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An Empirical Investigation of the Association Between Firm Characteristics and the Capital Structure Decision In High Technology Companies

By

Suduan Chen

A DISSERTATION

Submitted to
School of Business and Entrepreneurship
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Entitled

AN EMPIRICAL INVESTIGATION OF THE ASSOCIATION BETWEEN FIRM CHARACTERISTICS AND THE CAPITAL STRUCTURE DECISION IN HIGH TECHNOLOGY COMPANIES

By

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We hereby certify that this Dissertation submitted by Suduan Chen confirms to acceptable standards, and as such as is fully adequate in scope and quality. It is therefore approved as the fulfillment of the Dissertation requirements for the degree of Doctor of Business Administration-Accounting Specialization.

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2000

CERTIFICATION STATEMENT

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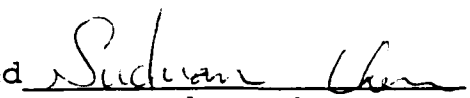
Signed 
Suduan Chen

ABSTRACT

An Empirical Investigation of the Association Between Firm Characteristics and the Capital Structure Decision In High Technology Companies

By

Suduan Chen

The primary purpose of this research is to assess the debt and equity financing of high technology companies and to assess whether a number of independent variables (e.g., tax advantage of debt, agency costs of debt, information asymmetric, bankruptcy cost, business risk, product market/input force, and corporate control) which previous literature has suggested as being important determinants of the level of debt usage in the firm's capital structure.

High technology companies are interested because they face a financial environment which cannot always reflect its characteristics - rapid growth, competition, technological innovation, and research and development. The explosive growth of high technology companies in the 1990s present an opportunity to examine if their financing patterns are consistent with corporate finance theory. So far, No consistent strategy of current capital structure policies in high technology companies has been identified in the research available.

This research finds that firm size, cost variability, corporate tax shields, depreciation tax shields, research and development costs, and earning variability are statistically related to the level of debt financing of high technology companies. The positive signs associated with firm size, corporate tax, research and development costs, earning variability, and cost variability are consistent with the prediction of more debt by large firms, high cost and earning variability, high corporate tax, and high research and development costs companies. However, the positive sign associated with depreciation tax shields was not as predicted. Finally, the predictions of business risk with regard to cash flow variability, asymmetric information hypothesis with regard to firm profitability, agency costs theory with regard to growth opportunities and dividend payment, and corporate control with regard to managerial ownership are not supported in this study.

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CHAPTER 1

INTRODUCTION

Background of the Problem

Capital is a critical resource for all firms. The capital structure of a company is an important influence on its profitability and stability. The main types of capital resource available to any firm fall into two broad categories: debt. Which consists of a contractual agreement whereby the firm borrows a fixed amount and undertakes to repay it at some specified time. And equity, where the firm essentially sells some of the ownership rights in the firm in order to gain funds. These two major classes of financial liabilities-debt and equity-are associated with different levels of benefits and control. Questions related to the choice of financing have increasingly gained importance in strategic management research. While a high proportion of debt may make a company highly profitable as it is growing, it also increases the probability of bankruptcy and ruin, especially if that growth slows down or temporarily becomes negative.

A number of theories (e.g., asymmetry information, agency theory, static trade-off theory) have been proposed

to explain the variation in debt and equity financing across firms. The theories suggest that firms select debt and equity financing depending on attributes that determine the various costs and benefits associated with debt and equity financing.

Modigliani and Miller (1958) were the first to raise the issue of capital structure relevance. They argued that in a world of perfect capital markets and no taxes a firm's financial structure does not influence its cost of capital and, consequently, there is no optimal capital structure. They posit that a firm's value increases as its debt-to-equity ratio increases due to a corporate tax shield effect. However, Stiglitz (1988) pointed out that MM paper was based on unrealistic perfect market economic theory. The importance of their work was that it prompted a re-examination of their assumptions in more realistic contexts. Extensions (e.g., Jensen & Meckling, 1976; DeAngelo & Masulis, 1980; Leland, 1994) argue that an increasing debt-equity leads to ever rising leverage-related costs such that firm value will eventually stop increasing.

In a recent review of capital structure studies, Harris and Raviv (1999) point out that, while the models survey have identified many potential determinants of capital structure, their importance in various contexts and

environments has yet to be sorted out. Several areas of examination have been advanced in the literature attempting to sort out the various potential determinants of capital structure and their effects. Different firm-related characteristics such as size (Warner, 1977; Wedig, Sloan, & Morrisey, 1988), growth opportunities (Myers, 1984; Titman & Wessels, 1988), business risk (Kim, 1984; Wedig, Sloan, & Morrisey, 1988), bankruptcy costs (Kale, Noe, & Ramirez, 1991; Myers, 1984, Shleifer & Vishny, 1992), agency costs (Jensen & Meckling, 1976, Mehran, 1992), and tax shields (DeAngelo & Mauslis, 1980; Cordes & Sheffrin, 1983) were generally considered to be among the determinants of the capital structure of a firm. The only consistent finding among these studies is that debt and equity financing often varies with firm size. Other firm-specific characteristics are not as consistent.

This paper focuses on the financing choice of high technology companies. Because high technology companies' unique characteristics of corporate tax deductibility of research and development costs and the distribution of their income earned in each period, the traditional capital structure models based on tax and information asymmetry may lead to different implications. The explosive growth of high technology companies in the 1990s present an

opportunity to examine if their financing patterns are consistent with corporate finance theory. So far, No consistent strategy of current capital structure policies in high technology companies has been identified in the research available.

The Purpose of the Study

The primary purpose of this research is to assess the debt and equity financing of high technology companies and to assess whether a number of independent variables which previous literature has suggested as being important determinants of the level of debt usage in the firm's capital structure. High technology companies are interested because they face a financial environment which cannot always reflect its characteristics - rapid growth, competition, technological innovation, and research and development.

Information asymmetry in high technology companies occurs because the insiders know more about new product innovation than it will reveal to outside capital suppliers. This causes companies with favorable prospects to rely upon internal financing and the issuance of safe securities as much as possible to avoid the underpricing or the rejection of an otherwise valuable project. As a rapidly growing

industry, research and development is one of the main features of the technological companies, high technology firms face the problem of raising capital from the financial markets in order to take advantage of high competition. Also because high technology firms are growing rapidly, any financial incentives are likely to be magnified, and as a consequence, high technology data tests can provide valuable links between capital structure and firms specific characteristics.

Theoretical Framework

Research into capital structure preferences abounds in both academic and practitioner publications. Several of the capital structure studies use an agency framework (e.g., Jensen & Meckling, 1976; Ryen, Vascancellos, & Kish, 1997) to explain variations in the capital structure. The agency theory viewpoint of debt has had a strong influence on strategic management research (Garvey, 1997). Agency theory focuses on how the gap between management and ownership can lead to conflicting interests between managers, bondholders, and owners (Jensen & Meckling, 1976). Agency theory proposes that debts reduce agency costs incurred by shareholders through increased managerial monitoring and pressure to meet interest payments. Jensen and Meckling (1976) were one of

the first to suggest that forces agents to take more care with their investments and that it reduces agency costs by performing a monitoring role valuable to investors. They argue that the existence of agency costs for both debt and equity results in an optimal capital structure that minimizes the combined agency costs. Agency costs of debt theory is supported by Grossman and Hart (1982), who argue that financial leverage can reduce agency costs by increasing the possibility of bankruptcy and providing a managerial discipline.

Another framework for explaining variations in firms' capital structure is the asymmetry information hypothesis. Asymmetry information signaling models posit different levels of information between insiders and outsiders such that behavior conveys information about firm value to outsiders. Myers and Majluf (1984) derive a pecking order theory of capital structure under asymmetric information where managers have superior information over investors concerning the value of the firm under alternative investment strategies. Pecking order theory states that managers may use capital structure to signal information about the firm's expected future cash flows and operation risk. Asymmetry information also leads to a financing pecking order where firms initially prefer to use available

internal funds to finance new projects in order to reduce costs when new debt or equity is underpriced by uninformed investors (Ryen et al, 1997). If this source proves inadequate the firm may resort to external funding. The pecking order hypothesis is supported by Bayless and Diltz (1994) who found that debt asymmetrical information leads to a hierarchy of preferred financing according to the relative costs of each security. Copeland and Weston (1988, p. 507) note that the dynamics of the pecking order theory implies that "an unusually profitable firm in an industry with relatively slow growth will end up with an unusually low debt-to-equity-ratio".

The third theory applied to explain the variations of capital structure was static trade-off theory. Static trade-off theory focused on the effects of capital structure on tax effect and exogenously specified administrative costs of bankruptcy. This theory states that firm with higher bankruptcy costs or lower tax advantages should use less debt. Modigliani and Miller (1958) stated that in a perfect world without taxes, changes in leverage should have no effect on a firm's value. However, many corporations have only a moderate amount of debt, which leads to the consideration of bankruptcy and liquidation costs due to the existence of market imperfections (Kochhar, 1996).

Accordingly, the observed capital structure may be explained by a trade-off theory: firms balance bankruptcy costs against tax advantage of debt. This theory was supported by many researchers (e.g., DeAngelo and Masulis, 1980; Givoly, et al. 1992; Graham, 1996).

Research Questions

The study aims to fill gaps in the literature by examining empirically the relationship between use of debt finance and factors related to it. Specifically, the following research questions are addressed:

1. What types of capital structure do Taiwanese technological companies use?
2. What factors influence levels of leverage among these companies?

Contributions of The Study

This study is expected to provide additional knowledge about corporate capital structure choices in the developing countries context. Such knowledge is expected to provide useful information for international audiences. In the Taiwanese context, the study is of great importance to certain groups such as creditors, investors, financial analysts, and regulatory authorities. An improved

understanding of management's debt financing incentives could help creditors in making proper evaluations of the inherent risk of an engagement and the related borrowing effort decisions. Similarly, investors could make decisions on which stocks to buy or sell and how much to spend on an information search based on their evaluation of a firm's debt financing incentives. It could also help regulatory authorities such as the SEC in properly evaluating existing stock ownership and others such as the FASB in identifying areas that may need further regulation.

Scope and Limitation

The scope of the research is limited to capital structure decision of high technology firms in Taiwan. A review of the relevant literature revealed that studies of the capital structure choices have been conducted among companies listed on the stock exchange of developed countries. An examination of capital structure on a relatively young and rapid growth industry in Taiwan will give some insight into the practice of corporate capital structure in a developing country.

Taiwan's highly technological firms were founded in 1980. The Hsinchu Science-based Industrial park (HSIP) was established with the aim of creating a center for the

development of high-tech industries in Taiwan, providing a high quality environment for both working and living. During the last 18 years, the government invested more than US$621 million in software and hardware facilities for the park, providing the high-tech industries a centralized space for development. The number of high-tech companies in the HSIP grew to two hundred and seventy-two in 1998. Of the companies in the park, two hundred and twenty-two were domestically owned and fifty were foreign-owned. HSIP companies are classified into six categories: Integrated Circuits, Computers and Peripherals, Telecommunication, Optoelectronics, Precision Machinery and Materials, and Biotechnology. HSIP firms' combined sales were US$14 billion. Aggregate investment increased by 24% from 1997 to reach US$16 billion. Domestic sources accounted for 90% of HSIP investment capital, while foreign sources accounted for 10%. HSIP firms by region of ownership: R.O.C. 81%, Europe, 2%, Asia, 4%, America, 13%. In the area of new investment, 42 new firms entered the park in 1998, with new investments amounting to US$968 million. In 1998, 84 companies increased US$4,042 million as the expanded capital. Thirty-nine companies of the integrated circuits sector alone raised a total of US$2,782 million in new capital.

Definition of Terms

Some of the most commonly used terms in this study are: *High Technology*: High technology represents advanced developments in an area of technology. Prentice Hall Encyclopedic (p. 159) defines high technology as "The phrase applied to new and rapidly expanding technologies such as those involved in electronics....". The high technology arena includes a critical portion of the economy of all developed and newly industrialized countries. Considerable discussion has been focused on definitional clarity of the high technology firm. Kleingartner and Anderson (1987) identify high tech firm as: The proportion of engineers and scientists is higher than in other industries; New products and production methods are based on scientific applications; R&D expenditures are higher than in other manufacturing firms. Mohran (1990, P 263) defines high technology industries as "These firms employ a large portion of scientists, engineers, and technologies; They have an unusually high percentage of R&D expenditures; The emergence of new technology makes existing technology obsolete very quickly; And high technology industries have the potential for extremely rapid growth, as the applications of new technology make possible the emergence of a stream of new products and processes."

High technology firms have different definitions specifying different researcher's purposes. This study is based on CorpTech Directory of Technology Industries and a review of several researchers' definitions of high technology firms. It included: Automation, Telecommunications, Biotechnology, Computer Hardware, Pharmaceuticals, Photonics, Medical Instruments, and Assembles and Components.

Agency Costs: An agency represents the relationship between two parties, one a principal and the other an agent who represents the principal in transactions with a third party. These separations produce conflicts and give rise to agency cost. Agency costs include the costs of structuring, monitoring, and bonding a set of contracts among agents with conflicting interests. Agency costs also include the value of output lost because the costs of full enforcement of contracts exceed the benefits. (Jensen & Meckling, 1976)

Bankruptcy Costs: Bankruptcy costs include direct costs such as legal and accounting fees, managerial costs of administrating the bankruptcy and the indirect costs which include maintenance costs and lost sales and profits due to bankruptcy procedures (Warner, 1977). Litzenberger and Sosin

(1979) categorize bankruptcy costs into two groups: The first includes costs associated with wealth re-distribution (e.g, bankrupt firm's customers switch to a competitor) and the second consists of the dead weight losses to the society (e.g., increased costs of production brought about by the shift in the production to less efficient companies). Because of the difficulties in quantifying indirect costs, the empirical study concentrates on the direct costs of bankruptcy only. ___

Organization of the Study

This chapter focuses on the concept of capital structure decisions and how agency theory, information asymmetry hypothesis, and static trade-off theory affect managers' decisions as to whether or not they should use debt or equity financing.

Chapter Two contains a review of the relevant literature on capital structure decisions. It includes studies pertaining to the environment of high technology firms. And, relationships between capital structure decisions and each of the following: agency costs, information asymmetry, bank and administrative costs, and tax shields.

Chapter Three develops the research hypotheses, presents the plans and procedures for sample selection and data collection, specifies the method for testing nonresponse bias, and identifies the statistics for testing the hypotheses.

CHAPTER II

REVIEW OF THE LITERATURE

In this chapter, a brief review of selected aspects of different areas of the related research literature is presented. The review of literature and research will cover the following five sub-topics: theoretical framework, optimal capital structure, determinants of corporate capital structure, and high technology environment. This review helps to provide a framework for the study, serves to discover findings from previous research, identifies the theories relevant to the study being undertaken, and assists in establishing an appropriate research methodology and procedure.

Theoretical Framework

Various theoretical models have explored the relation between a firm's capital structure. Modigliani and Miller (1958) were the first to raise the issue of capital structure relevance. They argued that in a world of perfect capital markets and no taxes, a firm's capital structure does not influence its cost of capital, and consequently, there is no relevance of capital structure for maximizing the value of the firm. In an environment with a corporate

income tax, Modigliani and Miller (1963) suggest that firms should 100% debt financing in a perfect market. Since Modigliani and Miller's (1953) debts irrelevance proportion, financial economists have advanced a number of leverage relevance theories based on the type of the imperfections considered. Stiglitz (1988) points out that, Modigliani and Miller's paper was based on unrealistic perfect market economic theory. The importance of their work was that it prompted a re-examination of their assumptions in a more realistic context.

