitted from the previous models. They employ annual US company level data on 370 firms for the period 1978-1988 and provide long-run steady-state equilibrium estimates of the determinants of capital structure by allowing for a dynamic structure in the empirical model. They find that in the long run the corporate tax rate is positively related to the leverage ratio. They also find that the short-run and the long-run relationships between nondebt tax shields and leverage are randomly distributed around zero. They follow Davis (1987) in constructing the tax rate variable as the unlevered effective tax rate.

Shenoy & Koch (1996) examine the firm's leverage - cash flow relationship with quarterly data from 162 US firms in six different industries (three manufacturing, three non-manufacturing) over the period 1979:1 - 1989:4. Their primary objective is to test the strength of the signalling theory and the pecking-order hypothesis in explaining the relationship between a firm's leverage and cash flow. They argue that the appropriate pecking-order relationship is

⁶⁷ *ZPROB* is a discriminant function predictor of the firm's financial condition. In his original analysis (1968) employing US data, Altman correctly classified 94 per cent of firms that went bankrupt the next year and 97 per cent of those that did not. *ZPROB* has been subsequently retested with similar results.

contemporaneous, between current leverage and current cash flow, while the relevant signalling relationship is intertemporal, between current leverage and future cash flow. In their empirical work, Shenoy & Koch employ a dynamic simultaneous equations model that describes the structural relationship between a firm's cash flow and leverage. They also include *NDTS*, measured as the firm's depreciation divided by total assets, in the leverage equation. Their results display a generally negative simultaneous relationship between cash flow and leverage, which is consistent with the pecking-order hypothesis. Furthermore, their results also show that increases in leverage are consistently followed by increases in cash flow. Their interpretation of the result is that it lends support to the signalling theory. However, it should be noted that the tax-based theories also predict a positive intertemporal relationship between borrowing and expected cash flow. Finally, their results also support a negative relationship between *NDTS* and leverage.

More recently, Graham (1996) provides further evidence in favour of tax effects on corporate borrowing. He analyses firms' incremental borrowing choices using combined cross-sectional time-series data from more than 10 000 US firms for the years 1980-1992. The dependent variable in his regressions is the first difference in the book value of long-term debt deflated by the lagged market value of the firm. His main contribution is in simulating firm-specific marginal tax rates that take due account of the US tax code. His results provide clear evidence which indicates that firms with simulated high marginal tax rates issue more debt than firms with simulated low marginal tax rates. As in MacKie-Mason (1990), he includes *NDTS* and *NDTS* interacted with a variant of Altman's *ZPROB* as separate explanatory variables in the empirical model. *NDTS* is measured as the sum of book depreciation and investment tax credits, ie as the actually used *NDTS*. Graham's *ZPROB* is defined as the inverse of MacKie-Mason's (1990) measure. Graham finds a positive relationship between *NDTS* and borrowing, and a negative relationship between *ZPROB* (inverse) times *NDTS* and borrowing, thus providing additional evidence for the hypothesis that the firms' responses to increases in *NDTS* vary according to profitability.

In the Nordic countries, Ekman (1995) provides empirical evidence on the tax effects on corporate financial policy in Sweden, employing the same econometric methodology as MacKie-Mason (1990). He argues that there are two different kinds of nondebt tax shields available to firms. The first of these is the conventional *NDTS* component, which reduces the future tax base of the firm and competes with the deductibility of interest expenses. The second type

of *NDTS* is modelled as an interest-free tax debt, which must be repaid in the future in the form of higher taxes. Ekman shows in a theoretical model that this latter type of *NDTS* should actually raise current borrowing. Ekman's empirical results support these conclusions. He employs a data set covering 337 bond and stock issues over the period 1977-1987 for the probit analysis. In the empirical work he uses two proxies for the different types of tax shields. First, the stock of inventory is used as a proxy for large future deductions. Secondly, a measure of the accumulated amount of untaxed reserves, the 'untaxed funds' of a firm, is employed to capture the effect of the interest free tax debt. Ekman's results provide evidence of a negative relationship between the inventory stock and debt issues, and a positive relationship between the untaxed funds and debt issues. However, there may be alternative explanations for Ekman's results. The negative relationship between the inventory stock and debt issues may simply reflect the fact that firms do not use debt to finance inventory investment. Furthermore, the accumulated amount of untaxed reserves may capture the effect of profitability on borrowing.

In Finland, the first empirical studies in this field did not appear until around the end of the 1980s. An empirical analysis by Kanninen & Airaksinen (1989) is based on a sample of 29 large Finnish manufacturing companies over the period 1967-1982. They perform both time-series and cross-sectional regressions. For cross-sectional analyses, they split the sample into two subperiods and measure the variables as averages over these subperiods. The main finding of their cross-sectional analysis is that internal financing appears to reduce corporate borrowing. This result is consistent with the pecking-order hypothesis and rejects the tax shield hypothesis. They fail to provide evidence of a tax effect since the coefficient estimate for nondebt tax shields is statistically insignificant. They use two alternative measures for *NDTS*, the ratio of annual tax (book) depreciation to estimated economic depreciation and the ratio of inventory undervaluation to its maximum under the tax laws. It should be noted that both of these variables measure the firm's actual use of *NDTS*.

Virolainen (1990, 1991) performs cross-sectional regressions of the determinants of the financial structure of 70 Finnish metal and engineering industry companies. The sample covers the years 1981-1985, and the variables are measured as averages over the sample period. The major finding of the study is that there appear to be significant differences in the financing behaviour of Finnish companies according to their tax status. The borrowing of tax

exhausted firms is explained solely by differences in their capital stock, which is consistent with the 'secured debt' hypothesis of Scott (1977). For nontax exhausted firms, the results show a positive effect of profitability on corporate borrowing and a negative relationship between the firm's R & D expenditure and borrowing. Tax exhaustion is measured by the firms' utilization rate of depreciation allowances and inventory undervaluation. The relationship between *NDTS* and borrowing turns out to be positive for both types of firms, although in the subsample of nontax exhausted firms, the coefficient estimate is not statistically significant. In an attempt to eliminate the potential bias in the *NDTS* estimate due to strong collinearity between the traditional measures of *NDTS* and the firm's capital stock, the *NDTS* variable is constructed as the available excess accounting depreciation over estimated economic depreciation (Virolainen 1990), or as the residual term of an auxiliary regression of the sum of available accounting depreciation and inventory undervaluation on the firm's capital stock (Virolainen 1991).

Langenskiöld (1993) performs an empirical analysis of the determinants of the financing choice using data on debt and equity issues collected from 94 Finnish publicly listed non-financial firms over the period 1987-1989. His main result is that companies with higher proportions invested in growth opportunities are more likely to choose equity financing than debt financing. Furthermore, the results provide weak evidence in favour of the tax hypothesis in that the relationship between the effective tax rate (in the year preceding the financing decision) and the probability of issuing new equity instead of debt was generally negative but not statistically highly significant.

Hansén (1994) tests the pecking-order hypothesis with Finnish data. He combines qualitative data collected through a questionnaire with previous empirical evidence in drawing conclusions about the strength of the pecking-order hypothesis in explaining corporate financing decisions. He sent a questionnaire to all Finnish firms quoted on the Helsinki Stock Exchange and the Finnish OTC list (maintained by the Finnish Securities Brokers Association) in February 1993 to find out whether firms aim at maintaining a target capital structure, or whether they follow the pecking-order hypothesis in raising funds. The final sample includes 54 responses (32 HSE firms and 22 OTC firms). Rather interestingly, 66.7 per cent of the respondents indicate that in raising new capital their company prefers to seek a target capital structure rather than to follow a financing hierarchy in which the most advantageous sources of funds are exhausted first. This view is more pronounced in the subsample of firms that are quoted on the HSE than in the subsample of firms that

are quoted on the OTC list. Hansén concludes that in general the pecking-order hypothesis does not appear to be highly relevant for the financing behaviour of Finnish firms. However, since the firms that are quoted on the OTC list indicated both a higher incidence of asymmetric information (measured as their perception of the mispricing of the firm's equity) and a higher preference for a financing hierarchy, Hansén interprets this as lending weak support for the pecking-order hypothesis.

In sum, empirical evidence for the various capital structure theories appears to be very mixed indeed. A problem with the standard cross-sectional regression analyses, which is highlighted in the study by Titman & Wessels (1988), appears to be that the results are highly sensitive to the way the empirical model is specified and the variables are constructed. In some cases, at least, the fact that the dependent variable in the regressions (the firm's debt level) has been scaled by some market value measure of the size of the firm (total firm value, the value of the firm's equity) may have resulted in biased estimates since these market value measures are themselves endogenous. Recently, Berens & Cuny (1995) have argued strongly against using debt-to-market-value or debt/equity measures in studies examining empirically the tradeoff theory of capital structure. Their point is that because of the fact that future growth in the firm's cash flows is reflected in the value of the firm's equity but not in the value of debt, the debt ratio becomes a distorted measure of tax shielding via interest expenses. Berens & Cuny argue that in empirical tests the dependent variable should reflect the marginal benefit of interest tax shields as closely as possible and that it should be unaffected by the future growth of the firm. They favour the idea of trying to explain the magnitude of tax payments in terms of the determinants usually employed in capital structure studies. However, while this may be a useful approach in the US, it is not readily applicable to Finland or in any of the countries in which the uniform reporting principle⁶⁸ applies and the firm's payout policies are linked to taxable profits.

Finally, it should be noted that differences in the empirical model specification and in the construction of the variables make direct comparisons between the results obtained in different studies very difficult. As evidenced in the theoretical analysis of the present study, in which interactions are allowed between the firm's real (investment) and financial decisions, it should not be surprising that the empirical evidence for the tax incentive effects has turned out to be ambiguous. It is not until recently that, by separating the income and the

⁶⁸ See chapter 2.

substitution effects of *NDTS* on debt usage, positive results have been obtained.

4.2 Estimation method and model specification

In recent years several attempts have been made to fully exploit the advantages offered by combined cross-sectional time-series, or panel, data. The advantages in exploiting panel data on individual firms are numerous. First, panel data allow the theory to be tested at the level at which it is formulated, thus reducing the econometric problems introduced by aggregation across firms. Furthermore, with panel data the estimates are obtained by using variation in both the time-series and cross-sectional data. This contributes to their precision and also enables consistent estimation in the presence of unobservable firm-specific effects. This last point is especially important to our empirical analysis. Our aim is to focus on the tax incentive effects on corporate borrowing, ignoring many factors that, on the basis of existing studies or on theoretical grounds, can be expected to have a role in corporate financing decisions. In particular, these factors include the variables that are important to the various agency theoretic models but whose empirical implementation has generally turned out to be difficult. The approach adopted in this study ensures that the parameter estimates obtained for the variables included in the model are not affected by firm-specific characteristics that are not explicitly controlled in the empirical model.

The empirical model that we employ is basically the same as that used in numerous cross-sectional studies on the subject. However, since we have at our disposal a panel data set, we estimate a dynamic version of the model, allowing for both company-specific and time-specific effects in the equation error term. Our theoretical model provides predictions for the steady-state, or long-run, equilibrium. Due to adjustment costs, there are ambiguities involved in choosing the timing of the variables, and a sufficiently dynamic structure is required in the model specification. We adopt the 'general-to-specific' econometric modelling strategy, starting with an over-parameterized second-order distributed lag model, leaving the suitable simplification to the data. Thus the model includes lagged values of the dependent variable as well as the explanatory variables.

There are various approaches to choosing the functional form of the empirical model. First, the model can be derived from the Euler equation representation of firms' optimizing behaviour, as in Hayashi

(1985) or more recently in Blundell, Bond, Devereaux & Schiantarelli (1992) for investment equations. In the theoretical model of this study, the nonlinearities introduced by the tax system modelling make this approach rather difficult. Second, the approach followed in most existing studies on corporate financial policy is to present the theory in levels and specify an empirical model in which all terms have been scaled by some measure of the size of the firm in order to standardize the unit of measurement across firms and to avoid spurious correlation results. In this study we adopt the latter approach and specify a linear regression model with all size-inflated terms scaled by a measure of the size of the firm. Regressors are chosen on the basis of the theoretical analysis in chapter 2.

Furthermore, the conventional approach has been to use the level of debt as the dependent variable in estimation. This is in line with the theoretical models that provide predictions for the long-run equilibrium. However, as pointed out by MacKie-Mason (1990) and Graham (1996), there are some problems associated with using a levels specification to test for tax incentive effects. Cumulative measures of financial policy, such as the debt/capital or debt/equity ratio, which are the result of separate decisions made over a number of years, can lead to incorrect interpretations of the relationship between taxes and financial policy. Thus MacKie-Mason (1990) and Graham (1996) both argue in favour of tests based on incremental financing decisions of firms. According to this view, we should look at changes in debt levels and associate these with the explanatory variables.

The approach favoured by MacKie-Mason and Graham is not without its problems. It may be difficult to reconcile the results with the long-run implications for financial policy of the theory. In particular, a regression of the change in debt on investment and cash flow (and other) variables is likely to reflect in large part the short-run 'cash flow identity' relationship between these variables (in the short-run there is a strong negative correlation between changes in debt and the firm's cash flow). It should also be noted that a dynamic specification of the levels model overcomes some of the criticism by MacKie-Mason and Graham. Our emphasis in this study is on a levels model with a sufficiently dynamic structure but we also report results for a model specification in which the dependent variable is the annual change in the level of debt.

The basic model we wish to estimate is

$$(49) \quad \left(\frac{DEBT}{K} \right)_{it} = \beta_0 + \sum_{k=1}^n \beta_k \left(\frac{X_k}{K} \right)_{it} + \alpha_i + \alpha_t + v_{it}$$

for firm $i = 1, 2, \dots, N$ at time $t = 1, 2, \dots, T$. *DEBT* denotes the level of debt of the firm, X_k denotes an explanatory variable and K denotes the scaling variable (beginning-of-period real capital stock of the firm). The error term is specified as being equal to three random components: a fixed but unobservable firm-specific effect, α_i , a time-specific effect, α_t , and a white noise disturbance, v_{it} .

A levels model would provide efficient parameter estimates if the regressors were uncorrelated with the unobservable firm-specific effects. However, it is highly likely that the right-hand side variables are correlated with firm-specific effects. Furthermore, standard fixed effects or within-group estimators are also biased in dynamic models with short panels (Nickell 1981). Therefore, the model is estimated in first differences to allow for firm-specific, time-invariant effects and an instrumental variable procedure is used to allow for the endogeneity of all the regressors. Working with company accounts data, it is reasonable to assume that most of the variables are simultaneously determined.

