Order Number 9013158

The effect of tax law changes on corporate investment and financing behavior: Empirical evidence from changes brought about by the Economic Recovery Tax Act of 1981

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The University of Arizona, 1989

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THE EFFECT OF TAX LAW CHANGES ON CORPORATE INVESTMENT AND FINANCING BEHAVIOR: EMPIRICAL EVIDENCE FROM CHANGES BROUGHT ABOUT BY THE ECONOMIC RECOVERY TAX ACT OF 1981

by

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A Dissertation Submitted to the Faculty of the

COMMITTEE ON BUSINESS ADMINISTRATION

In Partial Fulfillment of the Requirements
For the Degree of

DOCTOR OF PHILOSOPHY

In the Graduate College

THE UNIVERSITY OF ARIZONA

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THE UNIVERSITY OF ARIZONA
GRADUATE COLLEGE

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entitled THE EFFECT OF TAX LAW CHANGES ON CORPORATE INVESTMENT AND FINANCING BEHAVIOR: EMPIRICAL EVIDENCE FROM CHANGES BROUGHT ABOUT BY THE ECONOMIC RECOVERY TAX ACT OF 1981

and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosophy.

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Final approval and acceptance of this dissertation is contingent upon the candidate's submission of the final copy of the dissertation to the Graduate College.

I hereby certify that I have read this dissertation prepared under my direction and recommend that it be accepted as fulfilling the dissertation requirement.

Dissertation Director Dan S. Dhaliwal — 11/13/89 Date

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ACKNOWLEDGEMENT

This dissertation was prepared at The University of Arizona under the supervision of Dr. Dan S. Dhaliwal. I wish to express my gratitude for the guidance and encouragement that he has provided.

I would also like to thank the other members of my dissertation committee for their helpful suggestions. Specifically, I would like to thank Dr. Edward Dyl, Dr. Sharon Lassar, Dr. Ronald Oaxaca and Dr. Shiing-wu Wang for the generous sharing of their time and knowledge.

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ABSTRACT

This dissertation examines the relationship between debt and investment-related tax shields using changes in these classes of tax shields scaled by expected operating earnings following the passage of the Economic Recovery Tax Act(ERTA) in 1981. The substitution effect predicts that a negative relationship between changes in the two classes of tax shields will be observed in response to the increased investment-related tax shields offered by ERTA. Debt tax shields should decrease following ERTA since the probability of losing the tax benefit of tax shields would rise as investment-related tax shields increased following ERTA. Firms' probability of losing the deductibility of tax shields is used to segregate the sample into two groups. For the group of firms with a low probability of losing the deductibility of tax shields, the substitution effect is inapplicable and the relation between changes in the two classes of tax shields simply represents the debt securability effect. Since fixed assets can be used as collateral for debt, the debt securability hypothesis predicts a positive relationship between changes in debt and investment-related tax shields after the passage of ERTA. The model developed to segregate debt securability from the substitution effect reveals that, as predicted, the debt

securability effect is positive for all firms and that the substitution effect is negative for those firms with a large probability of losing the benefits of tax shields. This reverses the findings of prior research.

Controls for pecking order theory effects are introduced into the model to assure that the substitution effect observed is not due to debt ratio as predicted by Myers[1984]. The findings described above remain intact except that the debt securability effect does not exist and the substitution effect is weaker for high-debt firms. Furthermore, support is offered for the pecking order theory. These results are robust to alternate specifications of time periods tested, variable definitions, data screening criteria and model specifications.

I. INTRODUCTION

In 1958, Modigliani and Miller(MM hereafter) revolutionized the finance literature by demonstrating that in perfect and competitive capital markets the value of the firm is independent of its capital structure. Miller[1977] is able to show that this same conclusion holds if the MM assumption of no corporate or personal taxes is relaxed.