Agency Cost of Debt

One of the advancements toward a more realistic context examination of capital structure was made by Jensen and Meckling (1976), focuses on market imperfections in the form of agency costs associated with external financing to explain optimal capital structure for individual firms. Agency theory is concerned with the principal-agent problem in the separation of ownership and control of a firm (Jensen & Meckling, 1976; Kochhar, 1996), between different suppliers of capital (Smith & Warner, 1979), and in the separation of risk bearing, decision making and control functions in firms (Fama, 1980; Fama & Jensen, 1983). These separations produce conflicts and give rise to agency cost.

Agency cost includes the costs of structuring, monitoring, and bonding a set of contracts among agents with conflicting interests. Agency costs also include the value of output lost because the costs of full enforcement of contracts exceed the benefits (Fama & Jensen, 1983; Jensen & Meckling, 1976; Smith & Warner, 1979;).

The agency theory viewpoint presents debt as a governing device useful in reducing the conflict (Jensen, 1986). Agency theory proposes that debt reduces agency costs incurred by shareholders through increased managerial monitoring and pressure to meet interest payments. Jensen and Meckling (1976) were one of the first to suggest that forces agents to take more care with their investments and that it reduces agency costs by performing a monitoring role valuable to investors. They argue that the existence of agency costs for both debt and equity results in an optimal capital structure that minimizes the combined agency costs.

Empirical Research on Agency Cost of Debt

Agency costs of debt theory is supported by Grossman and Hart (1982), who argue that financial leverage can reduce agency costs by increasing the possibility of bankruptcy and providing a managerial discipline. Bradley, Jarrell, and Kim (1984) find firms with greater earnings

volatility will raise expected bankruptcy costs, which increases debt agency costs, thereby dictating less debt. Friend and Lang (1988) use advertising and research and development expenses as a proxy for discretionary investment opportunities in support of Myers' argument that, firms with higher level of discretionary investment have greater debt agency costs and thus use less leverage. Long and Malitz (1985) point out advertising and research and development outlays can be expensed for tax purposes, which reduces the tax benefit from debt financing and, therefore, will induce less leverage. Demsetz and Lehn (1985) conclude that insider ownership is associated with value-maximizing behavior of managers. Kim and Sorensen (1986) find a positive relationship between insider ownership and debt ratio. However, Jensen, Solberg, and Zorn (1992) indicate that insider ownership is related to wealth gains from the potential for control of the firm, and find that insider ownership leads to less debt, and there is a negative relationship between insider ownership and debt ratio.

The Effect of Information Asymmetry

Another framework for explaining variations in firms' capital structure is the asymmetry information hypothesis. Asymmetry information signaling models state different

levels of information between insiders and outsiders such that behavior conveys information about a firm's value to outsiders. Hartmann-Wendels (1993) states that "a situation is called hidden information if one individual is better informed about the characteristics of a good than others." (p. 143). This definition provides for the existence of information asymmetry in situations where the managers (agents) have more information relating to a firm's current condition and future performance than their respective shareholders (principal).

The information disclosed (or not disclosed) by a company, affects investors perceptions of its economic and future prospects. When it is costly to assess the degree of distortion in information, Healy and Palepu (1993) point out that the firm will be misvalued. Myers and Majluf (1984) showed that, if investors are not as well informed as the current firm's insiders about the value of the firm's assets, then the market may misprice the equity. The company will be undervalued, when its performance or financial health is under-appreciated by investors due to incomplete information. This will lead the company to low valuations and high cost of capital for new stock and bond issues (Diamond & Verrecchia, 1991). The high cost of capital resulting from low valuations and negative perceptions will

cause managers to forego investment opportunities and impede its ability to compete (Myers & Majluf, 1984). In contrast the undervalued company will be overvalued, when its performance or financial health are over-appreciated by investors due to incomplete information. Managers of firms that are overvalued are legally liable for failure to disclose information pertinent to investors (Healy & Palepu, 1993; Skinner, 1994).

Myers and Majluf (1984) derive a pecking order theory of capital structure under asymmetric information where managers have superior information over investors concerning the value of the firm under alternative investment strategies. Pecking order theory states that managers may use capital structure to signal information about the firm's expected future cash flows and operation risk. Asymmetry information leads to a financing pecking order where firms initially prefer to use available internal finance to finance new projects in order to reduce costs when new debt or equity is underpriced by uninformed investors (Ryen et al, 1997). If this source proves inadequate the firm may resort to external funding. Copeland and Weston (1988, p. 507) note that the dynamics of the pecking order theory implies that "an unusually profitable firm in an industry

with relatively slow growth will end up with an unusually low debt-to-equity-ratio".

Empirical Research on the Effect of Asymmetric Information

The information asymmetry hypothesis of debts is empirically tested by many studies (e.g., Myers & Majluf, 1984; Stulz & Johnson, 1983; Green, 1984; Kester, 1986; Bayless and Diltz, 1994). Myers and Majluf (1984) states that issuing equity is a signal to shareholders that equity is overvalued. They point out that equity should be issued only as a last resort. Bayless and Diltz (1994) find that debt asymmetrical information leads to a hierarchy of preferred financing according to the relative costs of each security. Stulz and Johnson (1983) point out that funding of new projects with secured debt can help relieve the under-investment problem by enabling shareholders to capture a larger fraction of the project's value than might be possible with various claim holders. Kester (1986) studies the capital structure of international companies and finds that short-term secured characteristic of foreign corporate debt helps lower the cost normally associated with debt. Green (1984) find that the issuance of convertible bond or a debt-warrant combination can meet a firm's financing

requirements. Baskin (1989) finds substantial empirical support for the pecking order theory in the information asymmetry framework.

Static Trade-off Theory

A third body of literature suggests that there are advantages and disadvantages of debt for the firm. At some point, a debt ratio is reached where the advantages and disadvantages balance. The essence of the static trade-off theory is that these advantages and disadvantages are traded off against one another (Kraus and Litzenberger, 1973).

Static trade-off theory focused on the effect of capital structure on tax effect and exogenously specified administrative costs of bankruptcy. This theory states that firm with higher bankruptcy costs or lower tax advantages should use less debt. Modigliani and Miller (1958) stated that in a perfect world without taxes, changes in leverage should have no effect on a firm's value. However, many corporations have only a moderate amount of debt, which leads to the consideration of bankruptcy and liquidation costs due to the existence of market imperfections (Kochhar, 1996). Accordingly, the observed capital structure may be explained by a trade-off theory: firms balance bankruptcy costs against tax advantage of debt.

Empirical Research on Static Trade-Off Theory of Debt

Static trade-off theory was supported by many researchers (e.g., Scott, 1976; Brennan & Schwartz, 1978; Warner, 1979; DeAngelo and Masulis, 1980; Givoly, et al. 1992; Graham, 1996). Scott (1976) argues that the probability of bankruptcy associated with increased levels of debt leads to an optimal capital structure for individual companies. He presents numerical solutions that show the trade-off between the tax advantages of debt and the increased bankruptcy costs associated with higher levels of debt. Brennan and Schwartz (1978) use an option-pricing model to test the importance of corporate taxes and bankruptcy costs in determining optimal capital structure. They point out that the increased probability of bankruptcy, with the resulting uncertainty of the tax savings, is sufficient to lead to optimal capital structure even when bankruptcy costs are absent. They find that bankruptcy costs have a small effect on the leverage ratio. Warner (1977) empirically tested the significance of bankruptcy costs in determining capital structure on data in the railroad industry, He found that the importance of bankruptcy costs in determining optimal capital structure is overstated.

Determinants of Corporate Capital Structure

The optimal capital structure of a firm has long been considered important in determining a firm's appropriate capital structure for business expansion (Modigliani & Miller, 1958). Several argument such as tax advantage of debt (e.g., Modigliani & Miller, 1958; Miller, 1977; Cordes & Sheffrin, 1983;), business risk (e.g., Kale, Noe, & Ramirez; Myers, 1984), bankruptcy costs (e.g., Myers, 1877; Titman & Wessels, 1988; Harris & Raviv, 1990; Alderson & Beaker, 1995), agency costs (e.g., Jensen & Meckling, 1976; Myers, 1977; Mehran, 1995; Lewis & Sappington, 1995; Norton, 1991; Ryen, Vasconcellos, & Kish, 1997)), asymmetric information (e.g., Smith, 1990; Myers & Majluf, 1984; Mikkelson & Partch, 1986; Viswanath, 1993, Asquith & Mullins), product/input market forces (e.g., Brander & Lewis, 1986; Maksimovic, 1988; Kovenock & Phillips, 1995 Chevalier, 1995; Sengupta, 1993), and corporate control (e.g., Smith & Kim, 1994; Stulz, 1988; Harris & Raviv, 1988) have been suggested as factors contributing to a firm's optimal capital structure.

Tax Advantage of Debt

The importance of tax advantage of debt as a determinant of corporate capital structure has been extensively debated in financing literature. Tax considerations of debts were introduced by Modigliani and Miller (1956) who argued that in a world of perfect capital markets and no taxes, a firm's capital structure does not influence its cost of capital, and consequently, there is no relevance of capital structure for maximizing the value of the firm. Five years later, they extend their previous analysis and include corporate taxes. It is shown that the use of leverage adds value to the firm because of the tax deductibility of the interest payments. Firms, therefore, should employ as much leverage as possible.

Miller (1977) modifies Modigliani and Miller's model by assuming that all firms have identical tax rates, and considering that differing personal tax rates exist for debt and equity holders. He states that the introduction of personal taxes still support the irrelevancy proposition since the gains from issuing debt at the corporate level are completely neutralized by the marginal personal disadvantages of debt. Miller (1977) suggests that investors in low tax brackets (below the corporate tax rate) will demand and hold taxable corporate debt, while investors in

the high tax brackets (above the corporate tax rate) will hold municipal bonds and equities. By doing so, investors will be able to alleviate their tax burden. He concludes that there is no advantage to debt because the advantage of debt, from the firm's point of view, may be offset by the higher interest it pays to offset the personal tax disadvantage of the debt holders.

DeAngelo and Masulis (1980) formally present and extend Miller's proposition. They show a optimal capital structure model which incorporating the impact of personal taxes, corporate taxes, and non-debt-related corporate tax shields. They argue that tax deductions for investment tax credits and depreciation are substitutes for the tax benefits of debt financing. As a result, firms with large non-debt tax shields relative to their expected cash flow include less debt in their capital structure.

Bradley, Jarrell, and Kim (1984) constructed a similar model. They found contradictory results. Their results indicate a significant positive relationship between leverage and the level of non-debt tax shield. Bradley, Jarrell, and Kim (1984), based on their results, they suggest that " firms that invest heavily in tangible assets, and thus generate relatively high levels of depreciation and

tax credits, tend to have higher financial leverage." (p. 874)

Which of the two perspectives is pervasive is not resolved. It is apparent in either case, however, that there is strong reason to suggest that non-debt tax shields may be related to a firm's debt level.

Business Risk

In addition to effective debt ceilings related to corporate and personal taxes, there are other factors that limit firms' use of debt. The issuance of debt introduces financial, or default risk. This is the risk that the firm will go bankrupt and make the equity virtually worthless. Kale, Noe, and Ramirez (1991) state that business risk affect the value of the firm at high versus low levels of debt. At low debt level, increase in business risk will increase a firm's tax liability. At high levels, however, the subordinate nature of the tax claim reduces the overall tax liability. They find that a U-shaped relationship between levels of business risk and optimal debt levels. Ryen, Vasconcellos, and Kish (1997) state that the variability of cash flows is at the heart of business risk. The greater the fluctuations in a company's cash flows, the greater the chance will be unable to meet its obligations in

any given period. Firms with steadier cash flow will be able to support higher debt levels than riskier firms.

A number of studies looked at the relationship between operating risks and debt ratios by using different proxies for business risk. Bradley, Jarrell, and Kim (1984)'s study show earning variability to be an important determinant of a firm's leverage. They conclude that higher risk companies tend to have lower debt ratios. Friend and Lang (1988) also explore this matter and find a negative relationship, meaning that risky firms borrow less. However, Ferri and Jones (1989) find contradictory results. Their conclusions are that a variation in income cannot be shown to be associated with a firm's leverage. Titman and Wessels (1988) drew a similar conclusion. They found no effect of earning volatility on a firm's choice of its capital structure.

Bankruptcy Costs

Scott (1976) is one of the first to suggest bankruptcy cost as an important determinant of a firm's optimal capital structure. He argues that the probability of bankruptcy associated with increased levels of debt leads to an optimal capital structure. Jaggia and Thakor (1994) states that leverages makes bankruptcy possible, which in turn permits

the invalidation of ex post inefficient arrangements. Warner (1977) states that bankruptcy costs include direct costs such as legal and accounting fees, managerial costs of administrating the bankruptcy and the indirect costs which include maintenance costs and lost sales and profits due to bankruptcy procedures. Litzenberger and Sosin (1979) categorize bankruptcy costs into two groups: The first includes costs associated with wealth re-distribution (e.g., bankrupt firm's customers switch to a competitor) and the second consists of the dead weight losses to the society (e.g., increased costs of production brought about by the shift in the production to less efficient companies).

Bankruptcy costs studied by Brennan and Schwartz (1978) use an option-pricing model to test the importance of bankruptcy costs in determining optimal capital structure. They find that firms with low debt ratios can increase the use of debt without jeopardizing their chances of survival. If, however, a firm is already highly leveraged, any issue of additional debt will increase the probability of bankruptcy so that the value of the firm decreases. Castanias (1983) studied bankruptcy costs for different industries. He finds that firms in industries with high failure rates tend to have lower leverage. However, Warner (1979) empirically tests the significance of bankruptcy

costs in determining capital structure on data for bankruptcies in the railroad industry. He finds that the importance of bankruptcy costs in determining optimal capital structure is overstated. The significance of the bankruptcy costs in explaining the relevancy of capital structure is also questioned by Haugen and Senbet (1978) who state that the costs of default are not high enough to offset the tax subsidies.

Agency Costs

The agency costs may also influence corporate capital structure. Agency costs of debt were introduced by Jensen and Meckling (1976) who argue that there was an agency costs of debt which would prompt bondholders to require covenants and monitoring devices to prevent managers and shareholders from expropriating corporate wealth. Agency cost includes the costs of structuring, monitoring, and bonding a set of contracts among agents with conflicting interests. Agency costs also include the value of output lost because the costs of full enforcement of contracts exceed the benefits (Fama & Jensen, 1983; Jensen & Meckling, 1976; Smith & Warner, 1979;). These agency costs reduce the value of debt and limit the amount of debt the firm will use.

Further, agency costs of equity arise due to costs of monitoring the performance and actions of management. Agency costs of equity assumed that under fractional management ownership of the firm, the consumption of perquisites by management is paid, in part, by outside shareholders. These shareholders, while paying part of the costs, derive no benefit from such consumption and incur an agency cost. Thus, monitoring costs are incurred to reduce agency costs.