Taking first differences introduces a moving average error term

$$(50) \quad \Delta \varepsilon_{it} = \Delta \alpha_t + \Delta v_{it}.$$

Estimation is carried out by a two-step generalized method of moments (GMM) procedure using the dynamic panel data (DPD) programme written by Arellano & Bond (1988).⁶⁹ This method allows the number of instruments in each cross-section to increase as we proceed through the panel. Provided that the idiosyncratic error term is serially uncorrelated, so that we have a first-order moving average error in the differenced model, the endogenous variables of the model lagged at least twice can be used as instruments. Since the validity of the instruments rests upon the MA(1) structure of the disturbance term, the presence of higher-order serial correlation must be tested. This is accomplished by employing the one degree of freedom test, $m2$, proposed by Arellano & Bond (1988). Furthermore, to check for potential misspecification of the model we use Sargan's statistic,

⁶⁹ DPD was used with GAUSS v.3.01. This version of GAUSS no longer imposes restrictions on the size of the matrices it can handle, so the DPD programme was altered to allow for larger instrument matrices than the originally specified maximum of 90 columns.

which tests for the absence of correlation between instruments and the error term. Robust standard errors are computed for the coefficients, allowing both for an MA(1) error structure and heteroscedasticity across firms. In the chosen estimation method, asymptotic arguments rest on limiting properties for large N ; T is considered finite throughout. Finally, the company-invariant $\Delta\alpha_i$ is allowed for by introducing time dummies into the model.

4.3 Data and construction of the variables

The sample we employ in the econometric analysis is drawn from individual accounting records of Finnish manufacturing companies collected by Statistics Finland.⁷⁰ The raw sample is composed of accounting records of a total of 623 Finnish manufacturing companies over the period 1978-1991. Due to the fact that in the GMM method we employ a first-differenced model with lags of two periods, and use a one-period lagged scaling variable, the basic criterion for inclusion of observations in the raw sample was that at least five years of consecutive data be available. From the raw sample, further observations were dropped according to the following criteria. First, neither missing observations nor observations taking the value zero in the key variables were allowed. Secondly, since in a first-differenced model observations with extreme changes have a disproportionate effect on the results, it was required that the year-on-year increase (decrease) in either the book value of total assets or in turnover must not exceed 200 per cent (67 per cent). Finally, the construction of a key explanatory variable (Z^{-1}) forced us to reject another 185 observations from the raw sample. The data and the sampling procedure are explained in more detail in appendix 3.

These criteria resulted in a final sample covering 548 companies and 3 478 observations. It should be noted that the number of records on each firm varies in the sample and that only 179 firms existed for the entire sample period. Furthermore, Statistics Finland classifies companies into manufacturing subsectors according to the activity for which the aggregate value added is the largest, using a three-digit application of the industrial classification. For the purposes of our study, the companies were reallocated into nine subsectors of manufacturing.

⁷⁰ This is the same sample as that used in the descriptive analysis in section 3.4.

After accounting for first-differencing, explanatory variables with lags of two periods and the use of a one-period lagged scaling variable, the period of the econometric analysis is finally reduced to 1982-1991.

We use the book value of the interest-bearing debt of a firm as the dependent variable, *DEBT*, in the estimations. According to the tax-based theories, it is the tax deductibility of corporate interest payments that makes debt financing advantageous; thus a firm's interest-bearing debt is the most relevant measure to use in testing the tax incentive effects. Our measure of the interest-bearing debt of a firm includes long-term debt, current portion of long-term loans, notes payable and other (interest-bearing) current liabilities. A detailed description of all the variables is given in appendix 4. Some regressions are also carried out using alternative measures of debt (total debt, long-term debt, short-term debt, bank loans) as the dependent variable to check whether the choice is relevant for the results.

The firm's cash flow is included as an explanatory variable in the empirical model. Cash flow is measured by the firm's earnings before depreciation, interest and tax expenses, *EBDIT*, to avoid reverse causality problems in estimation. According to the tax-based theories, an increase in the firm's (expected) pre-tax cash flow increases the demand for tax shields and therefore should raise corporate borrowing.⁷¹ However, two things must be noted. First, this relationship holds between the (long-run) average level of the firm's cash flow and the (long-run) average level of debt and, secondly, a higher average level of cash flow also implies a higher average level of capital stock (thus a positive relationship between debt and cash flow is at least partly a size effect). Given that in our empirical model specification, all size-inflated terms, cash flow included, are deflated by the firm's (beginning-of-period) capital stock in order to normalize the unit of measurement and to avoid heteroscedasticity problems, a positive long-run relationship may not be taken for granted. In fact, the results are more likely to reflect the short-run sources and uses of funds identity relationship between cash flow, debt and investment. That is, given a fixed investment policy, the firm has to adjust its borrowing according to fluctuations in the firm's cash flow (debt being the easiest source of funds to adjust). It should be noted that this positive short-run relationship is not inconsistent with the tax-based theories. On the other hand, it should also be noted that the agency-theoretic explanations for corporate financial policy, the

⁷¹ It may be recalled that Unni (1994) has recently shown that even in the tax-based models the relationship between cash flow improvements and optimal borrowing may be more complex.

Myers-Majluf (1984) pecking-order hypothesis in particular, suggest that there should be a negative relationship between the firm's cash flow and debt usage.

A proxy for the nondebt tax shields available to the firm, *NDTS*, is obtained by calculating the sum of the maximum inventory undervaluation and the maximum book depreciation as stipulated in the Finnish tax law. Our theoretical model implies that the tax incentive effect of *NDTS* should vary and even have the opposite sign across firms due to differences in the relative magnitudes of the income and substitution effects. In order to separate the two effects we follow the approach in MacKie-Mason (1990) and Graham (1996) and interact the *NDTS* variable with a measure of the firm's financial status. Our measure of the firm's financial status is a variant of Altman's (1968) original *ZPROB* specification, which has been used to measure the probability of a firm's bankruptcy.⁷² As in Graham (1996), we use a *ZPROB* measure that is the inverse of those employed by Altman (1968) and MacKie-Mason (1990) and denote it by Z^{-1} . Thus Z^{-1} equals the firm's total assets divided by the sum of 3.3 times earnings before interest and taxes plus sales plus 1.4 times retained earnings plus 1.2 times net working capital. The hypothesis is that *NDTS* alone captures the positive income effect while *NDTS* interacted with Z^{-1} captures the negative substitution effect on borrowing. For some observations, the calculated Z^{-1} value turned out to be negative. Firms with negative values for Z^{-1} are most likely to experience financial difficulties. Since Z^{-1} is constructed so that a higher value implies lower profitability, negative values would introduce a bias in the results and therefore these observations were excluded from the final sample. This resulted in a loss of 185 firm-year observations from a total of 3663 observations.

In addition to being part of the interaction variable, Z^{-1} itself is also included as a regressor in the model. As a predictor of bankruptcy it may have some explanatory power of its own (as implied eg by the tax-shelter vs bankruptcy-cost models of financial structure). The hypothesized relationship between Z^{-1} and borrowing is negative; a higher probability of bankruptcy should lower corporate borrowing. Furthermore, by including Z^{-1} in the model, we can test whether the *NDTS* substitution effect, supposedly captured by the interaction variable, is driven by Z^{-1} only.

As additional tax variables, we include the lagged values of the ratio of currently claimed inventory undervaluation and book

⁷² Prihti (1975) and Suominen (1985) have specified slightly modified *ZPROB* measures using Finnish data. However, we employ the same *ZPROB* measure as in MacKie-Mason (1990) and Graham (1996) to enable direct comparisons between the results.

depreciation to their maximum allowed values, ie the utilization rate of nondebt tax shields, *URNDTS*. The descriptive analysis in chapter 3 showed that there are significant differences in the degree of tax exhaustion across the Finnish manufacturing companies. Two possible explanations for this finding were suggested: first, the optimal probability of tax exhaustion may be firm-specific (due eg to clientele effects) or, secondly, there may be a uniform optimal probability of tax exhaustion with firms adjusting slowly toward the optimum after a cash flow shock. By including lagged values of *URNDTS* as regressors, it can be tested whether there is a uniform optimal probability of tax exhaustion for all firms and toward which all firms attempt to move, or whether the optimal probability of tax exhaustion is firm-specific. The former hypothesis suggests a positive relationship between *URNDTS* and borrowing: the higher the firm's utilization rate of *NDTS*, the more it needs to issue new debt to maintain an optimal probability of tax exhaustion. On the other hand, the latter hypothesis suggests that there should be no systematic relationship between *URNDTS* and the debt level.

Moreover, it should be noted that some previous studies have included a measure of the firm's effective tax rate as an explanatory variable in the regression to test directly for the tax effects (see eg Davis 1987 and Homaifar, Zietz & Benkato 1994). According to our theoretical model, in a steady state all firms should face the same exogenously determined effective tax rate. However, the inclusion of the effective tax rate as an explanatory variable can be thought of as capturing the short-term relationship implied by the tax-based theories. Existing studies have used a measure termed the 'unlevered effective tax rate', which is constructed as current tax payments less tax deferral plus the product of the statutory tax rate and interest expenses, divided by current before-tax cash flow. The argument is that in order to avoid testing the mere reverse causality relationship between interest expenses and tax payments, the tax rate hypothesis should be tested using a tax rate that is calculated before debt effects. On the other hand, one may argue that if the firm's interest expenses are large relative to tax payments, then one would expect to find a positive but spurious relationship between the debt level and the unlevered effective tax rate. This is a relevant point in Finland where debt has traditionally played a significant role in the financing of companies. In our sample the ratio of the tax shield of debt (statutory tax rate times interest expenses) to actual tax payments is on average⁷³ 10.9, suggesting that the unlevered effective tax rate is not a proper

⁷³ Averaging over companies, ie calculating first for each firm the ratio of cumulative interest tax shield to cumulative tax payments, and taking the average of these ratios across firms.

measure to use in testing the short-term tax incentive effect on debt financing. Moreover, in Finland the use of the observed effective tax rate of the firm in measuring the tax status is further complicated by the fact that in order to distribute dividends the firm must show taxable profit. Therefore, since the observed effective tax rate is likely to vary systematically according to firms' payout policies, we do not include a measure of the firm's effective tax rate in our empirical model.⁷⁴

Finally, the firm's gross fixed investment, I , measured by current total capital expenditure, is included as an additional explanatory variable in the model. The firm's fixed investment clearly affects its financing needs and the variable has proved to be a significant explanatory factor in previous empirical studies. By including investment as a regressor, we can isolate the effects of changes in the firm's investment opportunities on borrowing. Furthermore, it enables us to control for the effect that investment has on borrowing via an increase in $NDTS$. The hypothesized relationship between fixed investment and borrowing is positive.

Other potentially important explanatory factors are assumed to be included in the firm-specific error term. In particular, these include the quality of the firm, the firm's vulnerability to agency problems, cash flow volatility etc. On the assumption that these firm-specific characteristics remain constant throughout the estimation period, our chosen estimation method eliminates the effects of omitted variables on the parameter estimates for the variables that have been included in the model. Finally, time and industry dummies are included as regressors and instruments in all equations that are estimated using the GMM method.

As the deflator for all size-inflated variables, the beginning-of-period value of the replacement cost value of the capital stock of the firm, K , is used. This measure is obtained by the perpetual inventory method, taking into account the firm's sales of existing capital as well as different rates of economic depreciation for different forms of capital. A more detailed description of the construction of the replacement cost value series can be found in appendix 4.

Descriptive statistics on the variables employed in the empirical model are presented in table 4.1. The ratio of interest-bearing debt to the replacement cost value of capital has a mean of 0.877 and a standard deviation of 0.617. On the other hand, the ratio of the annual change in interest-bearing debt to the replacement cost value of

⁷⁴ The only meaningful way to measure the effective tax rate would be, following Graham (1996), to simulate firm-specific expected marginal tax rates. However, this was beyond the scope of the current study.

capital is just 0.0007, indicating that the average firm had a mere 0.07 per cent annual increase in borrowing (in proportion to the beginning-of-period real capital stock) over the sample period. The average ratio of cash flow to estimated beginning-of-period real capital stock is 0.196 in the sample. As can be expected, there is quite a lot of variation in cash flow across observations, ranging from a minimum value of -0.821 to a maximum of 2.11. The average utilization rate of *NDTS* is 0.74 in the sample, ranging from zero to as high as 2.48.⁷⁵ The unweighted average (over all observations) *URNDTS* of 74 per cent compares well with the weighted average *URNDTS* of 71.6 per cent as reported in table 3.6 in chapter 3. The average investment rate of the sample companies is 22.6 per cent, ranging from no investment at all to a maximum of nearly 400 per cent. Finally, the Z^{-1} variable appears to exhibit wide variation in the sample. In fact, there appeared to be a handful of extreme observations of Z^{-1} , which may influence the parameter estimates. Robustness of the results with respect to these extreme observations will be checked.

Table 4.1 Descriptive statistics for the variables, 1982-1991, 548 firms, 3478 observations

Variable	Mean	Std. dev.	Minimum	Maximum
<i>DEBT / K</i>	0.877	0.617	0.010	7.66
$\Delta DEBT / K$	0.0007	0.439	-4.16	4.18
<i>EBDIT / K</i>	0.196	0.192	-0.821	2.11
<i>NDTS / K</i>	0.343	0.323	0.001	4.96
$Z^{-1} \times NDTS / K$	0.254	1.37	0.001	71.8
<i>URNDTS</i>	0.740	0.384	0.0	2.48
<i>I / K</i>	0.226	0.272	0.0	3.97
Z^{-1}	0.797	3.15	0.121	144.6

⁷⁵ There is, apparently, some measurement error included in our *URNDTS* variable. However, the number of observations for which *URNDTS* exceeded unity by more than 20 per cent was very low.

4.4 Results

4.4.1 Levels specification of the basic model

Estimation results for a levels model specification are reported in table 4.2. In the first three columns we present results from GMM estimation of the model. The first column reports results for a specification in which both Z^{-1} interacted with *NDTS* and Z^{-1} itself have been left out. In the second column, Z^{-1} interacted with *NDTS* has been included. Finally, results for the full specification of the model are presented in the third column.

The first column indicates that if no attempt is made to separate the income and substitution effects of *NDTS*, the income effect dominates. This is in line with previous empirical findings. However, it is interesting to note that in the equation in which *NDTS* interacted with Z^{-1} is left out, the coefficient estimates for current *NDTS* and lagged *NDTS* are both rather large in absolute value and they have opposite signs, indicating that the long-run relationship is rather complex. This is not surprising due to the conflicting income and substitution effects. Furthermore, the results in column two, where Z^{-1} interacted with *NDTS* has been included, provide evidence supporting the implications of the theoretical model. The *NDTS* term is significantly positively related to borrowing while *NDTS* interacted with Z^{-1} is significantly negatively related to borrowing. This finding is in line with those of MacKie-Mason (1990) and Graham (1996) using US data. Thus the result shows that the hypothesis that nondebt tax shields crowd out interest deductibility for non-profitable firms but not for profitable firms also holds for Finnish data. In our model, there appears to be a lag of one period in the substitution effect of *NDTS*.