A number of studies look at the relationship between agency costs and capital structure by using different proxies for agency costs. Jensen and Meckling (1976) demonstrate that optimal capital structure will obtain at the point where total agency costs are minimized. Myers (1977) provides a model showing that the greater the present value of growth opportunities' component of firm value, the less debt is used. Scott (1977) indicates that the greater the firm's reliance on tangible assets, the more it borrows. Demsetz and Lehn (1985) state that insider ownership is associated with value-maximizing behavior of managers. Kim and Sorensen (1986) find a positive relationship between percentage of shares owned by insiders and debt ratio. Jensen, Solberg, and Zorn (1992) conclude that insider ownership leads to less debt, and there is a negative relationship between insider ownership and debt ratio.

Asymmetric Information

Asymmetric information models assume that managers maximize shareholder wealth but introduce the hypothesis that managers have better information about their firms than the market does. The managers' financing choices reveal some of their inside information to the market. These models imply that capital structure decisions may be used by managers as signaling devices in order to convey information about the value of the firm and its future prospects.

Signaling theory was first formalized by Ross (1977) who states that the market uses the stream of returns of the firm to determine the value of the firm, but does so without complete information. He states that managers may use debt to influence the perceived value of the firm. Debt becomes an effective signal because it is costly. He demonstrates a positive relationship between risk and the level of debt. Leland and Pyle (1977) propose that investors take increases in management stockholders as a positive signal about expected future earnings and the riskiness of the firm. They predict a positive relationship between insider ownership and debt. Lee, Thakor, and Vora (1983) posit that both the capital structure of the firm and the maturity of its debt serve as signals of the firm's future earnings. Flannery

(1986) posits that corporations can successfully signal their true value to the potential investors by choosing the appropriate maturity for their debt issues.

Myers and Majluf (1984) present a pecking order framework of capital structure under asymmetric information which suggest that firms prefer to use internal funds first, followed by debt, then equity, as sources of funds. According to Myers and Majluf's, more profitable firms will be able to provide needed funds internally and use less debt, and firms that are less profitable would use more debt.

Pecking order theory was supported by John (1993) who states that the existence of high liquidity precludes the use of debt as an alternative source of anticipated liquidity and finds a negative relationship consistent with Myers and Majluf. Bayless and Diltz (1994) find that debt asymmetrical information leads to a hierarchy of preferred financing according to the relative costs of each security. Stulz and Johnson (1983) point out that funding of new projects with secured debt can help relieve the under-investment problem by enabling shareholders to capture a larger fraction of the project's value than might be possible with various claim holders. Kester (1986) studies the capital structure of international companies and finds

that short-term secured characteristics of foreign corporate debt helps lower the cost normally associated with debt. Green (1984) finds that the issuance of convertible bond or a debt-warrant combination can meet a firm's financing requirements. Baskin (1989) finds substantial empirical support for the pecking order theory in the information asymmetry framework.

Product/Input Market Forces

Models of product and input market forces attempt to determine the link between debt levels and strategic variables. Brander and Lewis (1986) examine the connection between capital structure and firm strategy. They conclude that leverage changes the payoff to equity, and company managers quite often have incentives to maximize only their equity value. Debt forces oligopolists to undertake a more aggressive output strategy, which leads to all the producers being slightly worse off than they would be if all the firms had pure equity financing. Further work done by Maksimovic (1988) determined the maximum debt levels each oligopolist could have while still leaving open the possibility of a tacit collusion. He finds that debt capacity is an increasing function of the industry's elasticity of demand and a decreasing function of the discount rate. Chevalier

(1995) shows that a company's choice of capital structure influences the strategy of its competitors. She finds that the announcement of a leveraged buyout increases the expected future profits of that firm's competitors, and the presence of leverage buyout firms encourages local entry and expansion by rivals.

The second major product/input market force model links capital structure to customers and suppliers of inputs. Titman (1984) states that capital structure could help force a company to always follow an optimal strategy of only liquidating when the net benefits of liquidating outweigh the loss to customers. Sarig (1988) states that debt can be used to strengthen stockholders' bargaining power in negotiating with input suppliers. Perotti and Spier (1993) investigate the conditions wherein firms may use short-term strategic debt-for-equity swaps to extract concessions from workers during wage negotiations. Sengupta (1993) states that the greater the company's bargaining power, the more workers may stand to benefit from less debt.

Corporate Control

Ryen et, al (1997) state that capital structure has an important impact on the market for corporate control. Stulz (1988) states that "... the fraction *a* of the voting rights controlled by management is an important element of the

ownership structure of publicly traded firms." Israel (1991) investigates the role of leverage from a different angle. He concludes that higher debt levels decrease a company's chances of becoming an acquisition target. However, they increase its share of the total equity gain and eventually become the target of an acquisition. Smith and Kim (1994) analyze acquisition stock returns. They classify bidder and target firms as either "high free cash flow," "Slack poor," or "other". They find that total returns for all parties are greatest when slack poor firms are combined with high free cash flow firms.

Empirical Studies of Capital Structure Determinants

The varying perspectives developed in capital structure theory, and the conflicting views relative to some of the variables, has prompted an ongoing stream of attempts to determine the relative importance of various firms characteristics that have been predicted to influence the firm's capital structure.

Industry Classification and Capital Structure

Early empirical work has concentrated on the importance of industry classification in determining capital structure decisions. Schwartz and Aronson (1967) study four classes of

debt for 1928 to 1961. They observe a shift from preferred stock to debt and some increases in current liabilities for industrial and manufacturing firms over the time studied. They find that the debt structures for the groups differed significantly and were relatively stable over the time studied. Gupta (1969) examines manufacturing companies' capital structure by using six activity ratios, five leverage ratios, two liquidity ratios and five profitability ratios. He finds that growth tended to be positively related to higher debt levels, and firm size tended to be negatively related to debt levels. Scott and Martin expanded upon Schwartz and Aronson with a larger sample size and tests over a ten-year period. They conclude that the industries do have characteristically different financial structures.

International Activities and Capital Structure

The capital structure of multinational firms has been examined in some international studies (e.g., Fatemi, 1988; Lee and Kwok, 1988; Chen, Cheng, He, & Kim, 1997; Wald, 1999), but theories for predicting a direct relationship between international activities and capital structure are lacking. Lee and Kwok (1988) examine the difference in capital structure between U.S.-based multinational companies and domestic companies by relying on the difference in

bankruptcy and agency costs of debt between multinational companies and domestic companies. They find that the agency cost of debt is the dominant reason for multinational companies having lower debt-equity ratios. Wald investigates the factors correlated with capital structure in France, Germany, Japan, the United Kingdom, and the United States, He finds that differences appear in the correlation between long-term debt/asset ratios and the firms' riskiness, profitability, size, and growth. These correlations may be explained by differences in tax policies and agency problems, including differences in bankruptcy costs, information asymmetries, and shareholder/creditor conflicts.

Financial Ratios

Most studies of firm characteristics include financial ratios in some form. The questions of stability of the ratios over time are important considerations in determining the usefulness of a model of firm characteristics. Pinches, Mingo, and Caruthers (1973) investigate the stability of financial ratios over a period of time from 1951 to 1969. He finds that the classifications resulting from the ratios were reasonably stable over the time period studied. Gombola and Ketz (1983) further examine financial ratio patterns in retail and manufacturing firms, to assess the reported

stability previously suggested by Pinches, et al. The patterns were also found to be stable over time and support the notion of industry differences, in both the ratio values and differences on the classifications. Subsequent studies were done by Johnson (1979) and Chen and Shimerda (1981). Their studies suggest that the relative importance of certain financial ratios remains fairly stable for manufacturing, industrial, and retail firms.

Statistical Techniques

The theories of capital structure have been tested by utilizing a wide array of statistical techniques. Kim and Sorensen (1986) use OLS analysis to test whether agency theory can explain the cross-sectional variations in firms' capital structure. He finds a positive relationship between insider ownership and leverage. Jensen, Solberg, and Zorn (1992) use a three-stage least squares econometric approach to estimate a system of three structural equations. He finds a negative relationship between insider ownership and leverage contrary to the theories of Ross (1977), and Leland and Pyle (1977). Chen and Fanara (1992) use a multinational logit approach to test regulated firms' decisions to choose among debt, common, and preferred equity. They find that deviations from target short-term debt ratios and the

ownership structure variables are statistically significant in explaining capital structure decisions for public utilities. Taub (1975) uses a probit analysis to test the importance of a firm's size, tax rate, period of solvency, uncertainty of future earnings, and the cost of issuing debt versus equity, in determining the type of the securities selected by a firm. The results are in accord with the hypotheses proposed by the agency, bankruptcy, and signaling theories respectively.

Characteristics of High Technology Firms

Researchers have defined high technology industry by its major firm characteristics. Shanklin and Ryans (1984) apply three criteria to define high technology industry. These include: a strong scientific-technical basis, a very quick obsolescence of existing technology due to new technology, and the applications of new technology to create markets and demand. Mohrman and Von Glinow (1990) apply four criteria to define high technology industry. These include: a high percentage of research and development expenditures, the potential for very rapid growth, employment of a large portion of scientists, engineers, and technologists, and the very quick obsolescence of existing technology due to emergence of new technology. Weinstein (1994) defines high

technology firms according to users needs. He states that customer needs were the key market definition characteristic to high-tech firms - technology, competition, customer groups, and products." (p.28).

Several industries have been identified as high technology industries. Criteria used by different researchers include level of technology (Shanklin & Ryans, 1984), research and development expenditure (Department of Commerce Document 2, 1985), geographic areas (Rosenberg & Macauley, 1988), technology developed (Prentice Hall, 1995), and product categories (Corptech, 1997). Table 1 summaries industries included as high technology industries by different researchers.

Limitations of Past Research

The above review of the literature regarding determinants of corporate capital structure indicate that:

1. Based on empirical studies there is some controversy regarding the determinants of capital structure;
2. In spite of the controversy industry classification, size, and country seem to be important factors that should be examined in any new study of capital structure; and

Table 1

Industries Included in High Technology Industries

Researchers	Characteristics	Number of Industries
Shanklin and Ryans (1984)	Level of technology	36 SICs
McKinney and Rowley (1985)	Product category	10 Industries
Department of Commerce Doc 2 (1985)	R & D Expenditure	7 Industries
Rosenberg and Macauley (1988)	Geographic area	10 Industries
Florida Chamber of Commerce (1989)	Product Index	50 SICs
Barron's Dictionary of Business (1994)	Area of technology Advanced Development	5 Industries
Prentice Hall Encyclopedia (1995)	Area of technology Expanding	7 industries
Corptech (1997)	Product Index	17 Industries

3. Most of the empirical studies of the determinants of capital structure seem to be limited either by the data bases used or because important variables were excluded.

This review of relevant literature on capital structure also found that most past studies relied on agency theory,

asymmetric information hypothesis, or static trade-off theory to develop their hypotheses. Researchers focused on the association between certain characteristics of the firm and capital structure decisions. Variables suggested to be associated with the corporate capital structure include: tax advantage of debt, agency costs of debt, information asymmetric, bankruptcy cost, business risk, product market/input force, and corporate control. They used either surveys or existing data from financial analysts to measure the level of debt financing in different countries or different industries.

Most of the empirical studies concentrated on agency variables. There were few empirical studies on information asymmetry hypothesis and static trade-off theory variables.

This proposal is an empirical investigation into the relationship of between information asymmetry, agency cost, static trade-off and capital structure. It measured the level of debt financing by combining a number of metrics used in prior research. Then, it evaluated the relationship between level of debt financing and certain high technology firms' characteristics such as tax advantage of debt, agency costs of debt, information asymmetric, bankruptcy cost, business risk, product market/input force, and corporate

control. Chapter Three describes the methodology for the proposed research.

CHAPTER III

METHODOLOGY

This chapter begins with a general overview of determinants of capital structure in high technology companies. Then, the hypotheses underlying the empirical portion of the research are developed. Next, the sample of firms and the criteria for their selection are discussed. Finally, a description of the analytical methods employed is provided, as is a discussion of the criteria underlying their selection.

General Overview

The issue of corporate capital structure choice was brought to center stage when Modigliani and Miller (1956) published their papers. Modigliani and Miller's model, which argued that, under certain assumptions, the average cost of capital to any firm is completely independent of its capital structure and that firms maximize their market value by maximizing their use of debt financing has been debated roundly in finance literature. Several arguments such as tax advantage of debt (e.g., Modigliani & Miller, 1958; Miller, 1977; Cordes & Sheffrin, 1983;), business risk (e.g., Kale, Noe, & Ramirez; Myers, 1984),

bankruptcy costs (e.g., Myers, 1877; Titman & Wessels, 1988; Harris & Raviv, 1990; Alderson & Beaker, 1995), agency costs (e.g., Jensen & Meckling, 1976; Myers, 1977; Mehran, 1995; Lewis & Sappington, 1995; Norton, 1991; Ryen, Vasconcellos, & Kish, 1997)), asymmetric information (e.g., Smith, 1990; Myers & Majluf, 1984; Mikkelson & Partch, 1986; Viswanath, 1993, Asquith & Mullins), product/input market forces (e.g., Brander & Lewis, 1986; Maksimovic, 1988; Kovenock & Phillips, 1995 Chevalier, 1995; Sengupta, 1993), and corporate control (e.g., Smith & Kim, 1994; Stulz, 1988; Harris & Raviv, 1988) have been suggested as factors contributing to a firm's optimal capital structure. The only consistent finding among these studies is that debt and equity financing often varies with the size of the firm. Other firm-specific characteristics are not as consistent.

Hypotheses Development

The hypothesized determinants of capital structure was identified by a review of those determinants identified in other studies and by reference to theories of capital structure.

Tax Advantage of Debt

The tax advantage of debt over equity is due to the deductibility of interest payments from corporate income tax. Tax considerations of debts were introduced by Miller (1977) who argues that investors in low tax brackets (below the corporate tax rate) will demand and hold taxable corporate debt, while investors in the high tax brackets (above the corporate tax rate) will hold municipal bonds and equities. By doing so, investors will be able to alleviate their tax burden. DeAngelo and Masulis (1980) formally present and extend Miller's proposition. They argue that tax deductions for investment tax credits and depreciation are substitutes for the tax benefits of debt financing. As a result, firms with large non-debt tax shields relative to their expected cash flow include less debt in their capital structure.

Bradley, Jarrell, and Kim (1984) constructed a similar model. They find contradictory results. Their results indicate that there is a significant positive relationship between leverage and the level of non-debt tax shield. Bradley, Jarrell, and Kim (1984), based on their results, they suggest that " firms that invest heavily in tangible assets, and thus generate relatively high levels of

depreciation and tax credits, tend to have higher financial leverage." (p. 874)

This leads to the following hypothesis:

H1:

H1o: High technology firms with high depreciation tax shields will utilize less debt.

H1a: High technology firms with high depreciation tax shields will utilize no or more debt.

H2:

H2o: High technology firms with higher corporate tax rate will utilize more debt.

H2a: High technology firms with higher corporate tax rate will utilize no or less debt.

Business Risk

In addition to effective debt ceilings related to corporate and personal taxes, there are other factors that limit firms' use of debt. The issuances of debt introduces financial, or default risk. This is the risk that the firm will go bankrupt and make the equity virtually worthless. Kale, Noe, and Ramirez (1991) state that business risk affects the value of the firm at high versus low levels of

debt. At low debt levels, increase in business risk will increase a firm's tax liability. At high levels, however, the subordinate nature of the tax claim reduces the overall tax liability. Therefore a negative relationship should exist between risk and firm leverage.

Ryen, Vasconcellos, and Kish (1997) state that the variability of cash flows is at the heart of business risk. The greater the fluctuations in a company's cash flows, the greater the chance that the company will be unable to meet its obligations in any given period. Firms with steadier cash flow will be able to support higher debt levels than riskier firms. Bradley, Jarrell, and Kim (1984)'s studies show earning variability to be an important determinant of a firm's leverage. They conclude that higher risk companies tend to have lower debt ratios. Friend and Lang (1988) also explore this matter and find a negative relationship, meaning that risky firms borrow less. However, Ferri and Jones (1989) find contradictory results. Their conclusions are that a variation in income cannot be shown to be associated with a firm's leverage. Titman and Wessels (1988) drew a similar conclusion, they find no effect of earning volatility on a firm's choice of its capital structure.

This leads to the following hypothesis:

H3:

H3o: High technology firms with higher cash flow variability will issue more debts.

H3a: High technology firms with higher cash flow variability will issue no or less debts.

H4:

H4o: High technology firms with higher earning variability will issue more debts.

H4a: High technology firms with higher earning variability will issue no or less debts.

Bankruptcy Costs

Scott (1976) is one of the first to suggest bankruptcy cost as important determinant of a firm's optimal capital structure. He argues that the probability of bankruptcy associated with increased levels of debt leads to an optimal capital structure. Jaggia and Thakor (1994) state that leverages makes bankruptcy possible, which in turn permits the invalidation of ex post inefficient arrangements.

Bankruptcy costs are studied by Brennan and Schwartz (1978) who use an option-pricing model to test the importance of bankruptcy costs in determining optimal capital structure. They find that firms with low debt ratios

can increase the use of debt without jeopardizing their chances of survival. If, however, a firm is already highly leveraged, any issue of additional debt will increase the probability of bankruptcy so that the value of the firm decreases. Castanias (1983) study on bankruptcy costs for different industries finds that firms in industries with high failure rates tend to have lower leverage. However, Warner (1979) empirically tests the significance of bankruptcy costs in determining capital structure on data for bankruptcies in the railroad industry. He finds that the importance of bankruptcy costs in determining optimal capital structure is overstated.

Titman and Wessels (1988) have argued that the costs of liquidation are higher for firms that produce unique or specialized products. For these reasons, a high degree of specificity engenders high distress costs. Expenditures on research and development over sales are indications of being unique. R&D expenditures measure uniqueness because firms that sell products with close substitutes have low R&D intensity since their innovations can be easily duplicated. Measures of corporate liquidity should be higher for firms with high R&D.

This leads to the following hypothesis:

H5:

H5o: The research and development costs of high technology Companies are positively related to their levels of debts.

H5a: The research and development costs of high technology Companies are negatively or not related to their levels of debts.

Agency Costs

The agency costs may also influence corporate capital structures. Agency costs of debt were introduced by Jensen and Meckling (1976) who argue that there is an agency costs of debt which would prompt bondholders to require covenants and monitoring devices to prevent managers and shareholders from expropriating corporate wealth. Further, agency costs of equity arise due to costs of monitoring the performance and actions of management.

Myers (1977) provides a model showing that the greater the present value of growth opportunities' component of firm value, the less debt is used. Demsetz and Lehn (1985) state that insider ownership is associated with value-maximizing behavior of managers. Kim and Sorensen (1986) find a

positive relationship between percentage of shares owned by insiders and debt ratio. Jensen, Solberg, and Zorn (1992) conclude that insider ownership leads to less debt, and there is a negative relationship between insider ownership and debt ratio.

This leads to the following hypothesis:

H6:

H6o: The levels of growth opportunities of high technology companies are negatively related to their debt financing.

H6a: The levels of growth opportunities of high technology companies are positively or not related to their debt financing.

Agency conflicts may exist between managers and stockholders due to wealth expropriation by managers. One way to solve the manager/stockholder conflict is the payment of dividends. Payment of dividends should suggest strength in profitability and therefore less need for debt. Jensen and Meckling (1976) states that dividends reduce the amount of discretionary funds available to managers. Jensenn, Solberg, and Zorn (1992) find a negative relationship. However, Peterson and Benesch (1983) find dividends positively related to debt level.

This leads to the following hypothesis:

H7:

H7o: High technology firms with high payment of dividend will issue less debt.

H7a: High technology firms with high payment of dividend will issue no or more debt.

Asymmetric Information

Asymmetric information models imply that capital structure decisions may be used by managers as signaling devices in order to convey information about the value of the firm and its future prospects.

The signaling theory was formalized by Ross (1977) who states that the market uses the stream of returns from the firm to determine the value of the firm, but does so without complete information. He states that managers may use debt to influence the perceived value of the firm. Debt becomes an effective signal because it is costly. He demonstrates a positive relationship between risk and level of debt. Leland and Pyle (1977) propose that investors take increases in management stockholders as a positive signal about expected

future earnings and the riskiness of the firm, and predict a positive relationship between insider ownership and debt.

Ang et al. (1982) theorize that bankruptcy costs relative to assets decline and thus the advantage of debt financing grows as firms get larger. Additionally, large firms are less prone to bankruptcy than small firms because they generally are more diversified and have less volatile income streams relative to small firms

This leads to the following hypothesis:

H8:

H8o: High technology firms with large size will utilize more debt.

H8a: High technology firms with large size will utilize no or less debt.

Myers and Majluf (1984) present a pecking order framework of capital structure under asymmetric information which suggest that firms prefer to use internal funds first, followed by debt, then equity, as sources of funds. According to Myers and Majluf's, firms with more profitability will be able to provide needed funds internally and use less debt, and firms with less profitability would use more debt.

Pecking order theory was supported by John (1993) who states that the existence of high liquidity precludes the use of debt as an alternative source of anticipated liquidity and finds a negative relationship consistent with Myers and Majluf. Bayless and Diltz (1994) find that debt asymmetrical information leads to a hierarchy of preferred financing according to the relative costs of each security. Stulz and Johnson (1983) point out that funding of new projects with secured debt can help relieve the under-investment problem by enabling shareholders to capture a larger fraction of the project's value than might be possible with various claim holders.

This leads to the following hypothesis:

H9:

H9o: The levels of profitability of high technology companies are positively related to their debt financing.

H9a: The levels of profitability of high technology companies are negatively or not related to their debt financing.

Product/Input Market Forces

Models of product and input market forces attempt to determine the link between debt levels and strategic variables. Brander and Lewis (1986) examine the connection

between capital structure and firm strategy. They conclude that leverage changes the payoff to equity, and company managers quite often have incentives to maximize only their equity value. Debt forces oligopolists to undertake a more aggressive output strategy, which leads to all the producers being slightly worse off than they would be if all firms had pure equity financing.

Chevalier (1995) shows that a company's choice of capital structure influences the strategy of its competitors. She finds that the announcement of a leveraged buyout increases the expected future profits of that firm's competitors, and the presence of leverage buyout firms encourages local entry and expansion by rivals.

Showalter (1999) states that uncertain cost fluctuations influence firms in a different way. The theory of strategic debt shows that firms will hold more debt as costs become less certain because firms can gain a strategic advantage using debt to emphasize low cost states and commit to a higher output.

This leads to the following hypothesis:

H10:

H10o: High technology firms with high cost variability will issue more debts.

H10a: High technology firms with high cost variability will issue no or less debts.

Corporate Control

Ryen et, al (1997) state that capital structure has an important impact on the market for corporate control. Stulz (1988) states that "... the fraction *a* of the voting rights controlled by management is an important element of the ownership structure of publicly traded firms." Israel (1991) investigates the role of leverage from a different angle. He concludes that higher debt levels decrease a company's chances of becoming an acquisition target. However, they increase its share of the total equity gain and eventually become the target of an acquisition. Smith and Kim (1994) analyze acquisition stock returns. They classify bidder and target firms as either "high free cash flow," "Slack poor," "other". They find that total returns for all parties are greatest when slack poor firms are combined with high free cash flow firms.

This leads to the following hypothesis:

H11:

H11o: Managerial ownership levels of high technology companies are positively related to their debt financing.

H11a: Managerial ownership levels of high technology companies are negatively or not related to their debt financing.

Measurement

The Capital Structure Model

A regression model was developed for testing these hypotheses. The capital structure model implied by the above discussion is:

HTCPST = f (*ONRSHP, GRWOPT, RESRCH, SIZE, EARNVR, PFOFIT, COSTVR, DPTXSD, CAHFLW, CRTXSD, DIVIDN*)

Where HTCPST= The High Technology Companies Capital Structure

ONRSHP = Managerial Ownership
GRWOPT = Growth Opportunities
RESRCH = Research And Development Costs
SIZE = Size
EARNVR = Earning Variability
PFOFIT = Profitability
COSTVR = Cost Variability
DPTXSD = Depreciation Tax Shield
CAHFLW = Cash Flow Variability
CRTXSD = Corporate Tax Shield
DIVIDN = Payment of Dividend

Dependent Variables (HTCPST)

The dependent variable examined in this model is the levels of capital structure measured by (1) Short-Term Debt (2) Long-Term Debt, and (3) Total Liabilities. These measures were selected because they provide insight on a high technology company's policy not only for short-term debt but for long-term debt as well.

The dependent variable was designed to determine the impact of various influences on the financial structure of acceptable deals. The analysis of dependent variable provided insight into the factors that affect how particular deals were structured; that is, what deal characteristics are most likely to result in equity financing, or debt financing. Analysis of the dependent variable provided valuable insight into the factors and influences that affect deal structure.

Independent Variables

The independent variables were measured with data obtained from the high technology firms' annual reports, in the following manner:

Tax Advantage of Debt

Depreciation tax shields were measured as the depreciation expenses over total assets. DeAngelo and Masulis (1980) formally present and extend Miller's proposition. They argue that tax deductions for investment tax credits and depreciation are substitutes for the tax benefits of debt financing. As a result, firms with large non-debt tax shields relative to their expected cash flow include less debt in their capital structure. Therefore, levels of leverage were expected to be negatively associated with depreciation tax shields.

Corporate tax rate was measured as the tax expenses over income before income tax. Miller (1977) who argues that investors in low tax brackets (below the corporate tax rate) will demand and hold taxable corporate debt, while investors in the high tax brackets (above the corporate tax rate) will hold municipal bonds and equities. By doing so, investors will be able to alleviate their tax burden. The tax rate is directly related to the debt-equity ratio of the firm. Increases in the tax rate will cause the firm to increase its debt-equity ratio. Therefore, levels of leverage were expected to be positively associated with corporate tax rate.

Business Risk

Cash flow variability was measured as the variance of change of cash flows by average assets over the last five years. Ryen, Vasconcellos, and Kish (1997) state that the variability of cash flows is at the heart of business risk. The greater the fluctuations in a company's cash flows, the greater the chance will be unable to meet its obligations in any given period. Firm with steadier cash flow will be able to support higher debt levels than riskier firm. Therefore, levels of leverage were expected to be negatively associated with cash flow variability.

Earning variability was measured as the standard deviation of the earnings before interest and taxes over the last five years. Bradley, Jarrell, and Kim (1984)'s study show earning variability to be an important determinant of a firm's leverage. They conclude that higher risk companies tend to have lower debt ratios. Friend and Lang (1988) also explore this matter and find a negative relationship, meaning that risky firms borrow less. Therefore, levels of leverage were expected to be negatively associated with earning variability.

Bankruptcy Costs

Research and development costs were measured as the research and development expenses over net sales. Titman and Wessels (1988) have argued that the costs of liquidation are higher for firms that produce unique or specialized products. For these reasons, a high degree of specificity or uniqueness engenders high distress costs. Expenditures on research and development over sales are indicators of uniqueness. R&D expenditures measure uniqueness because firms that sell products with close substitutes have low R&D intensity since their innovations can be easily duplicated. Measures of corporate liquidity should be higher for firms with high R&D.

Agency Costs

Growth opportunities were measured as the ratio of the market value of the firm to the book value of its assets. Myers (1977) provides a model showing that the greater the present value of growth opportunities' component of firm value, the less debt is used. Therefore, levels of leverage were expected to be negatively associated with growth opportunities

Dividends were measured as the ratio of the dividends over earnings before interest and taxes. Agency conflicts

may exist between managers and stockholders due to wealth expropriation by managers. One way to solve the manager/stockholder conflict is the payment of dividends. Jensen and Meckling (1976) states that dividends reduce the amount of discretionary funds available to managers. Jensenn, Solberg, and Zorn (1992) find a negative relationship. Payment of dividends should suggest strength in profitability and therefore less need for debt.

Asymmetric Information

Firm size was measured as the natural log of average total assets, the same proxy used by Friend and Lang (1988).

Ang et al. (1982) theorize that bankruptcy costs relative to assets decline and thus the advantage of debt financing grows as firms get larger. Additionally, large firms are less prone to bankruptcy than small firms because they generally are more diversified and have less volatile income streams relative to small firms. Therefore, levels of leverage were expected to be positively associated with firm size.

Firm profitability was measured as the ratio of average earnings before taxes and interest to average total assets. Myers and Majluf (1984) present a pecking order framework of capital structure under asymmetric information which suggest

that firms prefer to use internal funds first, followed by debt, then equity, as sources of funds. According to Myers and Majluf's, firms with more profitable will be able to provide needed funds internally and use less debt, and firms with less profitable would use more debt.

Product/Input Market Forces

Cost variability was measured as the ratio of cost of good sold over net sales. Showalter (1999) states that uncertain cost fluctuations influence firms in a different way. The theory of strategic debt shows that firms will hold more debt as costs become less certain because firms can gain a strategic advantage using debt to emphasize low cost states and commit to a higher output. Therefore, levels of leverage were expected to be positively associated with cost variability.

Corporate Control

Managerial common stock ownership was measured as the total number of common stock held directly by the officers and directors out of the total number of outstanding shares of common stock. Stulz (1988) posits that "... the fraction *a* of the voting rights controlled by management is an important element of the ownership structure of publicly

traded firms." Israel (1991) concludes that higher debt levels decrease a company's chances of becoming an acquisition target. Therefore, levels of leverage were expected to be positively associated with managerial common stock ownership.

Table 2 summarizes the dependent variables as follow:

Selection of Samples of Companies

This analysis covers the annual reports of Taiwanese technological firms. The selection of companies (high technology companies) in the sample was based on the 1997 CorpTech Directory of Technology Companies. There are seventeen industries included in this directory: factory automation, biotechnology, chemicals, computer hardware, defense, energy, environmental, manufacturing, advanced materials, medical, pharmaceuticals, photonics, computer software, subassembling and components, test and measurement, telecommunications, and transportation.

An attempt was made to narrow down the number of industries, and use only those high technology industries which most closely meet the researchers definitions.