The results in the third column show that Z^{-1} dated $t-1$ is statistically significant and positively related to borrowing while the coefficients for current Z^{-1} and Z^{-1} dated $t-2$ are negative but not statistically significant. The negative effect of Z^{-1} times *NDTS* dated $t-1$ remains statistically significant and the size of the coefficient is increased in absolute value. All other terms in the equation are little affected when Z^{-1} is added. It can thus be concluded that Z^{-1} alone does not capture the effect of *NDTS* interacted with Z^{-1} . The statistically significant positive coefficient of Z^{-1} argues against the hypothesis that an increase in the probability of bankruptcy should reduce the firm's debt usage. Both MacKie-Mason (1990) and Graham (1996) find with US data that the probability of bankruptcy is

weakly negatively related to borrowing. Their findings suggest, as might be expected, that firms experiencing financial difficulties find it hard to issue additional debt in the US market-oriented financial system. However, in the Finnish bank-oriented system, financially troubled firms appear to resort more heavily to debt financing than their more profitable counterparts. It should be noted that part of the increase in debt usage, especially short-term borrowing, of financially troubled firms is automatic in a sense that such firms, by definition, must postpone the payment of bills etc. However, one might argue that the result in column three can be interpreted as evidence in favour of the hypothesis that in bank-oriented financial systems banks adopt a long-term objective and are committed to helping financially troubled firms by granting additional loans to them. A model specification with bank loans as the dependent variable will provide more direct evidence on this hypothesis in section 4.4.2.

The results in table 4.2 also show that the effect of cash flow on borrowing is captured by current and one-period lagged regressors. Current cash flow has a statistically significant negative effect on borrowing with a large coefficient. However, a positive and relatively large coefficient for lagged cash flow suggests that the impact of cash flow on borrowing is more complex than is suggested by the simple pecking-order hypothesis. It appears that short-run dynamics, ie the sources and uses of funds relationship, dominates the cash flow effect on borrowing, making the overall effect negative.⁷⁶

⁷⁶ We also explored whether future cash flow has a different effect on current borrowing than current and lagged cash flow. In doing so, we used realized future values (dated $t+1$ and $t+2$) of *EBDIT* as proxies for the firm's expectations about future cash flow (errors-in-variables problem was mitigated by using IV estimation procedure). This reduced our estimation period to 1982-1989. The results showed that when cash flow dated $t+1$ and $t+2$ were included in the model, cash flow dated both $t-1$ and $t-2$ were insignificant. The negative effect of current cash flow on borrowing remained virtually unchanged and significant. Cash flow dated $t+1$ had a negative but insignificant coefficient while cash flow dated $t+2$ turned out to have a positive and significant effect on current borrowing. These results are in line with those obtained by Shenoy & Koch (1996) with US data. Shenoy & Koch interpret the result as supporting the signalling theory of debt financing (Ross 1977), ie firms that anticipate an increase in future cash flow signal their private information to the market by issuing more debt. However, the result can also be interpreted to support the tax-based theories of corporate borrowing in that an increase in the expected cash flow raises the optimal level of debt.

Table 4.2 Full sample GMM results in first differences and OLS results in levels, 1982-1991, 548 companies, 3478 observations

Dependent variable	(1)	(2)	(3)	(4) (OLS levels)
$\Delta(DEBT/K)_t$				
$\Delta(DEBT/K)_{t-1}$	0.4563** (0.0251)	0.4270** (0.0211)	0.4129** (0.0182)	0.7126** (0.0408)
$\Delta(DEBT/K)_{t-2}$	0.0144 (0.0126)	0.0223* (0.0108)	0.0191* (0.0096)	0.1014** (0.0261)
$\Delta(EBDIT/K)_t$	-0.3478** (0.0646)	-0.3390** (0.0520)	-0.3359** (0.0443)	-0.3125** (0.0625)
$\Delta(EBDIT/K)_{t-1}$	0.1374** (0.0523)	0.1225** (0.0428)	0.1119** (0.0351)	0.1113 (0.0884)
$\Delta(EBDIT/K)_{t-2}$	0.0056 (0.0269)	-0.0135 (0.0223)	-0.0163 (0.0206)	0.0766 (0.0548)
$\Delta(NDTS/K)_t$	0.8895** (0.0498)	0.8255** (0.0415)	0.7336** (0.0373)	0.8852** (0.1133)
$\Delta(NDTS/K)_{t-1}$	-0.5427** (0.0527)	-0.3992** (0.0397)	-0.2923** (0.0335)	-0.5467** (0.1118)
$\Delta(NDTS/K)_{t-2}$	0.0161 (0.0209)	0.0343 (0.0217)	0.0264 (0.0212)	-0.1133 (0.0718)
$\Delta(Z^{-1} \times NDTS/K)_t$	-	0.0001 (0.0218)	-0.0145 (0.0174)	-0.0196** (0.0062)
$\Delta(Z^{-1} \times NDTS/K)_{t-1}$	-	-0.2207** (0.0339)	-0.3253** (0.0361)	-0.0906 (0.0842)
$\Delta(Z^{-1} \times NDTS/K)_{t-2}$	-	-0.0258* (0.0127)	-0.0143 (0.0126)	0.2079* (0.0936)
$\Delta URNDTS_{t-1}$	0.0038 (0.0461)	-0.0761* (0.0357)	-0.0814** (0.0285)	-0.0443 (0.0288)
$\Delta URNDTS_{t-2}$	-0.0898** (0.0325)	-0.0414 (0.0255)	-0.0332 (0.0214)	0.0023 (0.0270)
$\Delta(I/K)_t$	0.3799** (0.0503)	0.4498** (0.0398)	0.5250** (0.0339)	0.5520** (0.0396)
$\Delta(I/K)_{t-1}$	-0.1396** (0.0240)	-0.1137** (0.0206)	-0.1285** (0.0179)	-0.3794** (0.0324)
$\Delta(I/K)_{t-2}$	0.0200 (0.0128)	0.0186 (0.0118)	0.0208* (0.0102)	-0.0818** (0.0248)
ΔZ_t^{-1}	-	-	-0.0022 (0.0030)	0.0059** (0.0017)
ΔZ_{t-1}^{-1}	-	-	0.0512** (0.0116)	0.0087 (0.0162)
ΔZ_{t-2}^{-1}	-	-	-0.0034 (0.0056)	-0.0373 (0.0235)

D_{83}	-0.0506* (0.0204)	-0.0533** (0.0189)	-0.0621** (0.0167)	-
D_{84}	-0.0068 (0.0171)	-0.0049 (0.0157)	-0.0046 (0.0143)	-
D_{85}	-0.0068 (0.0160)	-0.0089 (0.0146)	-0.0138 (0.0126)	-
D_{86}	0.0071 (0.0162)	0.0166 (0.0149)	0.0115 (0.0134)	-
D_{87}	-0.0458** (0.0167)	-0.0528** (0.0151)	-0.0637** (0.0128)	-
D_{88}	-0.0701** (0.0168)	-0.0732** (0.0158)	-0.0691** (0.0142)	-
D_{89}	0.0389* (0.0168)	0.0347* (0.0149)	0.0347** (0.0134)	-
D_{90}	0.0006 (0.0162)	-0.0033 (0.0157)	-0.0115 (0.0142)	-
D_{91}	0.0105 (0.0167)	0.0148 (0.0152)	0.0105 (0.0133)	-
D_{IND2}	0.0310** (0.0102)	0.0368** (0.0090)	0.0365** (0.0083)	0.0673** (0.0217)
D_{IND3}	0.0088 (0.0088)	0.0005 (0.0088)	-0.0028 (0.0076)	0.0045 (0.0210)
D_{IND4}	0.0049 (0.0080)	-0.0008 (0.0074)	-0.0073 (0.0067)	-0.0103 (0.0190)
D_{IND5}	-0.0031 (0.0055)	-0.0015 (0.0058)	0.0010 (0.0055)	-0.0006 (0.0122)
D_{IND6}	0.0062 (0.0069)	0.0019 (0.0066)	0.0019 (0.0061)	-0.0119 (0.0154)
D_{IND7}	-0.0060 (0.0082)	-0.0092 (0.0080)	-0.0100 (0.0076)	-0.0104 (0.0152)
D_{IND8}	-0.0056 (0.0059)	-0.0088 (0.0057)	-0.0114* (0.0053)	0.0071 (0.0146)
D_{IND9}	-0.0113* (0.0054)	-0.0157** (0.0054)	-0.0171** (0.0050)	-0.0135 (0.0139)
$m1$	-7.03	-6.63	-6.36	-0.05
$m2$	1.07	0.58	0.38	-1.59
Sargan	140.7 (130)	175.9 (156)	207.0 (182)	-
$z1$	952.9 (13)	1527.0 (16)	2017.7 (19)	3443.3 (19)
$z2$	123.6 (10)	151.7 (10)	196.6 (10)	-
$z3$	25.7 (8)	42.5 (8)	59.8 (8)	16.2 (8)
Instruments	DEBT/K(2,3), EBDIT/K(2,3), NDTS/K(2,3), URNDTS(3,3), I/K(2,3), time and industry dummies	DEBT/K(2,3), EBDIT/K(2,3), NDTS/K(2,3), $Z^I \times$ NDTS/K(2,3), URNDTS(3,3), I/K(2,3), time and industry dummies	DEBT/K(2,3), EBDIT/K(2,3), NDTS/K(2,3), $Z^I \times$ NDTS/K(2,3), URNDTS(3,3), I/K(2,3), Z^I (2,3), time and ind. dummies	-

Notes to table 4.2:

- 1) Asymptotic standard errors are reported in parentheses. Standard errors and test statistics are asymptotically robust to heteroscedasticity across companies and over time.
- 2) m_1 is a test for first-order serial correlation and m_2 is a test for second-order serial correlation in the residuals, both asymptotically distributed as $N(0,1)$ under the null of no serial correlation.
- 3) The Sargan statistic is a test of the over-identifying restrictions, asymptotically distributed as $\chi^2(k)$ under the null. It tests whether the instruments are correlated with the error term.
- 4) $z_1(k)$ is a Wald test of joint significance of the reported coefficients, asymptotically distributed as $\chi^2(k)$ under the null of no relationship. $z_2(k)$ is a Wald test of joint significance of the time dummies. $z_3(k)$ is a Wald test of joint significance of the industry dummies.
- 5) Instruments in GMM estimations: the first argument in parentheses indicates the lag length of the latest instrument employed in each cross section; the second argument indicates the number of moment restrictions involving this variable exploited in each cross section.
- 6) Superscript asterisks indicate significance at $p < 0.01$ (**) and $p < 0.05$ (*).

It should also be noted that, as shown eg by Unni (1994), when the possibility of (even costless) bankruptcy is taken into account, the way in which an improvement in cash flow affects the shape of the probability distribution plays a crucial role in determining whether the optimal policy of the firm will be to increase or decrease borrowing, even in tax-based models. In particular, if an improvement in cash flow is such that there is a proportionately greater increase in the probability mass over the states in which the firm will not default but will not be able to claim full tax allowances than in the probability mass over the states in which the firm will be able to claim full tax allowances, then the optimal policy is to decrease borrowing. This is due to the fact that in the former states of the world there is a tax disadvantage to debt in that investors must pay tax at a rate m_b ($> z$) on their receipts of interest payments while the firm cannot utilize the tax shield of those interest payments.

Contrary to our expectations, the rate of utilization of nondebt tax shields (*URNDTS*) has a statistically significant negative effect on borrowing. Rather interestingly, in the model specification in which Z^{-1} is not included, *URNDTS* dated $t-2$ is statistically significant and the term dated $t-1$ is insignificant while in the third column, in which Z^{-1} is included, the reverse is true. In fact, this is not very surprising since our descriptive analysis in chapter 3 already revealed strong correlation between *URNDTS* and the firm's financial standing. The negative coefficient on *URNDTS* implies — if we accept the hypothesis that each firm has its own optimal probability of tax exhaustion — that there is significant inertia in firms' adjustment of their tax status. It should be noted, however, that the criticism by MacKie-Mason (1990) and Graham (1996) against using a levels

model specification to test for the tax incentive effects applies particularly well to the short-run relationship between *URNDTS* and borrowing.

Finally, as expected, there appears to be a strong positive relationship between capital expenditure and borrowing. This is in line with the findings of previous studies.

Column four in table 4.2 presents for comparison the results for a levels model estimated by OLS. OLS requires that the regressors be exogenous and also that they be uncorrelated with the unobservable firm-specific fixed effects. As appears in the table, the coefficient of the lagged dependent variable in the levels OLS specification is strongly biased upward, thus showing evidence of the presence of firm-specific effects, despite the inclusion of industry dummies. As a result, all long-run relationships implied by the levels OLS specification are biased and the use of GMM is strongly preferred.

In table 4.2, we also report the coefficient estimates for the year and industry dummies. The coefficients of the year dummies show a significant aggregate decrease in corporate borrowing in 1983 and 1987-1988 that cannot be explained by the regressors included in the model. Both in 1983 and in 1987-1988 the Finnish economy experienced strong growth and firms' cash flows were high. Since the cash flow variable is already included in the regressions, these negative year effects imply that boom periods have a greater effect on the firms' debt usage than what is captured by the cash flow variable alone. On the other hand, for 1989 there appears to have been a significant aggregate positive shock in debt usage. Apparently, since the severe recession did not hit the firms' cash flows until in 1991/1992, the aggregate increase in borrowing in 1989 is perhaps best interpreted as a correction for the overshooting in debt reduction that took place in 1987-1988. In light of simulation results obtained in chapter 2 suggesting that changes in statutory tax rates should have strong effects on corporate borrowing compared with the effects of most other exogenous variables that were examined, the exceptionally strong aggregate reduction in debt usage in 1987-1988 might also be explained as a delayed reaction to the reduction of the rate of corporate tax from 60 per cent to 50 per cent in 1986.⁷⁷ On the other hand, the more fundamental tax reform that took place in 1990 by the introduction of the imputation system of capital income taxation, followed by further changes in 1993, do not show up in the year dummies. It is likely that firms anticipated these changes already in

⁷⁷ It should be noted that at the same time reserve practices were tightened and the effective capital gains tax rate was increased. Hence the overall effect of these tax parameter changes on the firms' borrowing incentives is not clear-cut.

the late 1980s. Furthermore, it should be noted that a number of shocks in various macroeconomic factors were experienced especially in the latter part of the sample period, so that it is difficult to uncover aggregate tax effects.