Table 2

Summary of the Dependent Variables

Regression Model

HTCPST = f(*ONRSHP, GRWOPT, RESRCH, SIZE, EARNVR, PFOFIT, COSTVR, DPTXSD, CAHFLW, CRTXSD, DIVIDN*)

Where HTCPST= The High Technology Companies Capital Structure

ONRSHP = Managerial Ownership

GRWOPT = Growth Opportunities

RESRCH = Research And Development Costs

SIZE = Size

EARNVR = Earning Variability

PFOFIT = Profitability

COSTVR = Cost Variability

DPTXSD = Depreciation Tax Shield

CAHFLW = Cash Flow Variability

CRTXSD = Corporate Tax Shield

DIVIDN = Payment of Dividend

Dependent Variables

(1) Short Term Debt
(2) Long-Term Debt
(3) Total Debt

Table 3 summarizes the independent variables as follow:

Table 3

Summary of the Independent Variables

Independent Variables	
Hypotheses	The Measures
Tax Advantage of Debt	
A. Depreciation tax shields	Depreciation expenses over Total assets
B. Corporate tax rate	Tax expenses over income Before income tax
Business Risk	
A. Cash flow variability	Variance cash flows for the last three years
B. Earning variability	EBIT variance for the last three years
Bankruptcy Costs	
A. R&D costs	R&D expenses over net sales
Agency Costs	
A. Growth opportunities	Net sales growth for the last three years
B. Dividends	Dividends payment per share
Asymmetric Information	
A. Firm size	Natural log of average total Assets
B. Firm profitability	Average EBIT to average Total assets
Product/Input Market Forces	
A. Cost variability	Cost of good sold variance for the last three years
Corporate Control	
A. Managerial ownership	Common stock held by officers Over outstanding shares

The corporate reports used in this study will be the latest reports available in December 1999. Two hundred and forty-one annual reports of the Taiwanese technological firms from Taiwan Stock Exchange (TSE) and OTC (Over Table Counter) were collected.

Validity and Reliability of the Measures

Construct validity assesses the extent to which the index actually measures levels of capital structure. One way to assess this is to look at the various dimensions of capital structure and determine which items actually relate to each dimension. This has been done in previous research judgmentally--by having subject matter experts determine what are the various categories of capital structure e.g., Short term debt, long term debt, and total debt. (Thies & Klock, 1995). For this study the dimensionality of the capital structure followed Thies and Klock's (1995).

In regard to reliability of the measures, Nunnally and Bernstein (1994) indicate that reliability is concerned with the consistency of the measure. In this study, reliability of the variables used in multiple regression analysis was measured following Nunnally and Bernstein's approach.

Statistical Analysis

Descriptive Statistics

Descriptive statistics for the dependent variables provided information such as minimum, maximum, range, sum, mean, and standard deviation for each of five capital structure items. Descriptive statistics for independent variables provided information such as minimum, maximum, range, mean, and standard deviation for each of eleven independent variables. These information allow the researcher to see the distribution of each variable. These information also useful in testing data for extreme values such as a managerial ownership more than 100 percent, and negative research and development cost.

Statistics Used to Show Relationships

In this study, correlation coefficient (r) was used to measure the extent of the relationships between variables. Correlation coefficient value was expected to be between +1 to -1. Hanke and Reitsch (1994, p. 554) state that the correlation coefficient is a value between -1 and +1 that indicates the strength of the linear relationship between two quantitative variables." The correlation coefficient for examining the relationship between independent variables in

this study was presented according to the Pearson Correlation coefficient.

Squaring the multiple correlation gives the coefficient of determination (R^2). The coefficient of multiple determination (R^2) will be used in this study to measure the percentage of the variability in the dependent variable that can be explained by the independent.

Examining the Existence of Multicollinearity

The correlation coefficient has another function that can be used as an indicator of the presence of multicollinearity. The problem of multicollinearity is present when the independent variables (Ivs) are "highly" correlated among themselves. When excess multicollinearity exists, the regression coefficients may be unbiased in a large sample sense, but their sampling errors become unacceptably large. The multiple correlation of each independent variable with the other independent variables can be considered an acceptable index of collinearity.

Multiple Regression Model

A multiple regression analysis was employed to examine the relationship between the capital structure and the independent variables - tax advantage of debt, business

risk, bankruptcy costs, agency costs, asymmetric information, product/input market forces, corporate control. The purpose of this analysis is to answer the question of this study: What type of capital structure Taiwanese technological firms use? What factors influence capital structure among these companies?

An Ordinary Least Square (OLS) model was used as a multivariate test to assess the effect of each individual variable on capital structure decision. The test is based on the following model:

HTCPST = f (*ONRSHP, GRWOPT, RESRCH, SIZE, EARNVR, PFOFIT, COSTVR, DPTXSD, CAHFLW, CRTXSD, DIVIDN*)

Where HTCPST= High Technology Companies Debt Structure

ONRSHP = Managerial Ownership
GRWOPT = Growth Opportunities
RESRCH = Research And Development Costs
SIZE = Size
EARNVR = Earning Variability
PFOFIT = Profitability
COSTVR = Cost Variability
DPTXSD = Depreciation Tax Shield
CAHFLW = Cash Flow Variability
CRTXSD = Corporate Tax Shield
DIVIDN = Payment of Dividend

Tests of Hypotheses

The ANOVA approach (F-test) was used to determine

the existence of a linear relationship between dependent variable and independent variables. The conclusions regarding the hypotheses were determined from the sign and significance of the regression coefficient of the appropriate variable.

The null and alternative hypotheses are

H_0: $p^2 = 0$

H_1: $P^2 > 0$

The F test was used to test the null hypothesis. If the F statistic computed from the sample data is larger than the value from the F table, this hypothesis is rejected.

If the null hypothesis is rejected, then it can be concluded that, after controlling other variables in the model, the levels of leverage is positively or negatively related to independent variables (tax advantage of debt, business risk, bankruptcy costs, agency costs, asymmetric information, product/input market forces, corporate control).

CHAPTER IV

ANALYSIS AND PRESENTATION OF FINDINGS

Introduction

This chapter analyzes and presents the findings of the research. The purpose of the study is to examine debt financing decision in the high technology companies in order to assess the extent to which eleven independent variables - depreciation tax shield, corporate tax shield, cash flow variability, earning variability, research and development, growth opportunities, dividends payment, firm size, firm profitability, cost variability, and managerial ownership are associated with the level of debt financing. Attention focuses on the concept of debt financing decision and how tax advantage of debt, business risk, bankruptcy costs, agency costs, asymmetric information, product/input market forces, and corporate control affect managers decisions of debt financing.

The findings regarding the degree of correlation of the independent variables with the levels of debt financing and the differential predictability of the independent variables are presented in the following order. First, the sample is discussed, then the measures of validity and reliability are

presented. Next, descriptive statistics for each of the variables (dependent and independent variables) are reported. Then, several tests that examine the underlying assumption of the regression model are conducted in order to determine the appropriateness of the regression model. In the following part of the chapter, the results of each of the research hypotheses are presented. Multiple regression analysis is used to assess the relative influence of the major predictor variables. Through analysis of the variance, the presence or absence of differential predictability and the sign are determined. The last section discusses the overall results.

The Sampling

The initial samples of two hundred and sixty-five were drawn from high technology companies listing in the Taiwan Stock Exchange (TSE) and Over-Table Counteroffer (OTC). The samples were distributed equally in high technology industries to insure that it covers all of the selected industries. Of the two hundred and sixty-five selected high technology companies, two hundred and forty-one companies' annual financial data were collected either from TEJ or annual report. This represents ninety-one percent of the total population and produces statistically valid results.

Of the two hundred and forty-one annual financial data collected, two hundred and twenty (or ninety-one) were accepted for analysis; twenty-one were rejected because data for dependent and independent variables was not available from those annual reports. Table 4 summarizes the sample firms collected.

Table 4

Summaries of Sample Firms

Title	Total	%
Total Number of High Technology Companies Selected	265	100%
Total Annual Financial Data Collected	241	100%
Total Usable Annual Financial Data	220	91%
Total Unusable Annual Reports (3 Companies Missing debt information , 18 companies Missing Independent Variable Information)	21	9%

Descriptive Statistics

Descriptive statistics for the dependent and independent variables are summarized in Table 5. They

include statistics such as range, minimum, maximum, sum, mean, and standard deviation for each of twelve dependent and independent variables. A total of two hundred and twenty high technology companies' annual financial data were examined.

Table 5 summarizes the companies with the most current liabilities. There are six companies with current liabilities in a range from 83% to 58% of total liabilities and stockholder's equity. These companies represent three different industries (SIC Code 2000, 5000, and 8000). The most current liability is provided by Great Electronic Corporation, which amounted to NTD $ 2,042,501 or 83% of total liabilities and stockholder's equity. The second largest current liability is from Elitegroup Incorporated, which amounted to NTD $ 3,873,047 or 79% of total liabilities and stockholder's equity. The third highest current liability is from the Pan International Incorporated, which amounted to NTD $ 3,732,850, or 70% of total liabilities and stockholder's equity. The fourth is from the Chuntex Incorporated, which amounted to NTD $ 10,415,280 or 61% of total liabilities and stockholder's equity. The fifth is from the World Peace Incorporated, which amounted to NTD $ 2,022,074 or 58% of total liabilities and stockholder's equity. The sixth is from

Summit Corporation, which amounted to NTD $ 807,231 or 58% of total liabilities and stockholder's equity.

Table 5

The Companies with the Most Current Liabilities

Name	SIC Code	Amounts	% of Total Liability and Stockholder's Equity
Great Electronic	8704	2,042,501	.83
Elitegroup Inc.	2331	3,873,047	.79
Pan International	2328	3,732,850	.70
Chuntex Inc.	2320	10,415,280	.61
World Peace Inc.	5365	2,022,074	.59
Summit Corporation	5413	807,231	.58

Table 6 summarizes the companies with the least percentage of current liabilities. There are six companies with current liability range from six percent to seven percent of total liabilities and stockholder's equity. Those companies belong to two different industries (SIC Code 2000 and 5000). The company with the least current liability is from the Weltrend Semic Incorporated, which amounted to NTD $ 88,688 or 6% of total liabilities and stockholder's equity. Next is from the Everspring Incorporated, which amounted to NTD $ 167,992, or 6% of total liabilities and stockholder's equity. The third one is from the Syntek Incorporated, which amounted to NTD $136,797, or 7% of total liabilities and stockholder's equity. The fourth is from the United Radiant Incorporated, which amounted to NTD $ 225,377, or 7% of total liabilities and stockholder's equity. The fifth is from the Siliconware Incorporated, which amounted to NTD $ 1,288,596, or 7% of total liabilities and stockholder's equity. The sixth is from the TSMC Corporation, which amounted to NTD $ 8,138,796, or 7% of total liabilities and stockholder's equity.

Table 7 summarizes the companies with the most long-term liabilities. There are six companies with long-term liabilities in a range from 39% to 31% of total liabilities and stockholder's equity. These companies represent two

different industries (SIC Code 2000 and 5000). The most long-term liability is provided by Macronix Corporation, which amounted to NTD $ 18,692,471 or 39% of total liabilities and stockholder's equity. The second largest long-term liability is from Vanguard Corporation, which amounted to NTD $ 12,624,000 or 37% of total liabilities and stockholder's equity. The third highest long-term liability is from the Vate Technology Incorporated, which amounted to NTD $ 1,050,301, or 35% of total liabilities and stockholder's equity. The fourth is from the First International Computer Incorporated, which amounted to NTD $ 12,431,302 or 33% of total liabilities and stockholder's equity. The fifth is from the Taiwan Mask Incorporated, which amounted to NTD $ 2,097,888 or 32% of total liabilities and stockholder's equity. The sixth is from Promos Technology Incorporated, which amounted to NTD $ 14,810,744 or 31% of total liabilities and stockholder's equity.

Table 6

The Companies with the Least Current Liabilities

Name	SIC Code	Amounts	% of Total Liabilities and Stockholder's Equity
Weltrend Semic Inc	5322	88,688	.06
Everspring Inc.	2390	167,992	.06
Syntek Design Inc.	5302	136,797	.07
United Radiant Inc.	5315	225,377	.07
Siliconware Inc.	2325	1,288,596	.07
TSMC Corporation	2330	8,138,796	.07

Table 7

Companies with the Most Long-Term Liabilities

Name	SIC Code	Amounts	% of Total Liabilities and Stockholder's Equity
Macronix Corporation	2337	18,692,471	.39
Vanguard Corporation	5347	12,624,000	.37
Vate Tech. Inc.	5344	1,050,301	.35
First Int'l. Comp.	2319	12,431,302	.33
Taiwan Mask Inc.	2338	2,097,888	.32
ProMos Technol Inc.	5387	14,810,744	.31

Table 8 summarizes the companies with the least percentage of current liabilities. There are seven companies with long-term liability equal to zero percent of total liabilities and stockholder's equity. Those companies belong to two different industries (SIC Code 2000 and 5000). The companies with the least long-term liability are from the

Sunplus Technology Corporation, Chroma Corporation, Thinking Electronic Incorporated, Springsoft Incorporated, WYSE Technology Incorporated, Zyxel Communication Incorporated, and Elan Microelectronic Incorporated.

Table 9 summarizes the companies with the most total liabilities. There are six companies with total liabilities in a range from 99% to 64% of total liabilities and stockholder's equity. These companies represent two different industries (SIC Code 2000,5000 and 8000). The most total liability is provided by Great Electronic Corporation, which amounted to NTD $ 2,441,734 or 99% of total liabilities and stockholder's equity. The second largest total liability is from Elitegroup Corporation, which amounted to NTD $ 3,924,677 or 80% of total liabilities and stockholder's equity. The third highest total liability is from the Pan International Incorporated, which amounted to NTD $ 4,101,699, or 77% of total liabilities and stockholder's equity. The fourth is from the Chuntex

Table 8

Companies with the Least Long-Term Liabilities

Name	SIC Code	Amounts	% of Total Liabilities and Stockholder's Equity
Sunplus Technol Inc	2401	0.00	.00
Chroma Corporation	2360	0.00	.00
Thinking Elec. Inc.	5377	0.00	.00
Springsoft Inc.	5406	0.00	.00
WYSE Technology Inc.	5375	0.00	.00
Zyxel Communication	2391	0.00	.00
Élan Microelecto Inc.	5433	0.00	.00

Incorporated, which amounted to NTD $ 11,871,007 or 70% of total liabilities and stockholder's equity. The fifth is from the Team Young Incorporated, which amounted to NTD $

1,241,559 or 66% of total liabilities and stockholder's equity. The sixth is from Royal Information Incorporated, which amounted to NTD $ 6,218,563 or 64% of total liabilities and stockholder's equity.

Table 9

Companies with the Most Total Liabilities

Name	SIC Code	Amounts	% of Total Liabilities and Stockholder's Equity
Great Electronic	8704	2,441,734	.99
Elitegroup Inc.	2331	3,924,677	.80
Pan International	2328	4,101,699	.77
Chuntex Corporation	2320	11,871,007	.70
Team Young Inc.	5345	1,241,559	.66
Royal Information	5313	6,218,563	.64

Table 10 summarizes the companies with the least percentage of total liabilities. There are seven companies with total liability range from six percent to ten percent of total liabilities and stockholder's equity. Those companies belong to two different industries (SIC Code 2000 and 5000). The company with the least current liability is from the Everspring Incorporated, which amounted to NTD $ 175,446 or 6% of total liabilities and stockholder's equity. Next is from the Weltrend Incorporated Ltd, which amounted to NTD $ 116,833, or 8% of total liabilities and stockholder's equity. The third one is from the Springsoft Incorporated, which amounted to NTD $34,074, or 9% of total liabilities and stockholder's equity. The fourth is from the Thinking Incorporated, which amounted to NTD $ 75,442, or 9% of total liabilities and stockholder's equity. The fifth is from the Syntek Incorporated, which amounted to NTD $ 184,126, or10% of total liabilities and stockholder's equity. The sixth is from the Chroma Corporation, which amounted to NTD $ 304,029, or 10% of total liabilities and stockholder's equity. The seventh is from the Sunplus Incorporated, which amounted to NTD $ 387,459, or 10% of total liabilities and stockholder's equity.