Coefficient estimates of the industry dummies suggest that firms in the textiles, clothing, leather and footwear industry (IND2) have on average a higher debt usage than firms in the other manufacturing industries, which cannot be explained by factors included in the empirical model. On the other hand, compared with the base industry food, drink and tobacco (IND1), firms in almost all other industries use less debt on average. A negative industry effect is especially strong in the minerals and mineral products (IND7) subsector and in the 'Other' group (IND9), which includes mining, basic metal industries, other manufacturing industries and electricity supply.

The GMM estimates reported in table 4.2 are obtained by a two-step procedure. Arellano & Bond (1991) show that there is a downward finite-sample bias in the estimates of the two-step standard errors. Despite the fact that we have a relatively large sample, the one-step parameter estimates with robust test statistics for the full model specification in column three are reported in appendix 5. They show that the key results are statistically significant even if the power of the GMM method is not fully utilized.⁷⁸

Moreover, the results are generally robust to variations in the instrument set. It should be noted that the Sargan test statistic rejected the null hypothesis of no correlation between the instruments and the error term when the latest lag of *URNDTS* that was included in the instrument set was $t-2$ and hence the results reported in the tables have been obtained with an instrument set in which the latest lag of *URNDTS* employed is $t-3$. This implies that there is some serial correlation in the *URNDTS* variable. For all other instruments, the latest lag exploited in each cross section is $t-2$ and the reported Sargan test statistics for overidentifying restrictions suggest that the instruments are not correlated with the error term. It also appears that the equations do not exhibit second-order serial correlation according to the reported $m2$ statistics while the first-order serial correlation introduced by first differencing is evident in all the equations, according to the reported $m1$ statistics.

Finally, it may be noted that the models were also estimated with the beginning-of-period book value of fixed assets as the scaling variable instead of the estimated beginning-of-period real capital

⁷⁸ It may be noted that the one-step Sargan statistic rejects the overidentifying restrictions. However, Arellano & Bond (1991) show that the Sargan test has a strong tendency to reject too often in the presence of heteroscedasticity.

stock. The results turned out to be robust to the choice of a scaling variable.

Table 4.3 reports results for slightly different model specifications, in order to examine the robustness of the results for the tax incentive effects. Column one reports the results of model estimation with capital expenditure excluded. Both the cash flow and the Z^{-1} effects are significantly reduced in absolute value but the tax incentive effects of *NDTS* and *NDTS* interacted with Z^{-1} are little affected. In column two, the cash flow variable is also excluded, but again the tax incentive effects turn out to be robust. In this specification, Z^{-1} dated $t-1$ loses significance and it turns out that only the negative coefficient of Z^{-1} dated $t-2$ is statistically significant. Overall, the income (*NDTS*) and the substitution (Z^{-1} times *NDTS*) effects of nondebt tax shields appear to be robust to these variations in the model specification. Current *NDTS* has a large and positive coefficient while Z^{-1} times *NDTS* dated $t-1$ has a large and negative coefficient in all specifications.

Column three in table 4.3 presents our preferred restricted equation in which insignificant regressors have been dropped. The preferred equation shows that current cash has a large negative coefficient while one-period lagged cash flow has a positive but smaller effect on borrowing; the overall effect of *EBDIT* on borrowing is negative. The income effect of nondebt tax shields is positive while there is a negative substitution effect as captured by Z^{-1} times *NDTS* dated $t-1$. The one-period lagged utilization rate of nondebt tax shields has a significant negative effect on borrowing. Current investment is strongly positively related to borrowing while investment dated $t-1$ has a negative coefficient. The overall effect of investment on the debt level is however positive, as expected. Finally, the probability of bankruptcy lagged one period has a significant positive effect on the debt level.

Table 4.3 Additional full sample GMM results in first differences testing robustness, 1982-1991, 548 companies, 3478 observations

Dependent variable	(1)	(2)	(3)	(4) (N=3383)
$\Delta(DEBT/K)_t$				
$\Delta(DEBT/K)_{t-1}$	0.3570** (0.0201)	0.3821** (0.0233)	0.4135** (0.0165)	0.4363** (0.0177)
$\Delta(DEBT/K)_{t-2}$	0.0320** (0.0112)	0.0417** (0.0131)	-	0.0271** (0.0093)
$\Delta(EBDIT/K)_t$	-0.1793** (0.0536)	-	-0.2677** (0.0373)	-0.4103** (0.0554)
$\Delta(EBDIT/K)_{t-1}$	0.0814 (0.0460)	-	0.1290** (0.0317)	0.2007** (0.0401)
$\Delta(EBDIT/K)_{t-2}$	-0.0184 (0.0255)	-	-	0.0440* (0.0209)
$\Delta(NDTS/K)_t$	0.8378** (0.0450)	0.7060** (0.0495)	0.7034** (0.0336)	1.0001** (0.0800)
$\Delta(NDTS/K)_{t-1}$	-0.2093** (0.0479)	-0.1438** (0.0445)	-0.2672** (0.0339)	-0.2684** (0.0375)
$\Delta(NDTS/K)_{t-2}$	0.0203 (0.0275)	-0.0188 (0.0226)	-	-0.0561** (0.0209)
$\Delta(Z^{-1} \times NDTS/K)_t$	0.0131 (0.0136)	0.0373 (0.0224)	-	-0.4427** (0.1132)
$\Delta(Z^{-1} \times NDTS/K)_{t-1}$	-0.4403** (0.0618)	-0.4738** (0.0672)	-0.3600** (0.0338)	-0.4170** (0.0542)
$\Delta(Z^{-1} \times NDTS/K)_{t-2}$	-0.0304* (0.0140)	-0.0050 (0.0154)	-	0.1018** (0.0280)
$\Delta URNDTS_{t-1}$	-0.1013** (0.0359)	-0.0850* (0.0405)	-0.1231** (0.0232)	-0.0322 (0.0333)
$\Delta URNDTS_{t-2}$	-0.0097 (0.0264)	-0.0274 (0.0299)	-	-0.0612* (0.0247)
$\Delta(I/K)_t$	-	-	0.4729** (0.0292)	0.5003** (0.0363)
$\Delta(I/K)_{t-1}$	-	-	-0.1358** (0.0146)	-0.1646** (0.0181)
$\Delta(I/K)_{t-2}$	-	-	-	-0.0008 (0.0100)
ΔZ_t^{-1}	-0.0077 (0.0046)	-0.0078 (0.0059)	-	0.2328** (0.0519)
ΔZ_{t-1}^{-1}	0.0256* (0.0122)	0.0172 (0.0132)	0.0558** (0.0098)	0.2117** (0.0406)
ΔZ_{t-2}^{-1}	-0.0144* (0.0065)	-0.0229** (0.0074)	-	-0.0084 (0.0232)

Time dummies	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes
m_1	-6.55	-6.70	-6.40	-6.43
m_2	1.21	1.11	1.00	0.43
Sargan	173.8 (156)	134.4 (130)	213.9 (191)	206.2 (182)
z_1	851.0 (16)	598.5 (13)	2430.2 (10)	1811.4 (19)
z_2	76.9 (10)	66.3 (10)	195.2 (10)	115.0 (10)
z_3	47.0 (8)	37.5 (8)	69.9 (8)	47.4 (8)
Instruments	DEBT/K(2,3), EBDIT/K(2,3), NDTS/K(2,3), $Z^1 \times$ NDTS/K(2,3), URNDTS(3,3), $Z^1(2,3)$, time dummies, industry dummies	DEBT/K(2,3), NDTS/K(2,3), $Z^1 \times$ NDTS/K(2,3), URNDTS(3,3), $Z^1(2,3)$, time dummies, industry dummies	DEBT/K(2,3), EBDIT/K(2,3), NDTS/K(2,3), $Z^1 \times$ NDTS/K(2,3), URNDTS(3,3), $I/K(2,3)$, $Z^1(2,3)$, time dummies, industry dummies	DEBT/K(2,3), EBDIT/K(2,3), NDTS/K(2,3), $Z^1 \times$ NDTS/K(2,3), URNDTS(3,3), $I/K(2,3)$, $Z^1(2,3)$, time dummies, industry dummies

Notes to table 4.3:

- 1) Asymptotic standard errors are reported in parentheses. Standard errors and test statistics are asymptotically robust to heteroscedasticity across companies and over time.
- 2) m_1 is a test for first-order serial correlation and m_2 is a test for second-order serial correlation in the residuals, both asymptotically distributed as $N(0,1)$ under the null of no serial correlation.
- 3) The Sargan statistic is a test of the over-identifying restrictions, asymptotically distributed as $\chi^2(k)$ under the null. It tests whether the instruments are correlated with the error term.
- 4) $z_1(k)$ is a Wald test of joint significance of the reported coefficients, asymptotically distributed as $\chi^2(k)$ under the null of no relationship. $z_2(k)$ is a Wald test of joint significance of the time dummies. $z_3(k)$ is a Wald test of joint significance of the industry dummies.
- 5) Instruments in GMM estimations: the first argument in parentheses indicates the lag length of the latest instrument employed in each cross section; the second argument indicates the number of moment restrictions involving this variable exploited in each cross section.
- 6) Superscript asterisks indicate significance at $p < 0.01$ (**) and $p < 0.05$ (*).

In order to test whether the handful of extreme values for Z^{-1} influence the results, we dropped all observations for which the value of Z^{-1} was more than five standard deviations from the mean. This resulted in a loss of 95 observations. Results of the estimation are reported in column four of table 4.3. The dropping of extreme Z^{-1} observations has the effect that both the current Z^{-1} and the current Z^{-1} interacted with *NDTS* become statistically significant while the sign of the long-run effects of these variables remain unchanged. The coefficient estimate on current *NDTS* also increases noticeably. The dropping of extreme Z^{-1} observations has only minor effects on the other terms in the equation or on the diagnostic statistics. Thus the results show that extreme Z^{-1} values do not drive the tax incentive effects uncovered from the sample, but the hypothesized relationships are more significant if the extreme observations are excluded.

Table 4.4 Additional full sample GMM results with alternative definitions of debt as the dependent variable, 1982-1991, 548 companies, 3478 observations

Dependent variable	(1)	(2)	(3)	(4)
$\Delta(DEBT/K)_t$	Total debt	Long-term debt	Short-term debt	Bank loans
$\Delta(DEBT/K)_{t-1}$	0.4875** (0.0206)	0.4514** (0.0181)	0.4660** (0.0140)	0.4268** (0.0190)
$\Delta(DEBT/K)_{t-2}$	0.0970** (0.0090)	0.0680** (0.0088)	0.0965** (0.0075)	0.0203 (0.0105)
$\Delta(EBDIT/K)_t$	-0.3384** (0.0523)	-0.2073** (0.0377)	-0.0871* (0.0429)	-0.1624** (0.0468)
$\Delta(EBDIT/K)_{t-1}$	0.1818** (0.0452)	0.0237 (0.0253)	0.0830* (0.0369)	0.0720* (0.0357)
$\Delta(EBDIT/K)_{t-2}$	0.0821** (0.0242)	-0.0131 (0.0163)	0.0812** (0.0183)	0.0229 (0.0186)
$\Delta(NDTS/K)_t$	1.9709** (0.0438)	0.6215** (0.0335)	1.3372** (0.0364)	0.1785** (0.0458)
$\Delta(NDTS/K)_{t-1}$	-1.0110** (0.0568)	-0.2339** (0.0316)	-0.7255** (0.0312)	-0.0807* (0.0316)
$\Delta(NDTS/K)_{t-2}$	-0.1823** (0.0265)	0.0566** (0.0141)	-0.1777** (0.0220)	-0.0538** (0.0207)
$\Delta(Z^{-1} \times NDTS/K)_t$	-0.0281 (0.0173)	-0.0260** (0.0092)	0.0135 (0.0128)	-0.0083 (0.0172)
$\Delta(Z^{-1} \times NDTS/K)_{t-1}$	-0.2728** (0.0547)	-0.2000** (0.0252)	-0.1403** (0.0411)	-0.1432** (0.0322)
$\Delta(Z^{-1} \times NDTS/K)_{t-2}$	-0.0553** (0.0157)	-0.0689** (0.0110)	-0.0324* (0.0161)	0.0196 (0.0148)
$\Delta URNDTS_{t-1}$	-0.1813** (0.0357)	-0.0392 (0.0212)	-0.1138** (0.0333)	-0.0453 (0.0278)
$\Delta URNDTS_{t-2}$	-0.0391 (0.0249)	-0.0510* (0.0168)	-0.0369 (0.0244)	-0.0410* (0.0202)
$\Delta(I/K)_t$	0.7375** (0.0377)	0.2515** (0.0239)	0.3833** (0.0342)	0.4315** (0.0300)
$\Delta(I/K)_{t-1}$	-0.2435** (0.0193)	-0.0976** (0.0129)	-0.1034** (0.0138)	-0.1264** (0.0145)
$\Delta(I/K)_{t-2}$	-0.0298** (0.0109)	-0.0261** (0.0081)	-0.0021 (0.0076)	0.0181* (0.0091)
ΔZ_t^{-1}	0.0036 (0.0070)	0.0106** (0.0022)	-0.0115** (0.0041)	-0.0024 (0.0034)
ΔZ_{t-1}^{-1}	0.0372* (0.0208)	0.0369** (0.0082)	-0.0093 (0.0083)	0.0096 (0.0052)
ΔZ_{t-2}^{-1}	0.0048 (0.0041)	-0.0019 (0.0034)	0.0075* (0.0038)	0.0029 (0.0067)

Time dummies	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes
m_1	-7.18	-6.81	-7.89	-7.56
m_2	-0.83	-0.05	-1.07	-0.39
Sargan	195.8 (182)	206.1 (182)	194.3 (182)	204.0 (182)
z_1	5997.0 (19)	2187.0 (19)	6817.4 (19)	1314.4 (19)
z_2	212.0 (10)	194.2 (10)	142.3 (10)	100.9 (10)
z_3	45.0 (8)	35.8 (8)	15.5 (8)	17.7 (8)
Instruments	DEBT/K(2,3), EBDIT/K(2,3), NDTS/K(2,3), $Z^I \times$ NDTS/K(2,3), URNDTS(3,3), I/K(2,3), $Z^I(2,3)$, time dummies, industry dummies	DEBT/K(2,3), EBDIT/K(2,3), NDTS/K(2,3), $Z^I \times$ NDTS/K(2,3), URNDTS(3,3), I/K(2,3), $Z^I(2,3)$, time dummies, industry dummies	DEBT/K(2,3), EBDIT/K(2,3), NDTS/K(2,3), $Z^I \times$ NDTS/K(2,3), URNDTS(3,3), I/K(2,3), $Z^I(2,3)$, time dummies, industry dummies	DEBT/K(2,3), EBDIT/K(2,3), NDTS/K(2,3), $Z^I \times$ NDTS/K(2,3), URNDTS(3,3), I/K(2,3), $Z^I(2,3)$, time dummies, industry dummies

Notes to table 4.4:

- 1) Asymptotic standard errors are reported in parentheses. Standard errors and test statistics are asymptotically robust to heteroscedasticity across companies and over time.
- 2) m_1 is a test for first-order serial correlation and m_2 is a test for second-order serial correlation in the residuals, both asymptotically distributed as $N(0,1)$ under the null of no serial correlation.
- 3) The Sargan statistic is a test of the over-identifying restrictions, asymptotically distributed as $\chi^2(k)$ under the null. It tests whether the instruments are correlated with the error term.
- 4) $z_1(k)$ is a Wald test of joint significance of the reported coefficients, asymptotically distributed as $\chi^2(k)$ under the null of no relationship. $z_2(k)$ is a Wald test of joint significance of the time dummies. $z_3(k)$ is a Wald test of joint significance of the industry dummies.
- 5) Instruments in GMM estimations: the first argument in parentheses indicates the lag length of the latest instrument employed in each cross section; the second argument indicates the number of moment restrictions involving this variable exploited in each cross section.
- 6) Superscript asterisks indicate significance at $p < 0.01$ (**) and $p < 0.05$ (*).