Table 10

Companies with the Least Total Liabilities

Name	SIC Code	Amounts	% of Total Liabilities and Stockholder's Equity
Everspring Inc.	2390	175,446	.06
Weltrend Semic	5322	116,833	.08
Springsoft Inc.	5406	34,074	.09
Thinking Elec.	5377	75,442	.09
Syntek Design Inc.	5302	184,126	.10
Chroma Corporation	2360	304,029	.10
Sunplus Technology	2401	387,459	.10

Descriptive statistics for the dependent and independent variables are presented in Table 11. The dependent variable - debt ratio (total Liabilities divided by total liabilities and stockholder's equity) varies from 6% to 99%. The all mean debt ratio is only 38%. Depreciation tax shields, which is measured as the depreciation expense over total assets, varies from 0% to 28%. The all mean depreciation tax shields is about 3%. Corporate tax shields, which is measured as the tax expenses over income before income tax, varies from negative 58% to 38%. The all mean financial leverage is about 7%. Cash Flow Variability, which is measured as the cash flow variance for the last three years, varies from negative 323 times to positive 141 times. The all mean cash flow variability is about negative 1.22 times. Earning Variability, which is measured as the earning before interest and tax variance for the last three years, varies from negative 14 times to positive 22 times. The all mean earning variability is about 0.4 times. Bankruptcy cost, which is measured as the research and development costs of net sales, varies from 0 to 38%. The all mean research and development expenses is about 3.5%. Growth opportunities, which is measure as the growth of net sales over last three years, varies from negative 0.22 to positive 23 times. The all mean growth opportunities is about 49%.

Dividend payment, which is measured as the cash and stock dividends per share, varies from 0 to 8. The all mean dividend payment 2.16 per share. Firm size, which is measure as the natural log of average total assets, varies from negative 12.14 to 18.57. The all mean firm size is about 14.79. Firm profitability, which is measured as the average earning before interest and tax over average total assets, varies from negative 69% to positive 40%. The all mean firm profitability is about 10%. Cost variability, which is measure as the cost of good sold variance for the last three years, varies from negative 31% to positive 18.35 times. The all mean cost variability is about 57%. Managerial ownership, which is measured as the common stock held by officers over outstanding shares, varies from 0 to 34.59%. The all mean managerial ownership is about 3.6%.

Table 11

Descriptive Statistics for Dependent

And Independent Variables

	N	Range	Minimum	Maximum	Mean	Std. Dev.
LRATIO	220	.95	.06	.99	.3808	.1551
DPTXSD	220	.28	.00	.28	0.033	0.034
CAHFLW	220	465.20	-323.77	141.43	-1.2211	24.194
EARNVR	220	37.00	-14.44	22.57	.4174	2.574
RESRCH	220	.38	.00	.38	0.0349	0.050
GRWOPT	219	23.66	-.22	23.44	.4932	1.7951
DIVIDN	220	8.00	.00	8.00	2.1614	1.9410
SIZE	220	6.44	12.14	18.57	14.7915	1.3471
PROFIT	220	1.09	-.69	.40	.1020	.1081
COSTVR	219	18.66	-.31	18.35	.5720	1.6418
OWNRSP	220	34.59	.00	34.59	3.6190	6.8414
CRTXSD	220	.95	-.58	.38	0.0722	.1404
Valid N (listwise)	219					

Appropriateness of the Regression Model

Multiple regression analysis was employed to examine the relationship between the debt financing decision and the independent variables - tax advantage of debt, business risk, bankruptcy costs, agency costs, asymmetric information, product/input market forces, and corporate control. The purpose of this analysis is to answer the question of this study: What types of capital structure do Taiwanese technological companies use? What factors influence levels of debt financing among these companies?

The test is based on the following model:

$$HTCPST = f\ (ONRSHP, GRWOPT, RESRCH, SIZE, EARNVR, PFOFIT, COSTVR, DPTXSD, CAHFLW, CRTXSD, DIVIDN)$$

Where HTCPST= The High Technology Companies Capital Structure
ONRSHP = Managerial Ownership
GRWOPT = Growth Opportunities
RESRCH = Research And Development Costs
SIZE = Size
EARNVR = Earning Variability
PFOFIT = Profitability
COSTVR = Cost Variability
DPTXSD = Depreciation Tax Shield
CAHFLW = Cash Flow Variability
CRTXSD = Corporate Tax Shield
DIVIDN = Payment of Dividend

To determine the appropriateness of the model, several tests underlying the regression model were made as follows:

A. Examining the Existence of Multicollinearity

Multicollinearity between independent variables causes large variances and covariances for the estimators of the regression coefficients and it becomes difficult to distinguish their relative influences. This problem was tested by deriving the correlation coefficient matrix that is shown in Table 12. The correlations between variables were computed by using Pearson Correlation Coefficients.

The correlation matrix in Table 12 shows that the strongest correlation coefficients between independent variables was 0.615 between Firm Profitability (PROFIT) and dividend payment (DIVIDN) per share. The second highest correlation coefficient between independent variables was 0.466 between research and development costs (RESRCH) and cost variability (COSTVR). The third highest correlation coefficient between independent variables was 0.205 between earning variability (EARNVR) and research and development costs (RESRCH). Gujarati (1988) suggests that simple correlations between independent variables should not be considered harmful unless they exceed 0.80 or 0.90. The Pearson correlation coefficients (reported in Table 11) suggest that multicollinearity is not severe for the independent variables in this study.

Table 12
Pearson Correlation Coefficient Matrix

		TL-LA	DPTXSD	CAHFLW	EARNVR	RESRCH	GRWOPT	DIVIDN	SIZE	PROFI	COSTVR	OWINERSHIP	CRTXSD
TL-LA	Pearson Correlation	1.000											
	Sig.(2-tailed)	.											
DPTXSD	Pearson Correlation	.191**	1.000										
	Sig.(2-tailed)	.005	.										
CAHFLW	Pearson Correlation	.017	-.115	1.000									
	Sig.(2-tailed)	.802	.090	.									
EARNVR	Pearson Correlation	-.175**	-.078	-.027	1.000								
	Sig.(2-tailed)	.009	.250	.696	.								
RESRCH	Pearson Correlation	.126	.172**	.015	.205**	1.000							
	Sig.(2-tailed)	.062	.011	.825	.002	.							
GRWOPT	Pearson Correlation	.005	.088	-.001	.115	.058	1.000						
	Sig.(2-tailed)	.935	.193	.987	.090	.388	.						
DIVIDN	Pearson Correlation	-.094	-.200**	.042	.100	-.118	.170*	1.000					
	Sig.(2-tailed)	.163	.003	.532	.141	.082	.012	.					
SIZE	Pearson Correlation	.746**	.032	.078	-.152*	-.105	-.029	.049	1.000				
	Sig.(2-tailed)	.000	.638	.249	.024	.120	.670	.471	.				
PROFIT	Pearson Correlation	-.192**	-.153*	-.034	.095	.039	.137*	.615**	-.220**	1.000			
	Sig.(2-tailed)	.004	.023	.614	.158	.568	.042	.000	.001	.			
COSTVR	Pearson Correlation	.105	.193**	-.001	-.190**	.466**	.061	-.015	-.067	.041	1.000		
	Sig.(2-tailed)	.122	.004	.985	.005	.000	.365	.821	.326	.542	.		
OWINRP	Pearson Correlation	-.176**	-.002	-.099	-.009	-.036	-0.26	.051	-.273**	.173*	-.018	1.000	
	Sig.(2-tailed)	.009	.980	.142	.894	.592	.703	.448	.000	.010	.794	.	
CRTXSD	Pearson Correlation	.026	-.157*	-.017	-.066	-.078	.082	.058	-.061	.176*	.044	.090	1.000
	Sig.(2-tailed)	.707	.020	.807	.328	.249	.225	.329	.366	.009	.519	.183	.

Another method of detecting the presence of multicollinearity is by means of variance inflation factors (VIF). Variance inflation factors measure how much the variances of the estimated regression coefficients are inflated as compared to when the independent variables are not linearity related. The largest VIF among all variables is often used as an indicator of the severity of multicollinearity. Ryan (1997) suggests that multicollinearity is declared to exist whenever any VIF is at least equal to 10. (p. 133). Table 13 presents the variance inflation factors of variables. Table 13 indicates that the largest VIF observed for the regression model was firm profitability (PROFIT) (VIF = 1.79). The second largest VIF observed for the regression model was dividend payment (DIVIDN) (VIF=1.868). The remaining VIF was close to 1. Therefore, the observed correlations were not considered harmful.

B. Testing for Outliers

Outliers are problematic in the regression model. They can influence the results of the analysis, and their presence is a signal that the regression model fails to capture important characteristics of the data, because outliers may affect the Y value, or its X values. Therefore,

it is important to examine outlying from both Y and X values.

Table 13

Variance Inflation Factors of Variables

Independent Variable	Collinearity Statistics	
	Tolerance	VIF
DPTXSD	.860	1.162
CAHFLW	.966	1.035
EARNVR	.796	1.257
RESRCH	.650	1.539
GRWOPT	.928	1.077
DIVIDN	.535	1.868
SIZE	.814	1.229
PROFIT	.526	1.900
COSTVR	.670	1.492
OWINERSHIP	.894	1.119
CRTXSD	.913	1.095

1. Identification of Outlying Y Observations

To investigate the existence of outliers in the Y observations, residual analysis was used as a basis of a test of discordancy. Since a residual was viewed as the

deviation between the data and the fit, it is a measure of the variability not explained by the regression model. Thus any departures from the underlying assumptions on the errors should show up in the residuals. Analysis of the residuals is an effective method for discovering outliers.

To be more specific, the studentized deleted residuals were used instead of standard residuals for the purpose of making the analysis of residuals more effective for identifying outlying Y observations. Fox (1997) indicates that the standardized residual measure is slightly inconvenient because its numerator and denominator are not independent. The studentized deleted residuals do not present this problem, both the numerator and denominator are independent and follow a t-distribution. Neter, Wasserman, and Kutner (1996) also indicated that studentized deleted residual can be used for identifying outlying y observations without having to fit regression functions with the observation omitted.

The studentized deleted residuals Stem-and-Leaf Display for multiple regression Y (debt financing) and X (independent variables) shown in Table 13. The distribution appears to be reasonably symmetric, and there are no obvious outliers. Although a few cases appeared as extremes, they are all under 3 standard deviations from the mean. The same

process was repeated for the simple regression Y value (disclosure score) and each x value (depreciation tax shield, corporate tax shield, cash flow variability, earning variability, research and development, growth opportunities, dividends payment, firm size, firm profitability, cost variability, and managerial ownership). Table 14 summarized the Y distribution with respect to different x value. The results indicated that there were no extreme values (outliers) for outlying Y observations.

Table 14

Outlying Y Observation

Regression Model	Outlying Y Observation (Criterion: 3 standard dev.)
Y1=B0+B1X1 (X1=ONRSHP)	All Within 3 Standard Deviations
Y2=B0+B2X2 (X2=GRWOPT)	All Within 3 Standard Deviations
Y3=B0+B3X3 (X3=RESRCH)	All Within 3 Standard Deviations
Y4=B0+B4X4 (X4=SIZE)	All Within 3 Standard Deviations
Y5=B0+B5X5 (X5=EARNVR)	All Within 3 Standard Deviations
Y6=B0+B6X6 (X6=PROFIT)	All Within 3 Standard Deviations
Y7=B0+B7X7 (X7=COSTVR)	All Within 3 Standard Deviations
Y8=B0+B8X8 (X8=DPTXSD)	All Within 3 Standard Deviations
Y9=B0+B9X9 (X9=CAHFLW)	All Within 3 Standard Deviations
Y10=B0+B10X10 (X10=CRTXSD)	All Within 3 Standard Deviations
Y11=BO+B11X11 (X11=DIVIDN)	All Within 3 Standard Deviations

2. Identification of Outlying X Observations

Leverage Value is one of the most frequently used methods to detect whether or not the X values for the ith observation are outlying. Because it can be shown that leverage value is a measure of the distance between the x values for the ith observation and the means of the x values for all n observations. A large leverage value indicates that the ith observation is distant from the center of the x observations.

Table 15 summaries the outlying observation for the eleven independent variables X (depreciation tax shield, corporate tax shield, cash flow variability, earning variability, research and development, growth opportunities, dividends payment, firm size, firm profitability, cost variability, and managerial ownership). In the regression model of Y=Bo+B1X1, (X1=ONRSHP), observation item188 and 175 are distant from the center and have a large leverage value of 0.00124 and 0.00128. In the regression model of Y=Bo+B2X2 (X2=GRWOPT), observations Item 213 is distant from the center and has large leverage values of 0.74951. In the regression model of Y=Bo+B3X3 (X3=RESRCH), observations cases 192 and 165 have large values of 0.20904 and 0.20784. In the regression model of Y=B0+B4X4 (X4=SIZE), observation case 68 has a large leverage value of 0.03056. In the

regression model of Y=Bo+B5X5 (X5=EARNVR), observation item 178 has a large leverage value of 0.10877. In the regression model of Y=Bo+B6X6 (X6=PROFIT), observation items 220 and 179 have large leverage value of 0.24390 and 0.04012. In the regression model of Y=Bo+B7X7 (X7=COSTVR), observations case 192 has large values of 0.53794. In the regression model of Y=B0+B8X8 (X8=DPTXSD), observation case 28 has a large leverage value of 0.03229. In the regression model of Y=B9+B9X9 (X9=CAHFLW), observation item 157 has a large leverage value of 0.81151. In the regression model of Y=Bo+B10X10 (X10=CRTXSD), observation items 164 has a large leverage value of 0.01051. In the regression model of Y=Bo+B11X11 (X11=DIVIDN), observation items 207 has a large leverage value of 0.05661.

3. Influence Analysis

After identifying outlying observations with respect to their X values and their Y values, the next step is to ascertain whether or not they are affect the fit of regression function and whether or not they might lead to serious distortion effects.

One measure of the impact of the ith observation on the estimated regression coefficient is Cook s distance measure.