4.4.2 Levels specification with alternative debt measures

Table 4.4 reports results for the GMM estimation of the first-differenced full model specification, in which alternative definitions of debt are used as the dependent variable. Column one reports results for a specification in which the firm's total debt is the dependent variable. The results are very much in line with those obtained with the firm's interest-bearing debt as the dependent variable. The individual coefficients appear to be larger in absolute value but the implied long-run relationships are virtually the same. The positive income effect of *NDTS* is somewhat greater on the firm's total debt than on its interest-bearing debt.

Not surprisingly, in column two, in which the firm's long-term debt is the dependent variable, the results turn out to be similar to those obtained with the firm's interest-bearing debt as the dependent variable but with longer adjustment periods. In particular, the substitution effect of *NDTS* appears to require a longer adjustment period, the coefficients of both interaction terms, dated $t-1$ and $t-2$, are negative and significant.

In column three, with the firm's short-term debt as the dependent variable, these results remain to a large extent unchanged. Adjustment appears to be (not surprisingly) quicker for short-term debt than for long-term debt. An interesting finding is that the overall effect of an increase in *EBDIT* on the short-term debt usage of firms appears to be positive. However, since the short-term debt measure includes many noninterest-bearing debt components (eg trade credit), it is difficult to derive any tax incentive implications from this result.

Finally, the results in column four suggest that bank loans (including loans from other financial intermediaries) are not as sensitive to variations in the firms' cash flow as is the firm's interest-bearing debt. Furthermore, the income effect of nondebt tax shields appears to be rather modest in the case of bank loans compared with other debt measures. On the other hand, the negative substitution effect of nondebt tax shields is surprisingly robust to variations in the definition of debt.

The effect of Z^{-1} on the alternative definitions of debt is rather interesting. Surprisingly, it appears that Z^{-1} has the strongest positive correlation with the firm's long-term debt. In fact, the relationship between Z^{-1} and the firm's short-term debt is negative, which by contrast yields the result that the positive coefficient on Z^{-1} dated $t-1$ is only weakly statistically significant in the equation in which the firm's total debt is the dependent variable. These results imply that the firm's business partners react more rapidly to financial distress than the firm's suppliers of long-term credit. The results in column four, on the other hand, refute the 'relationship banking' hypothesis that banks would be willing to support financially troubled firms through difficult times. The only explanation left is that financially troubled firms have resorted to pension funds for credit by increasing their pension liability deficit when their financial status has deteriorated.

4.4.3 Levels specification testing parameter stability

In table 4.5 we report the results of an investigation of parameter stability, achieved by including as regressors both full sample variables and the same variables multiplied by a dummy that takes the value 1 when the observation is related to the subperiod 1987-1991 (the period of rapid deregulation of the Finnish financial markets) and 0 elsewhere. We report the results for the full model specification with the firm's interest-bearing debt as the dependent variable.

The Wald test statistic for the joint significance of the subperiod dummy interaction terms, z_4 , suggests that there is a significant structural break in Finnish firms' borrowing behaviour. The Wald test statistic is 205.8 compared with a critical value of 24.7 at the 1 per cent significance level. In particular, there appears to have been a shift in the timing of the income effect of nondebt tax shields on borrowing. The current positive effect is much stronger in the latter period while the long-run relationship remains practically the same. There is also a significant shift in the substitution effect of nondebt tax shields on borrowing. The overall effect is negative for both subperiods, but the size of the coefficient is noticeably smaller in absolute terms in the latter period.

Changes in the income and substitution effects of *NDTS* are likely to reflect Finnish firms' reactions to anticipated reforms in the tax code that took effect in 1990 along with the introduction of the imputation system of capital income taxation. The reform reduced considerably the amount of nondebt tax shields available to firms. The proposals to change the tax laws were widely known in the 1980s.

Moreover, there appears to be a shift in the timing of the effect of investment on borrowing between the two subperiods while the overall effect remains practically the same. On the other hand, there is a clear change in the relationship between the utilization rate of *NDTS* (*URNDTS*) and corporate borrowing between the two subperiods. In the first half of the 1980s the effect of *URNDTS* dated $t-1$ on borrowing is negative and significant while in the second half the overall effect is close to zero.

Table 4.5 Full sample GMM results in first differences testing subperiod parameter stability, 1982-1991, 548 companies, 3478 observations

Dependent variable	(1)	Subperiod 1987-1991 dummy
$\Delta(DEBT/K)_t$		
$\Delta(DEBT/K)_{t-1}$	0.3009** (0.0332)	0.0957 (0.0492)
$\Delta(DEBT/K)_{t-2}$	-0.0128 (0.0145)	0.0618* (0.0241)
$\Delta(EBDIT/K)_t$	-0.3407** (0.0905)	0.1283 (0.1115)
$\Delta(EBDIT/K)_{t-1}$	0.1655** (0.0624)	-0.1115 (0.0868)
$\Delta(EBDIT/K)_{t-2}$	0.0313 (0.0303)	-0.1361** (0.0509)
$\Delta(NDTS/K)_t$	0.3688** (0.0648)	0.7598** (0.0947)
$\Delta(NDTS/K)_{t-1}$	-0.0358 (0.0471)	-0.6908** (0.1079)
$\Delta(NDTS)_{t-2}$	0.0483 (0.0278)	-0.0369 (0.0713)
$\Delta(Z^{-1} \times NDTS/K)_t$	-0.0215 (0.0509)	-0.0734 (0.0609)
$\Delta(Z^{-1} \times NDTS/K)_{t-1}$	-0.5482** (0.0752)	0.6707** (0.1066)
$\Delta(Z^{-1} \times NDTS/K)_{t-2}$	0.0255 (0.0189)	-0.2276** (0.0657)
$\Delta URNDTS_{t-1}$	-0.1220* (0.0504)	0.2348** (0.0838)
$\Delta URNDTS_{t-2}$	0.0009 (0.0336)	-0.1343* (0.0566)
$\Delta(I/K)_t$	0.6629** (0.0575)	-0.2019** (0.0701)
$\Delta(I/K)_{t-1}$	-0.1761** (0.0312)	0.1473** (0.0427)
$\Delta(I/K)_{t-2}$	0.0129 (0.0144)	0.0844** (0.0228)
ΔZ_t^{-1}	0.0008 (0.0054)	0.0563* (0.0241)
ΔZ_{t-1}^{-1}	0.1554** (0.0232)	-0.1728** (0.0323)
ΔZ_{t-2}^{-1}	-0.0322** (0.0109)	0.0674** (0.0153)

Time dummies	yes
Industry dummies	yes
m_1	-6.13
m_2	0.66
Sargan	180.5 (163)
z_1	1758.0 (38)
z_2	136.6 (10)
z_3	51.4 (8)
z_4	205.8 (19)
Instruments	$DEBT/K(2,3)$, $EBDIT/K(2,3)$, $NDTS/K(2,3)$, $Z^1 \times NDTS/K(2,3)$, $URNDTS(3,3)$, $I/K(2,3)$, $Z^1(2,3)$, time dummies, industry dummies

Notes to table 4.5:

- 1) Asymptotic standard errors are reported in parentheses. Standard errors and test statistics are asymptotically robust to heteroscedasticity across companies and over time.
- 2) m_1 is a test for first-order serial correlation and m_2 is a test for second-order serial correlation in the residuals, both asymptotically distributed as $N(0,1)$ under the null of no serial correlation.
- 3) The Sargan statistic is a test of the over-identifying restrictions, asymptotically distributed as $\chi^2(k)$ under the null. It tests whether the instruments are correlated with the error term.
- 4) $z_1(k)$ is a Wald test of joint significance of the reported coefficients, asymptotically distributed as $\chi^2(k)$ under the null of no relationship. $z_2(k)$ is a Wald test of joint significance of the time dummies. $z_3(k)$ is a Wald test of joint significance of the industry dummies. $z_4(k)$ is a Wald test of joint significance of the coefficients on the subsample variables.
- 5) Instruments in GMM estimations: the first argument in parentheses indicates the lag length of the latest instrument employed in each cross section; the second argument indicates the number of moment restrictions involving this variable exploited in each cross section.
- 6) Superscript asterisks indicate significance at $p < 0.01$ (**) and $p < 0.05$ (*).

Finally, there appears to be a change also in the impact of Z^{-1} on borrowing as between the two subperiods. The overall effect of Z^{-1} on borrowing is positive and significant in the first half of the sample period but close to zero in the latter half.⁷⁹

In view of the exceptional nature of the time period 1987-1991 it is not surprising that the estimated relationships turn out not to be stable over the whole sample period. In the latter half of the 1980s, as a result of the deregulation of capital flows, the Finnish financial markets were overwhelmed by foreign capital and the economy experienced a period of rapid growth and accelerating inflation. Then, around the turn of the decade, the economy suddenly plunged into the most severe recession since the 1930s.

⁷⁹ Although not reported here, the same also holds true when estimating the model with bank loans as the dependent variable and allowing for the coefficients to vary between the two subperiods. This lends support to the widely held view that in the late 1980s the close ties between banks and companies loosened considerably.

4.4.4 Incremental debt usage model specification

In table 4.6 we report the results of re-estimating the model with the annual change in the level of interest-bearing debt of the firm as the dependent variable. Notice that the dependent variable is obtained by calculating first the first difference in interest-bearing debt and then dividing this by the beginning-of-period replacement cost value of the capital stock. In the GMM method the equation is then estimated in first differences to eliminate the bias resulting from correlation between the explanatory variables and the unobservable firm-specific effects. Therefore, it should be stressed that this specification is not equivalent to the levels specification that was estimated in the first-differenced form in the previous sections. Column one reports the full model specification and column two reports our preferred restricted equation in which insignificant regressors have been dropped.

As a whole, the results are in line with the specification in which the level of interest-bearing debt is the dependent variable. The coefficients of the lagged values of the dependent variable are both negative and highly significant, suggesting that there is some overshooting in the firms' borrowing behaviour. This is to be expected since it is most often debt that is used as a cushion against shocks in the firm's cash flow.

Current cash flow has a negative and large impact on debt issues whereas cash flow lagged one period has a positive impact on debt issues; the overall effect of cash flow on debt issues is negative. The income and substitution effects of nondebt tax shields can also be revealed with this model specification. Current *NDTS* is significant and positively related to debt issues while Z^{-1} times *NDTS* dated $t-1$ is significant and negatively related to debt issues.

Interestingly, the effect of *URNDS* (dated $t-2$) on incremental debt usage turns out to be positive, as implied by the tax incentive hypothesis. The result thus implies that firms tend to issue more debt if they have been able to utilize a greater proportion of the available *NDTS* and thus provides evidence supporting the view that the firm's tax status has a role in determining its incremental borrowing decisions. However, it should be noted that this finding is at odds with results obtained from a levels model specification in previous sections in which *URNDS* (dated $t-1$) turned out to be positively related to the firm's debt level. On the whole, these contradictory findings suggest that there may be some serial correlation in the *URNDS* variable, which makes it difficult to obtain reliable estimates of its true effect. On the other hand, the result also lends support to the views of MacKie-Mason (1990) and Graham (1996),

who argue that tests of the tax incentive effects should have higher power in regressions on the firm's incremental financing decisions.

We also explored whether measuring *NDTS* and *NDTS* interacted with Z^{-1} in the same way as the dependent variable, ie by taking the annual change in the level and scaling it by the beginning-of-period capital stock before taking the first difference — due to the GMM estimation method. Graham (1996) uses the annual change in *NDTS* but *ZPROB* interacted with *NDTS* in levels as explanatory variables in his model. It is not a priori very clear which specification should be used. However, on the basis of the diagnostic statistics it appears that the model specification reported in table 4.6 fits the data best. The results are nevertheless robust to the model specification in this respect.

Finally, it should be noted that the results also for this model specification are robust to variations in the instrument set. Furthermore, the equations do not exhibit second-order serial correlation according to the reported *m2* statistics, and the Sargan test of overidentifying restrictions suggests that the instruments are not correlated with the error term.