Cook s distance measure can be related to F distribution and ascertain the percentile value. The criterion is if the

Table 15

Outlying X Observation

Regression Model	Outlying X Observ. (Criterion:unusual large value and a big gap from most obser.)	Leverage Value
Y1=B0+B1X1 (X1=ONRSHP)	Item 188 Item 175	0.00124 0.00128
Y2=B0+B2X2 (X2=GRWOPT)	Item 213	0.74951
Y3=B0+B3X3 (X3=RESRCH)	Item 192 Item 165	0.20904 0.20784
Y4=B0+B4X4 (X4=SIZE)	Item 68	0.03056
Y5=B0+B5X5 (X5=EARNVR)	Item 178	0.1087
Y6=B0+B6X6 (X6=PROFIT)	Item 220 Item 179	0.24390 0.04012
Y7=B0+B7X7 (X7=COSTVR)	Item 192	0.53794
Y8=B0+B8X8 (X8=DPTXSD)	Item 28	0.03229
Y9=B0+B9X9 (X9=CAHFLW)	Item 157	0.81151
Y10=B0+B10X10 (X10=CRTXSD)	Item 164	0.01051
Y11=BO+B11X11 (X11=DIVIDN)	Item 207	0.05661

percentage value is less than about 10 to 20 percent, the outlier has little influence on the fitted regression function. If the percentile value is near 50 percent, the outlier has a substantial influence on the fit of regression function. The outliers indicated in Table 14 were reexamined by using Cook s Distance Measure.

The distance measures for the outliners' influence on the fit of the regression function are presented in Table 16. Noted from column 4 that all the x observations (outliers) have little influence on the fit of the regression model.

Fox (1997) stated that outlying data should not be deleted without investigation because it may provide insight into the structure of the data and motivate model respecification. He suggests that only bad data (e.g., an error in data entry) should be corrected or if correction is not possible, then to discard the outliers.

Since all information came from the annual report, and the outliers were not serious, the decision was made to keep all of the data.

Table 16

Outliers Influence on the Fit

of the Regression Function

A	B	C	D
Outlying X Observation	Cook s Distance	Cook s Distance to Corresponding F Distribution F(p, n-p)	Level of Influence Little If(B<C*20%) Large If(B>C*20%)
Item 188	0.00105	3.84	Little (B<C*20%)
Item 175	0.00105	3.84	Little (B<C*20%)
Item 213	0.05621	3.84	Little (B<C*20%)
Item 192	0.32203	3.84	Little (B<C*20%)
Item 165	0.31460	3.84	Little (B<C*20%)
Item 68	0.70502	3.84	Little (B<C*20%)
Item 178	0.12282	3.84	Little (B<C*20%)
Item 220	0.55193	3.84	Little (B<C*20%)
Item 179	0.02776	3.84	Little (B<C*20%)
Item 192	0.34705	3.84	Little (B<C*20%)
Item 28	0.47775	3.84	Little (B<C*20%)
Item 157	0.74731	3.84	Little (B<C*20%)
Item 164	0.00203	3.84	Little (B<C*20%)
Item 207	0.01883	3.84	Little (B<C*20%)

C. Testing of Symmetry of the Normal Distribution

To determine the appropriateness of the use of parametric statistics, it was necessary to determine the symmetry of the normal distribution.

In this study two ways were used to test for normality. One of the tests for normality was accomplished by dividing the skews of the variable by the standard error of the skew, which was obtained from the residual distribution for y (dependent variable) and each x (independent variable). If the calculated value exceeds a critical value, then the distribution is abnormal. In this study, a calculated value exceeding a plus or minus 2.58 would indicate that an assumption of a normal distribution would be rejected at the 0.01 probability level and parametric statistics would be inappropriate.

Table 17 summarizes the result of the tests of the variables in this study. The independent variables - depreciation tax shield, corporate tax shield, cash flow variability, earning variability, research and development, growth opportunities, dividends payment, firm size, firm profitability, cost variability, and managerial ownership are normally distributed, therefore, parametric statistics are appropriate for this study.

Table 17

Skewness Data from Residual Value

Variable	Skewness	S.E. Skew	Z-Value	Results
DPTXSD	0.3756	0.164	2.29	Normal D.
CAHFLW	0.3891	0.164	2.37	Normal D.
EARNVR	0.3734	0.164	2.27	Normal D.
RESRCH	0.3659	0.164	2.23	Normal D.
GRWOPT	0.3806	0.164	2.32	Normal D.
DIVIDN	0.3748	0.164	2.28	Normal D.
SIZE	0.3051	0.164	1.86	Normal D.
PROFIT	0.3755	0.164	2.28	Normal D.
COSTVR	0.3682	0.164	2.24	Normal D.
OWINERSHIP	0.3783	0.164	2.30	Normal D.
CRTXSD	0.3837	0.164	2.33	Normal D.

The Kolmogorov-Smirnov test is another way used to determine how well a random sample of data fits a normal distribution. The Kolmogorov-Smirnov output in Table 18 shows observed significance level of 4.15, 4.544, 4.219, 1.93, 4.39, 4.338, 4.365, 3.956, 4.548,4.45, 4.63 for eleven different variables. Since the observed significance level are quite large, the hypotheses of normal distribution (Ho= Normal Distribution) in each of eleven variables cannot be rejected.

Table 18

Kolmogorov-Smirnov Test

Of Normal Distribution

	N	Normal Parameter 1.Mean 2.Std. D.	Most Extreme Differences 0. Absolute 1. Positive 2. Negative	K-S Value	Asymp. Sig. 2-Tailed	Normal Dist.
Y1=B0+B1X1 (X1=ONRSHP)	220	0.009 1.043	0. 28 0. 258 -0.28	4.15	0.00	Normal
Y2=B0+B2X2 (X2=GRWOPT)	219	0. 007 1.046	0. 307 0. 295 -3.07	4.544	0.00	Normal
Y3=B0+B3X3 (X3=RESRCH)	220	0. 007 1. 047	0. 284 0. 284 -0.238	4.219	0.00	Normal
Y4=B0+B4X4 (X4=SIZE)	220	0. 009 1. 048	0. 13 0. 13 -0.11	1.93	0.01	Normal
Y5=B0+B5X5 (X5=EARNVR)	220	0. 014 1. 047	0. 296 0. 296 -0.273	4.39	0.00	Normal
Y6=B0+B6X6 (X6=PROFIT)	220	0. 008 1. 046	0. 292 0. 292 -0.241	4.338	0.00	Normal
Y7=B0+B7X7 (X7=COSTVR)	219	0. 008 1. 059	0. 295 0. 295 -0.283	4.365	0.02	Normal
Y8=B0+B8X8 (X8=DPTXSD)	220	0. 009 1. 046	0. 267 0. 267 -0.218	3.956	0.00	Normal
Y9=B0+B9X9 (X9=CAHFLW)	220	0. 007 1.043	0. 307 0. 298 -0.307	4.548	0.00	Normal
Y10=B0+B10X10 (X10=CRTXSD)	220	0. 009 1. 047	0. 300 0. 297 -0.300	4.450	0.01	Normal
Y11=BO+B11X11 (X11=DIVIDN)	220	0. 01 1.046	0. 312 0. 312 -0.276	4.623	0.03	Normal

D. Testing for Significance

The regression model was examined for significance since a nonsignificant model provides no basis for subsequent analysis of the coefficients.

The hypotheses are:

H_o: $B_1=B_2=B_3=B_4=B_5=B_6=0$

H_1: B_j 0 for at least one j

As reported in Table 19 the regression model indicated that six variables (Depreciation Tax Shields, Earning Variability, Research and Development Costs, Firm Size, Cost Variability, and Corporate Tax Shields) are statistically significant (P-value = 0.000). Based on this outcome, the null hypothesis is rejected in favor of the alternative hypothesis.

Rejection of $H_o: B_j=0$ implies that at least one of the regressors (depreciation tax shield, corporate tax shield, cash flow variability, earning variability, research and development, growth opportunities, dividends payment, firm size, firm profitability, cost variability, and managerial ownership) contributes significantly to the model.

Table 19

Results of Regression Model

Model	B	Std. Error	Beta	T	Sig. T
Constant	-0.395	0.024		-16.775	0.000
DPTXSD	0.199	0.055	0.152	3.639	0.000
CAHFLW	-0.049	0.000	-0.027	-0.685	0.494
EARNVR	-0.014	0.001	-0.085	-1.961	0.050
RESRCH	0.15	0.043	0.170	3.508	0.001
GRWOPT	0.09	0.001	0.040	0.995	0.321
DIVIDN	-0.001	0.001	-0.045	-0.840	0.402
SIZE	0.02	0.002	0.766	17.712	0.000
PROFIT	-0.02	0.022	-0.055	-1.030	0.304
COSTVR	0.003	0.001	0.113	2.380	0.018
OWNRSP	0.001	0.000	0.025	0.612	0.542
CRTXSD	0.06	0.014	0.198	4.904	0.000

Multiple R .836
R Square .699
Adjusted R Square .683
Standard Error .025
DF: (11 201)
F = 11.41584 Signif. F = .0000

After determining the appropriateness of the regression

model, the next step is to examine each of the independent Variables to see how they correlate with voluntary disclosure. The ANOVA approach (F-test) was used to determine the existence of a linear relationship between dependent variable (debt ratio) and independent variables (depreciation tax shield, corporate tax shield, cash flow variability, earning variability, research and development, growth opportunities, dividends payment, firm size, firm profitability, cost variability, and managerial ownership). The conclusions regarding the hypotheses were determined from the sign and significance of the regression coefficient of the appropriate variable.

Tests of Hypotheses

This part of the analysis started by running a simple regression equation using the predictor variable that has the highest correlation with the dependent variable, because it explains the largest percentage of Y variance. Table 19 summaries eleven independent variables partial correlation score with dependent variable. Table 20 shows that independent variable SIZE has the highest partial correlation score. Therefore, the SIZE variable is entered first.

Size

Company size was selected as a independent variable of the multiple regression model. Past studies indicate that company size is the variable most consistently reported as significant in studies examining differences among firms' debt financing decision. Company size is expected to be positively related to the levels of debt financing.

Table 20

Partial Correlation Value
for Independent Variables

Independent Variables	Partial Correlation Value
DPTXSD	0.249
CAHFLW	-0.048
EARNVR	-0.137
RESRCH	0.240
GRWOPT	0.070
DIVIDN	-0.059
SIZE	**0.781**
PROFIT	-0.072
COSTVR	0.166
OWNRSP	0.043
CRTXSD	0.327

The regression model after Size variable is entered is: High Technology Companies levels of debt = -36.7 + 2.67 SIZE This model explains 74% of the levels of debt financing variance.

The null and alternative hypothesis to determine whether the SIZE explains a significant percentage of the variance in the debt financing decision (y) are:

Ho: $\sigma_1^2 = 0$

H1: $\sigma_1^2 \neq 0$

$\sigma_1^2 = 0$ means that size (X) does not explain a significant percent of the variance in level of debt financing(y).

The test is conducted at the 0.05 significance level. The critical F statistic based on (1, 211) degrees of freedom is 3.86. The decision rule is if the calculated F statistics is greater than 3.86, reject the null hypothesis. Table 17 gives the results for this regression.

Since the computed F ratio found in Table 21, 257.222, is greater than the critical value 3.86, the null hypothesis is rejected.

The p value provided in Table 21 leads to the same conclusion. The p-value for the F statistics is 0.000,

meaning that the probability of rejecting a true null hypothesis is very small.

Based on the above analysis, one can conclude the SIZE variable explains a significant percentage of the variance in the level of debt financing. The sign is positive, as expected, indicating that size is positively related to the levels of high technology companies' debt financing decision.

Table 21

Results of STEPWISE Regression Model

- Stepwise 1

Model	B	Std. Error	Beta	T	Sig. T
Constant	-0.367	0.025		-14.901	0.000
SIZE	0.027	0.002	0.741	16.038	0.000

Variable(s) Entered on Step Number: SIZE

Multiple R .741
R Square .549
Adjusted R Square .547
Standard Error 0.030
DF: (1 211)
F Distribution: 257.222 Sig. T: 0.000

Cost Variability

This hypothesis tests whether the levels of cost variability of high technology companies are positively related to their levels of debt financing.

The regression model after the cost variability (COSTVR) variable is entered is:

High Technology Companies levels of debt = -37.9+2.73 SIZE + 0.67 COSTVR

This regression model explains 78% of the variance in levels of debt financing. The null and alternative hypothesis to determine whether the cost variability variable explains a significant percentage of the variance in the levels of debt financing (Y) are:

Ho: $\sigma_2^2 = 0$

H1: $\sigma_2^2 \neq 0$

$\sigma_2^2 = 0$ means that cost variability (X) does not explain a significant percentage of the variance in the level of debt financing (y).

The test is conducted at the 0.05 significance level. The critical F statistic based on (2, 210) degrees of freedom is 3.02. The decision rule is if the calculated F statistics is greater than 3.00, reject the null hypothesis. Table 22 gives the results for this regression.

Since the computed F ratio found in Table 22, 164.5, is greater than the critical value 3.00, the null hypothesis is

rejected. The cost variability variable does explain a significant percent of the variance in the disclosure score.

The p value provided in Table 22 leads to the same conclusion. The p-value for the F statistics is 0.000, indicating that the probability that this conclusion is wrong is very small (0.000).

According to the above analysis, the following conclusion was made. Cost variability variable does explain a significant portion of the variance in the levels of debt financing. The sign is positive as expected, indicating that the levels of cost variability of high technology companies are positively related to their levels of debt financing.

Table 22

Results of STEPWISE Regression Model
- Stepwise 2

Model	B	Std. Error	Beta	T	Sig. T
Constant	-0.379	0.023		-16.422	0.000
SIZE	0.027	0.002	0.755	17.506	0.000
COSTVR	0.006	0.001	0.247	5.735	0.000

Variable(s) Entered on Step Number: SIZE, COSTVR
Multiple R .781
R Square .610
Adjusted R Square .607
Standard Error 0.028
DF: (2 210)
F Distribution: 164.5 Sig. T: 0.000

Corporate Tax Shields

This hypothesis tests whether the amounts of corporate taxes by high technology companies are negatively related to their levels of debt financing.

The regression model after the corporate tax variable (CRTXSD) is entered is:

High Technology Companies levels of debt =-38.4+ 2.73 SIZE + 0.6 COSTVR + 5.3 CRTXSD

This regression model explains 79% of the debt financing variable.

The null and alternative hypothesis to determine whether the amounts of corporate taxes variable explains a significant percentage of the variance in the levels of debt financing (y) are:

Ho: $\sigma_3^2 = 0$

H1: $\sigma_3^2 \neq 0$

$\sigma_3^2 = 0$ means that amounts of corporate taxes (X) does not explain a significant percent of the variance in the levels of debt financing (y).

The test is conducted at the 0.05 significance level. The critical F statistic, based on (3, 209) degrees of freedom is 2.63. The decision rule is: if the calculated F statistics is greater than 2.60, reject the null hypothesis.

Since the computed F ratio found in Table 23, 121.371, is greater than the critical value 2.60, the null hypothesis is rejected.

The p value provided in Table 23 leads to the same conclusion. The p-value for the F statistics is 0.000, meaning that the chance of this error is quite low (0.000).

The above analysis leads to the following conclusion. The corporate tax shields variable does explain a significant portion of the variance in the levels of debt financing. The sign is not as expected, indicating that the amounts of corporate taxes are positively related to their levels of debt financing.

Table 23

Results of STEPWISE Regression Model
- Stepwise 3

Model	B	Std. Error	Beta	T	Sig. T
Constant	-0.384	0.022		-17.13	0.000
SIZE	0.027	0.002	0.757	18.096	0.000
COSTVR	0.006	0.001	0.242	5.785	0.000
CRTXSD	0.053	0.014	0.158	3.780	0.000

Variable(s) Entered on Step Number: SIZE, COSTVR, CRTXSD
Multiple R .797
R Square .635
Adjusted R Square .630
Standard Error 0.027
DF: (3 209)
F Distribution: 121.371 Sig. T:0.000

Depreciation Tax Shields

This hypothesis tests whether the depreciation expense of high technology companies are positively related to their levels of debt financing.