Table 4.6 Full sample GMM results in first differences with the annual change in interest-bearing debt as the dependent variable, 1982-1991, 548 companies, 3478 observations

Dependent variable $\Delta(\Delta DEBT/K)_t$	(1)	(2)
$\Delta(\Delta DEBT/K)_{t-1}$	-0.1393** (0.0121)	-0.1334** (0.0113)
$\Delta(\Delta DEBT/K)_{t-2}$	-0.1121** (0.0105)	-0.1063** (0.0095)
$\Delta(EBDIT/K)_t$	-0.5270** (0.0436)	-0.5279** (0.0399)
$\Delta(EBDIT/K)_{t-1}$	0.2340** (0.0319)	0.2250** (0.0300)
$\Delta(EBDIT/K)_{t-2}$	-0.0182 (0.0233)	-
$\Delta(NDTS/K)_t$	0.2143** (0.0489)	0.2327** (0.0406)
$\Delta(NDTS/K)_{t-1}$	-0.0350 (0.0337)	-
$\Delta(NDTS/K)_{t-2}$	-0.0687** (0.0261)	-
$\Delta(Z^{-1} \times NDTS/K)_t$	0.0064 (0.0161)	-
$\Delta(Z^{-1} \times NDTS/K)_{t-1}$	-0.2482** (0.0373)	-0.2527** (0.0283)
$\Delta(Z^{-1} \times NDTS/K)_{t-2}$	-0.0229 (0.0191)	-
$\Delta URNDTS_{t-1}$	-0.0175 (0.0319)	-
$\Delta URNDTS_{t-2}$	0.1025** (0.0273)	0.0599** (0.0203)
$\Delta(I/K)_t$	0.5786** (0.0359)	0.5554** (0.0346)
$\Delta(I/K)_{t-1}$	0.1127** (0.0142)	0.1155** (0.0121)
$\Delta(I/K)_{t-2}$	0.0762** (0.0106)	0.0848** (0.0088)
ΔZ_t^{-1}	-0.0072* (0.0032)	-
ΔZ_{t-1}^{-1}	0.0605** (0.0121)	0.0576** (0.0107)
ΔZ_{t-2}^{-1}	0.0053 (0.0036)	-

$m1$	-8.19	-8.27
$m2$	0.58	0.50
Sargan	209.0 (179)	215.7 (187)
$z1$	923.9 (19)	940.4 (11)
$z2$	210.2 (10)	234.6 (10)
$z3$	17.7 (8)	24.0 (8)
Instruments	$\Delta DEBT/K(2,3),$ $EBDIT/K(2,3),$ $NDTS/K(2,3),$ $Z^1 \times NDTS/K(2,3),$ $URNDTS(4,3), I/K(2,3),$ $Z^1(2,3),$ time dummies, industry dummies	$\Delta DEBT/K(2,3),$ $EBDIT/K(2,3),$ $NDTS/K(2,3),$ $Z^1 \times NDTS/K(2,3),$ $URNDTS(4,3), I/K(2,3),$ $Z^1(2,3),$ time dummies, industry dummies

Notes to table 4.6:

- 1) Asymptotic standard errors are reported in parentheses. Standard errors and test statistics are asymptotically robust to heteroscedasticity across companies and over time.
- 2) m_1 is a test for first-order serial correlation and m_2 is a test for second-order serial correlation in the residuals, both asymptotically distributed as $N(0,1)$ under the null of no serial correlation.
- 3) The Sargan statistic is a test of the over-identifying restrictions, asymptotically distributed as $\chi^2(k)$ under the null. It tests whether the instruments are correlated with the error term.
- 4) $z_1(k)$ is a Wald test of joint significance of the reported coefficients, asymptotically distributed as $\chi^2(k)$ under the null of no relationship. $z_2(k)$ is a Wald test of joint significance of the time dummies. $z_3(k)$ is a Wald test of joint significance of the industry dummies.
- 5) Instruments in GMM estimations: the first argument in parentheses indicates the lag length of the latest instrument employed in each cross section; the second argument indicates the number of moment restrictions involving this variable exploited in each cross section.
- 6) Superscript asterisks indicate significance at $p < 0.01$ (**) and $p < 0.05$ (*).

4.5 Summary of econometric analysis

In this chapter we have carried out econometric analyses of tax incentives and corporate borrowing. In doing so, we ignored a number of factors that on the basis of theoretical arguments or previous empirical studies might have an impact on firms' debt usage and we have focused rather exclusively on tax incentive effects. This narrow focus in the empirical work was made possible by the use of an estimation method that mitigates the effects of omitted variables on the parameter estimates for the variables included in the empirical model.

Table 4.7 reports the long-run relationships between the regressors and the level of interest-bearing debt of a firm implied by the preferred restricted model specification (column three in table 4.3).⁸⁰ The long-run effect of a unit increase in the firm's cash flow is to reduce the firm's debt level by 0.24 units. The long-run income effect of nondebt tax shields on the debt level is 0.74 while the long-run substitution effect of nondebt tax shields (*NDTS* interacted with Z^{-1}) is -0.61. The parameter estimates also suggest that a unit increase in fixed investment induces a 0.57 unit increase in the firm's debt level. Finally, a unit increase in the inverse of Altman's (1968) *Z* score, Z^{-1} , ie an increase in the probability of bankruptcy, somewhat perversely implies a long-run increase of 0.1 units in the firm's debt level.

The most important finding of the empirical work is the fact that the income and substitution effects of nondebt tax shields can be uncovered from the Finnish data. This finding is in line with the theoretical analysis of chapter 2 and with previous empirical findings by Graham (1996) and MacKie-Mason (1990) using US data. Hence this appears to be an empirical regularity that exists both in the US and in Finland.

⁸⁰ The long-run coefficients are obtained in the usual way; ie if we write a dynamic empirical model as $A(L)y_t = B(L)x_t + \varepsilon_t$, where $A(L)$ and $B(L)$ are polynomials of certain order in the lag operator L , then the vector of long-run coefficients can be retrieved by the transformation $B(L)/A(L)$.

Table 4.7 Long-run effects implied by the preferred restricted levels model

	Long-run effect on debt level
<i>EBDIT</i>	-0.24
<i>NDTS (income effect)</i>	0.74
<i>NDTS (substitution effect)</i>	-0.61
<i>URNDS</i>	-0.21
<i>I</i>	0.57
<i>Z⁻¹</i>	0.10

With regard to the other tax incentive variable included in the empirical model, *URNDS*, the results turned out to be more controversial. In the levels model specification, *URNDS* was unexpectedly negatively and significantly related to debt usage while in the firms' incremental borrowing model specification, *URNDS* had the expected positive effect on borrowing. One is tempted to conclude from these mixed results that (as argued by MacKie-Mason 1990 and Graham 1996) using incremental debt usage as the dependent variable leads to more powerful tests in detecting short-run tax incentive effects. However, in view of the fact that the estimated coefficients of *URNDS* were statistically significant in both directions, it is perhaps justified to conclude that empirical evidence with respect to this effect remains ambiguous.

The empirical results also confirm that the short-run role of debt financing in absorbing shocks to the firm's income stream dominates the relationship between cash flow and borrowing.

The positive relationship between the firm's fixed investment and borrowing is in line with the expectations and previous findings. The result suggests that, *ceteris paribus*, Finnish manufacturing companies finance about 57 per cent of their gross fixed investment by debt.

The empirical analysis uncovered a rather interesting relationship between the probability of bankruptcy, *Z⁻¹*, and debt usage. In particular, according to the results, it is the firm's long-term debt that is most significantly positively related to the probability of bankruptcy. It was concluded that the result is most likely due to a special characteristic of the Finnish institutional environment, namely

the fact that in times of financial distress firms have been able to delay their pension fund contributions.

The key results of the empirical analysis were shown to be robust to a number of modifications of the basic model specification. However, it turned out that the estimated relationships are not stable over the whole sample period, 1982-1991. In view of the fact that the Finnish economy and the Finnish financial markets in particular underwent deep structural changes in the late 1980s, this finding is not very surprising. The key results nevertheless turned out to hold in both subperiods, although Finnish firms' adjustment toward a new tax environment already shows up in the weakening of the tax incentive effects (as captured by *NDTS* interacted with Z^{-1}) in the latter subperiod.

5 Conclusions

In this study we have analysed the relationship between tax incentives and corporate borrowing both theoretically and empirically. We constructed a dynamic stochastic model of taxes and corporate financial policy that allowed for interactions with the investment decisions. The model followed closely the approach in Mayer (1986) but was generalized to take into account various systems of capital income taxation. In particular, our focus was on a two-rate system of taxation that was in operation in Finland in the 1980s. As in Mayer, it was shown that when the existence of tax exhaustion is taken into account, an internal financial optimum for a firm may be reached on the basis of tax factors alone, without the need to resort to institutional borrowing constraints. In view of the empirical observation that firms do not pursue extreme financial policies, the theoretical analysis concentrated on examining the properties of the model in the case of an internal financial optimum.

Assuming that an internal financial optimum is attainable, the comparative static analysis of the model revealed that the analytical results with respect to the firm's optimal debt level remained mostly indeterminate due to conflicting income and substitution effects. Nevertheless, it was possible to prove analytically that firms' borrowing responses to changes in the available nondebt tax shields should vary according to their profitability. This analytical result was also confirmed by a simulation analysis.

In the empirical work of the study we have analysed the borrowing behaviour of Finnish companies both descriptively and econometrically. The descriptive analysis focused on flows of finance instead of stocks and reported financing proportions on a gross as well as a net (of accumulation of equivalent financial assets) funding basis. In accordance with previous studies, debt financing seemed to be the dominant source of funds in the Finnish nonfinancial corporate sector on a gross funding basis, while on a net funding basis retentions seemed to be the most preferred form of financing.

Furthermore, the descriptive analysis of interfirm differences revealed that there is significant variation in the degree of tax exhaustion across companies, and also that the degree of tax exhaustion and poor financial performance of the firm are positively correlated. On the other hand, from the theory we learned that, from a purely tax perspective, all firms should aim at a uniform optimal degree of tax exhaustion. It was argued that the observed variation in the degree of tax exhaustion can be explained either by the fact that

the optimal probability of tax exhaustion is firm-specific, eg due to clientele effects, or by taking into account the short-term role of debt in absorbing shocks to the firm's cash flow, with possibly long adjustment periods.

The econometric analysis was carried out on company-level panel data covering 548 Finnish manufacturing companies over the period 1978-1991. In the econometric analysis we employed an estimation method that allowed consistent estimation of the tax incentive effects in the presence of unobservable firm-specific effects. This was accomplished by a two-step generalized method of moments estimation procedure.

The main result of the econometric analysis was the fact that the income and substitution effects of nondebt tax shields on the firm's debt usage could be uncovered. The method adopted to separate these two effects followed the approach of MacKie-Mason (1990) and Graham (1996), which employed US data and different estimation procedures. Hence in this study we were able to provide evidence in favour of the tax-based hypotheses that is consistent with results obtained with US data. With regard to the other tax incentive variable included in our empirical model, the utilization rate of nondebt tax shields, the results turned out to be more controversial.

The key results of the econometric analysis were shown to be robust to a number of modifications of the basic model specification. However, the estimated relationships turned out to be relatively unstable over the total sample period 1982-1991. In view of the exceptional nature of the sample period, this finding was not very surprising. Most importantly, the key results turned out to hold for both subperiods although Finnish firms' adjustment toward a new tax environment already showed up in the weakening of the tax incentive effects in the latter subperiod.

Overall, the results of this study provide support for a positive role for taxation in the firm's financial decision-making. They also imply that changes in the tax system may give rise to significant shifts in the financing behaviour of companies.

As such, the theoretical model employed in this study is not capable of analysing the tax incentive effects of the imputation, or *avoir fiscal*, system of capital income taxation that has been operated in Finland since 1990. In particular, the tax incentive of debt financing appears to disappear in our simplified framework if one takes into account the fact that in 1993 the Finnish tax code was modified so that $u = \tau$ holds. A comprehensive analysis of taxes and corporate borrowing under the Finnish imputation system would require a more detailed description of the current tax code, including

the tax surplus carry-forwards that result from current mainstream corporate tax payments exceeding the tax credit to shareholders. Furthermore, inflation has a greater role in the present imputation system than it had under the two-rate system of taxation.

On the basis of existing studies on the effects of the Finnish tax reform it is apparent that the tax incentive effects on corporate financial policy have changed significantly.⁸¹ All capital income — corporate, dividend and interest income and capital gains — is taxed at a flat tax rate.⁸² Initially the tax rate was set at 25 per cent but it has subsequently been raised to 28 per cent. In general, the imputation system has thus brought about tax neutrality between debt and new equity financing. However, with the introduction of the new system, retained earnings became subject to double taxation. This implies that from a tax perspective firms should currently pay out dividends instead of accumulating retained earnings and issue new equity to finance investments.

In the light of the argument that there is tax neutrality between debt and new equity issues, it may be necessary to resort to nontax-based models to establish a positive role for debt financing in the current institutional environment. However, a comprehensive theoretical analysis of the current Finnish system that would allow for uncertainty has not yet been undertaken. This is a subject that deserves further study.

Finally, a few points are worth noting with regard to the econometric analysis of corporate financial policy. As the results of this study have shown, the short-term role of debt as a cushion to absorb shocks to the firm's cash flow makes it rather difficult to examine the long-run relationship between the firm's profitability and debt usage. In this respect the more traditional approach in the empirical capital structure literature of calculating the variables as averages over a certain time period does have some advantages. However, it must be noted that useful information is lost when average figures are used, and it is questionable whether the relationships can be thought of as remaining stable over longer time periods. Nevertheless, since there exist empirical modelling techniques that are capable of separating the short-run and long-run relationships between the variables, it might be useful to extend the empirical work on financial policy in this direction.

Furthermore, with regard to analysing tax incentive effects on corporate financial policy empirically, a fruitful alternative approach

⁸¹ See eg Myhrman, Kröger, Rauhanen, Junka, Kari & Koskenkylä (1995) and Kanninen (1991b).

⁸² In 1991-1992 there still was some variation in these tax parameters but they have been equal since 1993.

to explaining either the debt level or the incremental borrowing of the firm might be to explain the degree of tax exhaustion of the firm.

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Appendix 1

Proof that terms involving induced changes in s' vanish

We have the general expression for the gross dividends of the firm as

$$(A1.1) \quad E_t(G_t) = \int_{\underline{s}}^{s'} X_t(s) \varphi(s) ds + \hat{\theta} \int_{s'}^{\bar{s}} (X_t(s) - \tau \pi_t(s)) \varphi(s) ds.$$

In the derivation, by applying Leibnitz' rule, we obtain for the terms involving induced changes in s'

$$(A1.2) \quad \frac{\partial E(G_t)}{\partial \xi} = \dots + [X_t(s') - \hat{\theta}(X_t(s') - \tau \pi(s'))] \varphi(s') + \dots$$

For a **classical system**, $\pi(s') = 0 \wedge \hat{\theta} = 1$, and it follows that

$$X_t(s') - (X_t(s') - 0) = 0.$$

For a **two-rate system**, $\pi(s') = v C_t(s') = v X_t(s') \wedge \hat{\theta} = \frac{1}{1 - v\tau}$, and it follows that

$$X_t(s') - \frac{1}{1 - v\tau} (X_t(s') - v\tau X_t(s')) = \left(\frac{1 - v\tau - 1 + v\tau}{1 - v\tau} \right) X_t(s') = 0.$$

For an **imputation system**, $\pi(s') = \frac{1}{1 - u} C_t(s') = X_t(s') \wedge \hat{\theta} = \frac{1}{1 - u}$, and it follows that

$$X_t(s') - \frac{1}{1 - u} (X_t(s') - \tau X_t(s')) = \left(\frac{1 - u - 1 + \tau}{1 - u} \right) X_t(s') = \left(\frac{\tau - u}{1 - u} \right) X_t(s') = 0$$

if $\tau = u$.

Appendix 2

Comparative static properties

We have the two-equation system

$$(A2.1) \quad \begin{cases} G^1(K^*, B^*; \gamma) = E(f_K(K^*)) - \delta - r \left[1 - \frac{\frac{m_b - z}{1 - z}(\Delta - \delta)}{\frac{1 - m_b}{1 - z}r + \Delta} \right] = 0 \\ G^2(K^*, B^*; \gamma) = f(K^*, \Phi^{*-1}(\eta)) - rB^* - \delta K^* = 0 \end{cases}$$

where

$$s' = \Phi^{*-1}(\eta) \quad , \quad \eta = \frac{[(1 - m_b) - (1 - \tau)(1 - z)]\hat{\theta}}{[(1 - m_b) - (1 - \tau)(1 - z)]\hat{\theta} + (m_b - z)}.$$

The Jacobian of the system is given by

$$(A2.2) \quad |J| = \begin{vmatrix} G_{K^*}^1 & G_{B^*}^1 \\ G_{K^*}^2 & G_{B^*}^2 \end{vmatrix} = \begin{vmatrix} E(f_{KK}(K^*)) & 0 \\ f_K(K^*, s') - \delta & -r \end{vmatrix} = -rE(f_{KK}(K^*)) > 0$$

Furthermore, we have

$$G_{K^*}^1 = E(f_{KK}(K^*)) < 0$$

$$G_{K^*}^2 = f_K(K^*, s') - \delta \quad \text{with} \quad \begin{matrix} G_{K^*}^2 > 0 & \text{(profitable firms)} \\ G_{K^*}^2 < 0 & \text{(nonprofitable firms)} \end{matrix}$$

$$G_{B^*}^1 = 0$$

$$G_{B^*}^2 = -r < 0.$$

The comparative static properties can be derived applying Cramer's rule as

$$(A2.3) \quad \begin{cases} \frac{\partial B^*}{\partial \gamma} = \frac{G_\gamma^1 G_{K^*}^2 - G_{K^*}^1 G_\gamma^2}{|J|} \\ \frac{\partial K^*}{\partial \gamma} = \frac{G_{B^*}^1 G_\gamma^2 - G_\gamma^1 G_{B^*}^2}{|J|} \end{cases}$$

In fact, since there is no feedback from the financial decision to the investment decision, the effects of exogenous variables on the optimal capital stock can be derived directly from equation $G^1(K^*, B^*; \gamma) = 0$ in (A2.1). Furthermore, this property of the model enables us to determine the impact of most exogenous variables on the firm's optimal debt/capital ratio even if their effect on the optimal debt level remains ambiguous in general. For this purpose, rewrite $G^2(K^*, B^*; \gamma) = 0$ as

$$(A2.4) \quad r \frac{B^*}{K^*} = \frac{f(K^*, s')}{K^*} - \delta.$$

By total differentiation we obtain

$$(A2.5) \quad r \frac{\partial \left(\frac{B^*}{K^*} \right)}{\partial \gamma} = \frac{\left(f_K \frac{\partial K^*}{\partial \gamma} + f_s \frac{\partial s'}{\partial \gamma} \right) K^* - f \frac{\partial K^*}{\partial \gamma}}{K^{*2}} \\ = \frac{1}{K^*} \left[\left(f_K - \frac{f}{K^*} \right) \frac{\partial K^*}{\partial \gamma} + f_s \frac{\partial s'}{\partial \gamma} \right] \text{ for } \gamma \neq \delta, r$$

$$(A2.6) \quad r \frac{\partial \left(\frac{B^*}{K^*} \right)}{\partial \delta} = \frac{1}{K^*} \left[\left(f_K - \frac{f}{K^*} \right) \frac{\partial K^*}{\partial \delta} + f_s \frac{\partial s'}{\partial \delta} \right] - 1$$

$$(A2.7) \quad \frac{\partial \left(\frac{B^*}{K^*} \right)}{\partial r} = -\frac{1}{r^2} \left(\frac{f}{K^*} - \delta \right) + \frac{1}{r} \left[\frac{1}{K^*} \left[\left(f_K - \frac{f}{K^*} \right) \frac{\partial K^*}{\partial r} + f_s \frac{\partial s'}{\partial r} \right] \right]$$

Finally, note that by the assumptions of the model the following inequalities hold:

$\left(f_K - \frac{f}{K^*}\right) < 0$	concavity of the production function
$f_s > 0$	ordered states of nature
$\frac{f(K^*, s')}{K^*} - \delta = r \frac{B^*}{K^*} \geq 0$	definition of the critical state s'
$(1 - m_b) - (1 - \tau)(1 - z) > 0$	net tax advantage of debt financing
$m_b - z > 0$	tax disadvantage in personal taxation
$\Delta - \delta > 0$	accelerated book depreciation

(a) Corporate tax rate τ

$$G_\tau^1 = 0$$

$$G_\tau^2 = f_s \frac{\partial \Phi^{*-1}(\eta)}{\partial \tau}.$$

Use the definition that $f_s > 0$ and apply the inverse function rule, ie

$$\frac{\partial \Phi^{*-1}(\eta)}{\partial \gamma} = 1 / \frac{\partial \Phi^*(s')}{\partial \gamma} \Leftrightarrow \text{sign} \left(\frac{\partial \Phi^{*-1}(\eta)}{\partial \gamma} \right) = \text{sign} \left(\frac{\partial \Phi^*(s')}{\partial \gamma} \right)$$

$$\begin{aligned} \frac{\partial \Phi^*}{\partial \tau} &= \left\{ \left((1-z)\hat{\theta} + \frac{\partial \hat{\theta}}{\partial \tau} [(1-m_b) - (1-\tau)(1-z)] \right) \left([(1-m_b) - (1-\tau)(1-z)]\hat{\theta} + (m_b - z) \right) \right. \\ &\quad \left. - \left((1-z)\hat{\theta} + \frac{\partial \hat{\theta}}{\partial \tau} [(1-m_b) - (1-\tau)(1-z)] \right) \left([(1-m_b) - (1-\tau)(1-z)]\hat{\theta} \right) \right\} \\ &\quad \times \left([(1-m_b) - (1-\tau)(1-z)]\hat{\theta} + (m_b - z) \right)^{-2} \\ &= \left((1-z)\hat{\theta} + \frac{\partial \hat{\theta}}{\partial \tau} [(1-m_b) - (1-\tau)(1-z)] \right) (m_b - z) \\ &\quad \times \left([(1-m_b) - (1-\tau)(1-z)]\hat{\theta} + (m_b - z) \right)^{-2} \\ &> 0 \end{aligned}$$

where $\frac{\partial \hat{\theta}}{\partial \tau} = \frac{v}{(1-v\tau)^2} > 0$ for a two-rate system and $\frac{\partial \hat{\theta}}{\partial \tau} = 0$ for a classical and an imputation system.

$$\Rightarrow G_{\tau}^2 = f_s \frac{\partial \Phi^{*-1}(\eta)}{\partial \tau} > 0.$$

$$\text{Therefore, } \frac{\partial B^*}{\partial \tau} > 0, \quad \frac{\partial K^*}{\partial \tau} = 0 \quad \text{and} \quad \frac{\partial \left(\frac{B^*}{K^*} \right)}{\partial \tau} > 0$$

(b) Personal tax rate on interest income m_b

$$\begin{aligned} G_{m_b}^1 &= r \left[\frac{\frac{\Delta - \delta}{1-z} \left(\frac{1-m_b}{1-z} r + \Delta \right) + \frac{r}{1-z} \left(\frac{m_b - z}{1-z} (\Delta - \delta) \right)}{\left(\frac{1-m_b}{1-z} r + \Delta \right)^2} \right] \\ &= r \frac{\frac{(\Delta - \delta)(1-z)r}{1-z} + \Delta(\Delta - \delta)}{(1-z) \left(\frac{1-m_b}{1-z} r + \Delta \right)^2} \\ &= \frac{r(\Delta - \delta)(r + \Delta)}{(1-z) \left(\frac{1-m_b}{1-z} r + \Delta \right)^2} > 0 \end{aligned}$$

$$G_{m_b}^2 = f_s \frac{\partial \Phi^{*-1}(\eta)}{\partial m_b}$$

$$\begin{aligned} \frac{\partial \Phi^*}{\partial m_b} &= \frac{-\hat{\theta} \{ [(1-m_b) - (1-\tau)(1-z)] \hat{\theta} + (m_b - z) \} + (\hat{\theta} - 1) \{ [(1-m_b) - (1-\tau)(1-z)] \hat{\theta} \}}{\left([(1-m_b) - (1-\tau)(1-z)] \hat{\theta} + (m_b - z) \right)^2} \\ &= \frac{-\hat{\theta} \{ [(1-m_b) - (1-\tau)(1-z)] + (m_b - z) \}}{\left([(1-m_b) - (1-\tau)(1-z)] \hat{\theta} + (m_b - z) \right)^2} < 0 \end{aligned}$$

$$\Rightarrow G_{m_b}^2 = f_s \frac{\partial \Phi^{*-1}(\eta)}{\partial m_b} < 0$$

$$\text{Therefore, } \frac{\partial B^*}{\partial m_b} \begin{cases} = ? \text{ (profitable firm)} \\ < 0 \text{ (nonprofitable firm)} \end{cases}, \frac{\partial K^*}{\partial m_b} > 0 \text{ and } \frac{\partial \left(\frac{B^*}{K^*} \right)}{\partial m_b} < 0.$$

(c) Personal tax rate on capital gains z

$$\begin{aligned} G_z^1 &= r \left[\frac{-\frac{(\Delta - \delta)(1 - z) - (m_b - z)(\Delta - \delta)}{(1 - z)^2} \left(\frac{1 - m_b}{1 - z} r + \Delta \right) - \frac{(1 - m_b)r}{(1 - z)^2} \left(\frac{m_b - z}{1 - z} (\Delta - \delta) \right)}{\left(\frac{1 - m_b}{1 - z} r + \Delta \right)^2} \right] \\ &= r(1 - m_b) \frac{-\frac{(\delta - \Delta)(1 - z)r}{1 - z} - \Delta(\Delta - \delta)}{(1 - z)^2 \left(\frac{1 - m_b}{1 - z} r + \Delta \right)^2} \\ &= -\frac{r(1 - m_b)(\Delta - \delta)(r + \Delta)}{(1 - z)^2 \left(\frac{1 - m_b}{1 - z} r + \Delta \right)^2} < 0 \end{aligned}$$

$$G_z^2 = f_s \frac{\partial \Phi^{*-1}(\eta)}{\partial z}$$

$$\begin{aligned} \frac{\partial \Phi^*}{\partial z} &= \left\{ (1 - \tau) \hat{\theta} \left[[(1 - m_b) - (1 - \tau)(1 - z)] \hat{\theta} + (m_b - z) \right] \right. \\ &\quad \left. + \left(1 - (1 - \tau) \hat{\theta} \right) \left[[(1 - m_b) - (1 - \tau)(1 - z)] \hat{\theta} \right] \right. \\ &\quad \left. \times \left[[(1 - m_b) - (1 - \tau)(1 - z)] \hat{\theta} + (m_b - z) \right]^2 \right\} \\ &= \frac{\hat{\theta} \left\{ [(1 - m_b) - (1 - \tau)(1 - z)] + (1 - \tau)(m_b - z) \right\}}{\left[[(1 - m_b) - (1 - \tau)(1 - z)] \hat{\theta} + (m_b - z) \right]^2} > 0 \end{aligned}$$

$$\Rightarrow G_z^2 = f_s \frac{\partial \Phi^{*-1}(\eta)}{\partial z} > 0$$

Therefore, $\frac{\partial B^*}{\partial z} \begin{cases} = ? \text{ (profitable firm)} \\ > 0 \text{ (nonprofitable firm)} \end{cases}, \frac{\partial K^*}{\partial z} < 0 \text{ and } \frac{\partial \left(\frac{B^*}{K^*} \right)}{\partial z} > 0.$

(d) Interest rate r

$$\begin{aligned}
 G_r^1 &= - \left[1 - \frac{\frac{m_b - z}{1 - z} (\Delta - \delta)}{\frac{1 - m_b}{1 - z} r + \Delta} \right] + r \left[\frac{- \frac{1 - m_b}{1 - z} \left(\frac{m_b - z}{1 - z} (\Delta - \delta) \right)}{\left(\frac{1 - m_b}{1 - z} r + \Delta \right)^2} \right] \\
 &= -1 + \frac{\frac{m_b - z}{1 - z} (\Delta - \delta) \left(\frac{1 - m_b}{1 - z} r + \Delta \right) - \frac{1 - m_b}{1 - z} r \left(\frac{m_b - z}{1 - z} (\Delta - \delta) \right)}{\left(\frac{1 - m_b}{1 - z} r + \Delta \right)^2} \\
 &= \frac{-(1 - z) \left(\frac{1 - m_b}{1 - z} r + \Delta \right)^2 + (m_b - z) \Delta (\Delta - \delta)}{(1 - z) \left(\frac{1 - m_b}{1 - z} r + \Delta \right)^2} \\
 &= \frac{- \left((1 - m_b) r \left(\frac{1 - m_b}{1 - z} r + \Delta \right) \right) - (1 - m_b) r \Delta - (1 - z) \Delta^2 + (m_b - z) \Delta (\Delta - \delta)}{(1 - z) \left(\frac{1 - m_b}{1 - z} r + \Delta \right)^2} \\
 &= - \frac{(1 - m_b) \Delta (r + \Delta) + (m_b - z) \delta \Delta}{(1 - m_b)(1 - z) \left(\frac{1 - m_b}{1 - z} r + \Delta \right)^2} < 0
 \end{aligned}$$

$$G_r^2 = -B^* < 0.$$

Therefore, $\frac{\partial B^*}{\partial r} \begin{cases} < 0 \text{ (profitable firm)} \\ = ? \text{ (nonprofitable firm)} \end{cases}, \frac{\partial K^*}{\partial r} < 0 \text{ and } \frac{\partial \left(\frac{B^*}{K^*} \right)}{\partial r} = ?.$

(e) Rate of economic depreciation δ

$$G_{\delta}^1 = -1 + r \left[-\frac{\frac{m_b - z}{1 - z}}{\frac{1 - m_b}{1 - z} r + \Delta} \right] = -\frac{\left(\frac{1 - m_b}{1 - z} r + \Delta \right) + \frac{m_b - z}{1 - z} r}{\frac{1 - m_b}{1 - z} r + \Delta}$$

$$= -\frac{(r + \Delta)}{\frac{1 - m_b}{1 - z} r + \Delta} < 0$$

$$G_{\delta}^2 = -K^* < 0.$$

Therefore, $\frac{\partial B^*}{\partial \delta} \begin{cases} < 0 \text{ (profitable firm)} \\ = ? \text{ (nonprofitable firm)} \end{cases}, \frac{\partial K^*}{\partial \delta} < 0 \text{ and } \frac{\partial \left(\frac{B^*}{K^*} \right)}{\partial \delta} = ?.$