The regression model after the depreciation tax shields variable (DPTXSD) is entered is:

High Technology Companies levels of debt = -39.1+ 2.73 SIZE + 0.5 COSTVR + 6.31 CRTXSD + 25 DPTXSD

This regression model explains 82% of the levels of debt financing variable variance. The null and alternative hypothesis to determine whether the depreciation tax shield explain a significant percentage of the variance in levels of debt financing (y) are:

Ho: $\sigma_4^2 = 0$

H1: $\sigma_4^2 \neq 0$

$\sigma_4^2 = 0$ means that depreciation tax shields (X) does not explain a significant percentage of the variance in levels of debt financing (y).

The test is conducted at the 0.05 significance level. The critical F statistic based on (4, 208) degrees of freedom, is 2.37. The decision rule is if the calculated F statistics is greater than 2.37, reject the null hypothesis.

Since the computed F ratio found in Table 24, 105.309, is greater than the critical value 2.37, the null hypothesis is rejected. The p value provided in Table 23 leads to the same conclusion. The p-value for the F statistics is 0.000, meaning that the chance of this error is quite low (0.000).

Since the p-value 0.00 is less than the chosen significance level 0.05, the null hypothesis can be rejected. The depreciation tax shields do explain a significant percentage of the variance in the levels of debt financing (y).

Table 24

Results of STEPWISE Regression Model - Stepwise 4

Model	B	Std. Error	Beta	T	Sig. T
Constant	-0.391	0.021		-18.86	0.000
SIZE	0.027	0.001	0.755	18.914	0.000
COSTVR	0.005	0.001	0.203	4.970	0.000
CRTXSD	0.063	0.014	0.187	4.641	0.000
DPTXSD	0.250	0.054	0.191	4.633	0.000

Variable(s) Entered on Step Number: SIZE, COSTVR, CRTXSD DPTXSD.

Multiple R .818
R Square .669
Adjusted R Square .663
Standard Error 0.026
DF: (4 208)
F Distribution: 105.309 Sig. T: 0.000

Research and Development Costs

This hypothesis tests whether the research and development costs of high technology companies are positively related to their levels of debt financing.

The regression model after research and development variable (RESRCH) is entered is:

High Technology Companies levels of debt =-40.4+ 2.79 SIZE + 0.37 COSTVR + 6.74 CRTXSD + 24 DPTXSD + 12.4 RESRCH

This regression model explains 83% of the debt financing variable variance. The null and alternative hypothesis to determine whether the research and development cost explains a significant percentage of the variance in the levels of debt financing (y) are:

Ho: $\sigma_5^2 = 0$

H1: $\sigma_5^2 \neq 0$

$\sigma_5^2 = 0$ means that research and development cost (X) does not explain a significant percentage of the variance in the levels of debt financing (y).

The test is conducted at the 0.05 significance level. The critical F statistic based on (5, 207) degrees of freedom is 2.21. The decision rule is if the calculated F statistics is greater than 2.21, reject the null hypothesis.

Since the computed F ratio found in Table 25, 89.627, is greater than the critical value 2.21, the null hypothesis is rejected. However, the P value provided in Table 25 leads to the same conclusion. The p-value for the F statistics is 0.000, indicating that the probability of rejecting a null hypothesis Ho that is true is as low as zero.

Since the p-value 0.00 is less than the chosen significance level 0.05, the null hypothesis can be rejected. The research and development cost does explain a significant percentage of the variance in the levels of debt financing (y).

Earning Variability

This hypothesis tests whether earning variability of high technology companies are negatively related to their levels of debt financing.

The regression model after earning variability variable (EARNVR) is entered is:

High Technology Companies levels of debt == -39.8+ 2.75 SIZE + 0.28 COSTVR + 6.59CRTXSD + 23.2 DPTXSD +15.4 RESRCH - 0.155 EARNVR

Table 25

Results of STEPWISE Regression Model
- Stepwise 5

Model	B	Std. Error	Beta	T	Sig. T
Constant	-0.404	0.021		-18.86	0.000
SIZE	0.027	0.001	0.774	19.544	0.000
COSTVR	0.003	0.001	0.138	3.068	0.002
CRTXSD	0.067	0.013	0.200	5.028	0.000
DPTXSD	0.240	0.053	0.183	4.530	0.000
RESRCH	0.124	0.040	0.140	3.092	0.002

Variable(s) Entered on Step Number: SIZE, COSTVR, CRTXSD DPTXSD.

Multiple R .827
R Square .684
Adjusted R Square .676
Standard Error 0.025
DF: (5 207)
F Distribution: 89.627 Sig. T: 0.000

This regression model explains 83% of the levels of debt financing variable variance. The null and alternative hypothesis to determine whether the earning variability explains a significant percentage of the variance in the levels of debt financing (y) are:

Ho: $\sigma_6^2 = 0$

H1: $\sigma_6^2 \neq 0$

$\sigma_6^2 = 0$ means that earning variability (X) does not explain a significant percentage of the variance in the levels of debt financing (y).

The test is conducted at the 0.05 significance level. The critical F statistic based on (6, 206) degrees of freedom is 2.10. The decision rule is : if the calculated F statistics is greater than 2.10, reject the null hypothesis.

Since the computed F ratio found on the Table 26, 76.695, is greater than the critical value 2.10, the null hypothesis is rejected. The P value provided in Table 26 leads to the same conclusion. The P-value for the F statistics is 0.00, indicating that the probability that this conclusion is wrong is as low as zero.

Since the p-value 0.00 is less than the chosen significance level 0.05, the null hypothesis can be rejected. The earning variability does explain a significant percentage of the variance in the levels of debt financing (y).

Table 26

Results of STEPWISE Regression Model
- Stepwise 6

Model	B	Std. Error	Beta	T	Sig. T
Constant	-0.398	0.021		-18.593	0.000
SIZE	0.027	0.001	0.764	19.317	0.000
COSTVR	0.002	0.001	0.106	2.238	0.026
CRTXSD	0.065	0.013	0.196	4.952	0.000
DPTXSD	0.232	0.053	0.177	4.392	0.000
RESRCH	0.154	0.042	0.174	3.647	0.000
EARNVR	-0.001	0.001	-0.090	-2.118	0.035

Variable(s) Entered on Step Number: SIZE, COSTVR, CRTXSD
DPTXSD, RESRCH, EARNVR

Multiple R .831
R Square .691
Adjusted R Square .682
Standard Error 0.025
DF: (6 206)
F Distribution: 76.695 Sig. T: 0.000

The final regression model therefore is:

High Technology Companies levels of debt == -39.8+ 2.75 SIZE + 0.28 COSTVR + 6.59CRTXSD + 23.2 DPTXSD +15.4 RESRCH - 0.155 EARNVR

This regression model explains 83% of the levels of debt financing variable variance.

Discussion of Results

Table 19 presents the results of multiple regression. Because the R Square (R Square = 0.836) was considered high (Adjusted R Square =0.699), the model was statistically significant (*P*-value =0 at the 0.05 level). The intercept term represents the amount that is not accounted for by the means of the independent variables. This implies that 39% of the dependent variable (levels of debt financing) is attributable to factors other than those considered in the model.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary of the Study

The purpose of this research was to assess the level of debt financing decision in the high technology companies and to assess whether or not the independent variables - depreciation tax shield, corporate tax shield, cash flow variability, earning variability, research and development, growth opportunities, dividends payment, firm size, firm profitability, cost variability, and managerial ownership were associated with levels of debt financing.

Numerous researchers have attempted to identify the variables that explain the levels of debt financing. Different firm-related characteristics such as size, growth opportunities, business risk, bankruptcy costs, agency costs, and tax shields were generally considered to be among the determinants of the capital structure of a firm. The only consistent finding among these studies is that debt and equity financing often varies with firm size. Other firm-specific characteristics are not as consistent.

The study covers the debt financing of high technology companies of Taiwan Stock Exchange (TSE) and Over-Table

Counter (OTC). Six industries-- Integrated Circuits, Computers and Peripherals, Telecommunication, Optoelectronics, Precision Machinery and Materials, and Biotechnology were selected because they most closely met the researcher definitions of high technology companies.

The dependent variable was constructed from a review of the annual reports and TEJ. The hypothesized predictors of levels of debt financing were identified by a review of those determinants identified in other studies and by reference to several theories such as agency theory, and information asymmetry hypothesis.

The data were collected from the annual financial data of TEJ and annual report. Descriptive statistics for each of the variables were presented in Chapter Four. Several tests examined the appropriateness of the regression model. Multiple regression models were developed to determine the most suitable predictors. Through analysis of variance, the presence or absence of differential predictability of the independent variables and their signs were determined.

Summary of Research Findings

Size

Company size is the independent variable in the study. Company size was positively related to the levels of debt

financing, as expected. The results (*B*= 2.67, T= 16.038, p= 0.000) show a significance relationship between size and levels of debt financing. The positive sign indicates that the size of high technology companies is positively related to levels of debt financing.

This finding is consistent with the findings of Ang et al. (1982) who indicates that bankruptcy costs relative to assets decline and thus the advantage of debt financing grows as firms get larger. Additionally, large firms are less prone to bankruptcy than small firms because they generally are more diversified and have less volatile income streams relative to small firms

Cost Variability

The cost variability hypothesis under investigation stated that: The levels of cost variability of high technology companies are positively related to their levels of debt financing. The results (*B*= 0.6, T=5.735, p=0.000) show there is a significant relationship between cost variability and levels of debt financing. The sign was positive, as expected, indicating that the levels of cost variability of high technology companies are positively related to their levels of debt financing.

This is consistent with the findings of Showalter (1999) who stated that uncertain cost fluctuations influence firms in a different way. The theory of strategic debt shows that firms will hold more debt as costs become less certain because firms can gain a strategic advantage using debt to emphasize low cost states and commit to a higher output.

Corporate Tax Shields

The corporate tax shields hypothesis under investigation stated that: The amounts of corporate tax are negatively related to their levels of debt financing. The results (B= 0.05, T=3.78, p=0.000) show there is a significant relationship between corporate tax shields and levels of debt financing. The positive sign indicates the corporate taxes of high technology companies are positively related to their levels of debt financing. This finding is consistent with the finding of Bradley, Jarrell, and Kim (1984) who indicated that firms that invest heavily in tangible assets, and thus generate relatively high levels of depreciation and tax credits, tend to have higher financial leverage.

Depreciation Tax Shields

The depreciation tax shields hypothesis under investigation stated that: The depreciation tax shields of

high technology companies are positively related to their levels of debt financing. The results (*B*= 0.25, T= 4.633, p= 0.000) indicated that the depreciation tax shields of high technology companies are positively related to their levels of debt financing. This finding is consistent with the finding of Bradley, Jarrell, and Kim (1984) who indicated that firms that invest heavily in tangible assets, and thus generate relatively high levels of depreciation and tax credits, tend to have higher financial leverage.

Research and Development Costs

The research and development costs hypothesis under investigation stated that: research and development costs of high technology companies are positively related to their levels of debt financing. The results (*B*= 0.124, T=0.14, p= 0.00) indicated that research and development costs of high technology companies are positively related to their levels of debt financing. This is consistent with the findings of Titman and Wessels (1988) who argued that the costs of liquidation are higher for firms that produce unique or specialized products. For these reasons, a high degree of specificity engenders high distress costs. Expenditures on research and development over sales are indications of being unique. R&D expenditures measure uniqueness because firms

that sell products with close substitutes have low R&D intensity since their innovations can be easily duplicated. Measures of corporate liquidity should be higher for firms with high R&D.

Earning Variability

The earning variability hypothesis under investigation stated that: Earning variability levels of high technology companies are negatively related to their voluntary disclosure of corporate information. The results (*B*= -0.001, T= -2.118, p= 0.000) indicated that earning variability levels are negatively related to their levels of debt financing. This finding is consistent with the findings of Jarrell and Kim (1984) who show earning variability to be an important determinant of a firm's leverage. They conclude that higher risk companies tend to have lower debt ratios. Friend and Lang (1988) also explore this matter and find a negative relationship, meaning that risky firms borrow less.

Theoretical Implications

Several theories of capital structure are examined in corporate debt financing studies. These theories highlight the possibility that significant incentives exist that may cause firms to borrow more or less debts.

Two hypotheses based on agency theory of growth opportunity, and dividend payments were developed. The levels of debt financing were expected to be positively related to growth opportunity, and negatively related to dividend payment. The results indicated that the prediction of agency theory concerning growth opportunity was supported in this study. However, there was not sufficient evidence to support the relationship between levels of debt financing and agency theory prescriptions concerning dividend payment.

Information asymmetry hypothesis is another theory used to explain firms' levels of debt financing. Two hypotheses based on information asymmetry hypothesis were developed. The level of debt financing was expected to be positively related with both information asymmetry hypothesis variables. The results supported the prediction and the direction of information asymmetry hypothesis regarding firm size and its levels of debt financing. The prediction of information asymmetry hypothesis with regard to firm profitability is not supported in this study.

Conclusions

This research finds that firm size, cost variability, corporate tax shields, depreciation tax shields, research and development costs, and earning variability are

statistically related to the level of debt financing of high technology companies. The positive signs associated with firm size, corporate tax, research and development costs, earning variability, and cost variability are consistent with the prediction of more debt by large firms, high cost and earning variability, high corporate tax, and high research and development costs companies. However, the positive sign associated with depreciation tax shields was not as predicted. Finally, the predictions of business risk with regard to cash flow variability, asymmetric information hypothesis with regard to firm profitability, agency costs theory with regard to growth opportunities and dividend payment, and corporate control with regard to managerial ownership are not supported in this study.

Limitations of the Study

The scope of the research is limited to debt financing decision in Taiwanese high technology companies. Data were collected directly from TEJ and annual reports. Other company documents may provide more accurate numbers.

The second limitation of this study is that the samples are limited to public companies. The limitations of samples indicated that the results might not be applicable to the

market as a whole. Especially, most of Taiwanese companies are small-medium size (93%) and most of them are private.

The third limitation of this study is the selection and the measurement of each independent variable. In this study, eleven firms characteristics derived from theories of capital structure were hypothesized as the predictors for explaining the variance of debt financing. However, the different firms characteristics used to predict the variance of debt financing may cause the results different.

Recommendations for Future Research

The limitations of this study provide opportunities for continued research. There are several directions for extending future research in voluntary information disclosure. They are:

1. Extend the study to include more companies (e.g, Small-medium size companies)

This study focused on the Taiwanese public high technology companies. The limitations of samples indicated that the results might not be applicable to the market as a whole. Especially, most of Taiwanese companies are small-medium size (93%) and most of them are private. Further study might include additional industries and companies (both public and private).

2. The Component for measuring independent variables

In this study, eleven firms characteristics derived from theories of capital structure were hypothesized as the predictors for explaining the variance of debt financing. However, the different firm's characteristics and ratio used to predict the variance of debt financing might cause the results different. Further study, might use the components of the independent variables instead of the ratio itself. Then, the proposed multiple regression models would combine the components of these derived financial ratios in the best way actuarially to explain the variance in the dependent variable.

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