(f) Nondebt tax shields Δ

$$G_{\Delta}^1 = r \left[\frac{\frac{m_b - z}{1 - z} \left(\frac{1 - m_b}{1 - z} r + \Delta \right) - \frac{m_b - z}{1 - z} (\Delta - \delta)}{\left(\frac{1 - m_b}{1 - z} r + \Delta \right)^2} \right]$$

$$= r \left[\frac{\frac{m_b - z}{1 - z} \left(\frac{1 - m_b}{1 - z} r + \delta \right)}{\left(\frac{1 - m_b}{1 - z} r + \Delta \right)^2} \right] > 0$$

$$G_{\Delta}^2 = 0.$$

Therefore, $\frac{\partial B^*}{\partial \Delta} \begin{cases} > 0 \text{ (profitable firm)} \\ < 0 \text{ (nonprofitable firm)} \end{cases}, \frac{\partial K^*}{\partial \Delta} > 0 \text{ and } \frac{\partial \left(\frac{B^*}{K^*} \right)}{\partial \Delta} < 0.$

(g) Rate of dividend deduction v

Under a two-rate system, $\hat{\theta} = \frac{1}{1-v\tau}$ and $\frac{\partial \hat{\theta}}{\partial v} = \frac{\tau}{(1-v\tau)^2} > 0$.

$$G_v^1 = 0$$

$$G_v^2 = f_s \frac{\partial \Phi^{*-1}(\eta)}{\partial v}$$

$$\begin{aligned} \frac{\partial \Phi^*}{\partial v} &= \left\{ [(1-m_b) - (1-\tau)(1-z)] \frac{\partial \hat{\theta}}{\partial v} \{ [(1-m_b) - (1-\tau)(1-z)] \hat{\theta} + (m_b - z) \} \right. \\ &\quad \left. - [(1-m_b) - (1-\tau)(1-z)] \frac{\partial \hat{\theta}}{\partial v} \{ [(1-m_b) - (1-\tau)(1-z)] \hat{\theta} \} \right\} \\ &\quad \times \{ [(1-m_b) - (1-\tau)(1-z)] \hat{\theta} + (m_b - z) \}^2 \\ &= \frac{\frac{\partial \hat{\theta}}{\partial v} [(1-m_b) - (1-\tau)(1-z)] (m_b - z)}{\{ [(1-m_b) - (1-\tau)(1-z)] \hat{\theta} + (m_b - z) \}^2} > 0 \end{aligned}$$

$$\Rightarrow G_v^2 = f_s \frac{\partial \Phi^{*-1}(\eta)}{\partial v} > 0$$

$$\text{Therefore, } \frac{\partial B^*}{\partial v} > 0, \quad \frac{\partial K^*}{\partial v} = 0 \quad \text{and} \quad \frac{\partial \left(\frac{B^*}{K^*} \right)}{\partial v} > 0.$$

(h) Rate of imputation u

Under an imputation system, $\hat{\theta} = \frac{1}{1-u}$ and $\frac{\partial \hat{\theta}}{\partial u} = \frac{1}{(1-u)^2} > 0$.

$$G_u^1 = 0$$

$$G_u^2 = f_s \frac{\partial \Phi^{*-1}(\eta)}{\partial u}$$

$$\begin{aligned} \frac{\partial \Phi^*}{\partial u} &= \left\{ [(1-m_b) - (1-\tau)(1-z)] \frac{\partial \hat{\theta}}{\partial u} \{ [(1-m_b) - (1-\tau)(1-z)] \hat{\theta} + (m_b - z) \} \right. \\ &\quad \left. - [(1-m_b) - (1-\tau)(1-z)] \frac{\partial \hat{\theta}}{\partial u} \{ [(1-m_b) - (1-\tau)(1-z)] \hat{\theta} \} \right\} \\ &\quad \times \left([(1-m_b) - (1-\tau)(1-z)] \hat{\theta} + (m_b - z) \right)^{-2} \\ &= \frac{\frac{\partial \hat{\theta}}{\partial u} [(1-m_b) - (1-\tau)(1-z)] (m_b - z)}{\left([(1-m_b) - (1-\tau)(1-z)] \hat{\theta} + (m_b - z) \right)^2} > 0 \end{aligned}$$

$$\Rightarrow G_u^2 = f_s \frac{\partial \Phi^{*-1}(\eta)}{\partial u} > 0$$

$$\text{Therefore, } \frac{\partial B^*}{\partial u} > 0, \quad \frac{\partial K^*}{\partial u} = 0 \quad \text{and} \quad \frac{\partial \left(\frac{B^*}{K^*} \right)}{\partial u} > 0.$$

Appendix 3

Data presentation and sampling procedure

The individual company accounts data employed in the study are provided by Statistics Finland. Statistics Finland compiles annually the financial statements statistics on the basis of the corporate income statement and balance sheet data that it collects. The financial statements statistics are published in an aggregate form covering eg the manufacturing industry as a whole. Due to the fact that the individual company accounts data are classified material, the data were provided anonymously, ie only the manufacturing subsector in which the firm belongs was indicated.

The data collection procedure applied by Statistics Finland in constructing the financial statements statistics is as follows. The statistical unit is an independent enterprise; groups of companies are not covered. Furthermore, central and local government enterprises, voluntary associations and foundations are excluded from the data. The data are collected from companies using official Statistics Finland questionnaires. All large companies are surveyed each year whereas a rotating sample is taken of the small companies. In manufacturing, a company is classified as large if it has 100 or more employees. The sample of small firms is selected by stratified sampling using the firm's activity and size group of personnel as stratification variables. In constructing the industry level statistics, the data obtained from accepted responses is raised to the population level using proportional estimation with the turnover figure for the population as the raising variable. In cases where the length of the accounting period deviates from twelve months, the data have been adjusted to correspond to a twelve-month accounting period. In 1990 the coverage of the sample was 83 per cent in manufacturing in terms of aggregated turnover.

The raw sample employed in this study is composed of company accounts records of a total of 623 Finnish manufacturing companies drawn from the financial statements statistics of Statistics Finland. The time period covered by the raw sample is 1978-1991. In our chosen estimation method for the econometric analysis, we employ a first-differenced model with lags of two periods, and use a one-period lagged scaling variable. Therefore, the basic criterion for inclusion of

observations in the raw sample was that at least five years of consecutive data were available.

From the raw sample, further observations were dropped according to the following criteria. First, neither missing observations nor observations taking the value zero in the key variables were allowed. Secondly, since in a first-differenced model observations with extreme changes have a disproportionate effect on the results, it was required that the year-on-year increase (decrease) in either the book value of total assets or in turnover must not exceed 200 per cent (67 per cent). Finally, the construction of a key explanatory variable (Z^{-1}) forced us to reject another 185 observations from the raw sample. These criteria resulted in a final sample covering 548 companies and 3 478 observations.

It should be noted that the number of records on each firm varies in the sample and that only 179 firms existed for the entire sample period. The structure of the sample by number of observations per company is given in table A3.1. Furthermore, Statistics Finland classifies companies into manufacturing subsectors according to the activity for which the aggregate value added is the largest. The financial statements statistics use a three-digit application of the industrial classification. For the purposes of this study, the companies were reallocated into nine subsectors of manufacturing. Table A3.2 shows how the companies are distributed across different manufacturing subsectors.

Finally, it should be noted that after accounting for first-differencing, explanatory variables with lags of two periods and the use of a one-period lagged scaling variable, the time period of the econometric analysis is reduced to 1982-1991.

Table A3.1 Details of the final sample

Number of records per company	Number of companies
5	50
6	53
7	42
8	54
9	34
10	41
11	27
12	27
13	41
14	179

Table A3.2 Sample breakdown by industry class

Group	Industry	SIC classes	Number
1	Food, drink and tobacco	11	87
2	Textiles, clothing, leather and footwear	12, 13	86
3	Timber and wooden furniture	14, 17	49
4	Pulp, paper and paper products	15	33
5	Printing and publishing	16	51
6	Chemicals and man made fibres	18, 19	46
7	Other minerals and mineral products	22	16
8	Mechanical, electrical and instrument engineering	24, 25, 26, 27	128
9	Other	9, 23, 29, 31	52

'Other' includes 'Mining and quarrying', 'Basic metal industries', 'Other manufacturing industries', and 'Electricity supply'.

Appendix 4

Construction of the variables from company accounts data

The variables were constructed as follows:

<i>Total debt</i>	Book value of total loan capital plus other long-term liabilities (including unfunded liabilities of pension funds).
<i>Long-term debt</i>	Book value of long-term liabilities.
<i>Short-term debt</i>	Book value of short-term liabilities.
<i>Interest-bearing debt</i>	Book value of total interest-bearing liabilities.
<i>Trade credits</i>	Accounts payable plus advances received plus suppliers' credits.
<i>Bank loans</i>	Book value of loans from banks and other financial intermediaries.
<i>New equity capital</i>	Increase in share capital, share issue or partners' investments plus gains/losses from issue. (Gains/losses from issue were available only for 1989-1991.)
<i>Retentions</i>	Operating income plus financial income plus extraordinary income less interest expenses less taxes less dividends.
<i>Dividends</i>	Total dividends paid.
<i>Taxes</i>	Direct taxes less tax refunds plus taxes paid from equity.

Interest expenses

Interest expenses plus other expenses on liabilities.

Fixed assets Book value of total fixed assets.

Inventory Book value of inventory.

Financial assets

Book value of financial assets.

Cash flow Operating income plus financial income plus extraordinary income.

EBDIT Earnings before depreciation, interest and taxes (= operating income).

Gross investment

Total new fixed assets.

Net investment

Total new fixed assets less sales (including capital gains/losses) of fixed assets.

Production Production.

Sales Turnover.

Replacement cost value of the capital stock

This was calculated using the perpetual inventory formula

$$p'_{t+1}K^i_{t+1} = p'_tK^i_t(1 - \delta^i)(p'_{t+1}/p'_t) + p'_{t+1}I^i_{t+1} \quad \text{for } i = P, B$$

where $p'_tI^P_t$ and $p'_tI^B_t$ denote the value of investment in plant and machinery and buildings respectively. The value of investment was obtained by deducting from gross fixed new investment sales of existing fixed assets (including capital gains/losses). Values for δ of 12.51% for plant and machinery and 4.87% for buildings were used, as taken from estimates in Ilvonen ("Verouudistuksen vaikutukset investointien efektiivisiin marginaaliveroasteisiin", Tampere Economic Working Papers 8/1990) for the Finnish

manufacturing industry. For starting values it was assumed that the replacement cost and historic cost valuations of the capital stock were equal in the first year of data. The replacement cost value of total fixed capital was finally obtained by summing the replacement cost values of plant and machinery, and buildings. The price of investment goods (p') was an implicit price deflator for gross fixed investment by manufacturing industry, calculated by the Statistics Finland.

Economic depreciation

This was calculated from the replacement cost values of plant and machinery and buildings respectively, using estimates of the rate of economic depreciation by Ilvonen (1990).

Available nondebt tax shields

Maximum accounting depreciation plus maximum inventory undervaluation as stipulated in the tax law.

Utilized nondebt tax shields

Total realized accounting depreciation plus inventory undervaluation.

Appendix 5

Table A5.1 Full sample one-step GMM results in first differences, 1982-1991, 548 companies, 3478 observations

Dependent variable	
$\Delta(DEBT/K)_t$	
$\Delta(DEBT/K)_{t-1}$	0.4136** (0.0704)
$\Delta(DEBT/K)_{t-2}$	0.0120 (0.0411)
$\Delta(EBDIT/K)_t$	-0.3736** (0.1305)
$\Delta(EBDIT/K)_{t-1}$	0.1343 (0.1022)
$\Delta(EBDIT/K)_{t-2}$	0.0104 (0.0690)
$\Delta(NDTS/K)_t$	0.7409** (0.1528)
$\Delta(NDTS/K)_{t-1}$	-0.2972* (0.1367)
$\Delta(NDTS/K)_{t-2}$	0.0373 (0.0751)
$\Delta(Z^{-1} \times NDTS/K)_t$	-0.0362 (0.0351)
$\Delta(Z^{-1} \times NDTS/K)_{t-1}$	-0.3383* (0.1564)
$\Delta(Z^{-1} \times NDTS/K)_{t-2}$	-0.0186 (0.0455)
$\Delta URNDTS_{t-1}$	-0.0702 (0.0776)
$\Delta URNDTS_{t-2}$	-0.0860 (0.0630)
$\Delta(I/K)_t$	0.5317** (0.1044)
$\Delta(I/K)_{t-1}$	-0.1407* (0.0579)
$\Delta(I/K)_{t-2}$	0.0234 (0.0338)
ΔZ_t^{-1}	-0.0036 (0.0097)
ΔZ_{t-1}^{-1}	0.0474 (0.0334)
ΔZ_{t-2}^{-1}	-0.0033 (0.0185)

Time dummies	yes
Industry dummies	yes
m_1	-5.54
m_2	0.54
Sargan	402.1 (182)
z_1	194.5 (19)
z_2	44.1 (10)
z_3	16.9 (8)
Instruments	$DEBT/K(2,3)$, $EBDIT/K(2,3)$, $NDTS/K(2,3)$, $Z^1 \times NDTs/K(2,3)$, $URNDTS(3,3)$, $IK(2,3)$ $Z^1(2,3)$, time dummies, industry dummies

Notes to table A5.1:

- 1) Asymptotic standard errors are reported in parentheses. Standard errors and test statistics are asymptotically robust to heteroscedasticity across companies and over time.
- 2) m_1 is a test for first-order serial correlation and m_2 is a test for second-order serial correlation in the residuals, both asymptotically distributed as $N(0,1)$ under the null of no serial correlation.
- 3) The Sargan statistic is a test of the over-identifying restrictions, asymptotically distributed as $\chi^2(k)$ under the null. It tests whether the instruments are correlated with the error term.
- 4) $z_1(k)$ is a Wald test of joint significance of the reported coefficients, asymptotically distributed as $\chi^2(k)$ under the null of no relationship. $z_2(k)$ is a Wald test of joint significance of the time dummies. $z_3(k)$ is a Wald test of joint significance of the industry dummies.
- 5) Instruments in GMM estimations: the first argument in parentheses indicates the lag length of the latest instrument employed in each cross section, the second argument indicates the number of moment restrictions involving this variable exploited in each cross section.
- 6) Superscript asterisks indicate significance at $p < 0.01$ (**) and $p < 0.05$ (*).

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