An implication of MM[1958] and Miller[1977] is the familiar result that the investment and financing decisions of the firm are independent and thus can be made separately. DeAngelo and Masulis[1980], however, demonstrate that this result will not hold with the assumptions of investment-related corporate tax shields such as depreciation, the corporate tax deductibility of interest expense, and tax rules requiring that corporations pay tax on positive taxable income while receiving no immediate rebate for negative taxable income. Specifically, DeAngelo and Masulis show that a firm's value is not independent of its debt/equity structure since the probability of losing the tax deductibility of depreciation and other tax shields increases as debt is added to the capital structure and, hence, the marginal value of debt decreases as debt is added to the capital structure. This is called the debt-related and investment-related tax shields substitution effect. Importantly, DeAngelo and Masulis[1980] treat firms' investment decisions as an exogenous variable to derive their results.

Dammon and Senbet[1988] extend the results of DeAngelo and Masulis[1980] by endogenizing the investment decision and considering the theoretical work of Hite[1977]. They show that an increase in depreciation allowed due to changes in the corporate tax rules will lead to a decrease in the firm's cost of capital and an increase in output. Since this increase in output will increase a firm's taxable operating income, a firm's demand for interest deductions will increase; this is the income effect. At the same time, as a firm's depreciation deductions increase, the demand for interest deductions will decrease due to the increased probability that tax shields will be lost in those state of nature in which a firm's depreciation and interest expense exceed its taxable operating income; this is the substitution effect. Dammon and Senbet's results suggest that one cannot state unambiguously whether an increase in tax depreciation allowed will lead to an increase or decrease in debt employed since the income effect predicts an increase in debt utilized while the substitution effect predicts the opposite. However, they do show that if changes in investment-related tax shields and changes in debt tax shields in response to a change in the depreciation provisions of the tax laws are both scaled by expected operating earnings, the income effect will be controlled for and the prediction of the substitution effect of a negative relation between changes in investment-related and debt tax shields should be observed. This relation between the investment and leverage decisions of the firm due to taxes has less restrictive assumptions than the relations derived from the models of DeAngelo and Masulis[1980] and Miller[1977]; these latter two models can be considered special cases of Dammon and Senbet[1988].

The objective of this dissertation is to empirically test the proposition of Dammon and Senbet[1988] that a negative relation between changes in investment-related and debt tax shields, both scaled by expected operating earnings, should exist following a tax law change that increases tax depreciation allowed. The Economic Recovery Tax Act of 1981(ERTA) provides an ideal environment to examine this proposition since its major provisions with regards to corporations involved liberalized investment-related tax shield write-offs for depreciation, the investment tax credit and a new research and development credit. Accordingly, the relationship between changes in debt-related and investment-related tax shields subsequent to ERTA is examined in this dissertation.

The tests employed in this dissertation are based on models that recognize that the debt and investment-related tax shields substitution effect seems to be more applicable to firms that are subject to a reasonable probability of losing the deductibility of tax shields. That is, the models take into account the fact that for firms that consistently have enough operating income to utilize all tax shields the risk of losing the deductibility of tax shields is low and the substitution effect between debt and investment-related tax shields may not be observed. Prior empirical tests of the substitution effect have ignored this consideration which may explain the fact that these tests have yielded results significantly opposite to those predicted(e.g. Bradley, Jarrell and Kim[1984]).

Further, Scott[1977] noted that fixed assets are normally used as collateral for corporate debt, i.e. a debt securability effect exists. Ceteris paribus, the debt securability effect predicts a positive relation between changes in debt and investment-related tax shields following the passage of ERTA. Since this debt securability effect is common to all firms with fixed assets, it may obscure the negative relation between changes in debt and investment-related tax shields following the enactment of ERTA predicted by the theoretical work of Dammon and Senbet[1988] and cause mixed results. This dissertation designs an empirical test that can separate the confounding of the debt and investment-related tax shields substitution by the debt securability effect. This is accomplished by partitioning sample firms into two groups; the first group consists of firms with a great probability of losing the deductibility of tax shields, while the second group consists of firms with a low probability of shield loss. Since the debt and investment-related tax shields substitution effect is not a concern for firms in the second group, their debt and investment-related tax shields relation simply represents the debt securability effect. A model is then developed to integrate the two groups of firms so that the debt securability factor, common to both sets of firms, can be isolated and the substitution effect can be separately assessed. The results of these tests strongly support the debt securability hypothesis as well as predictions of the substitution effect.

In addition to controls for the income effect, the probability of losing tax shields and the debt securability effect, this research takes into account pecking order theory effects that could offer an alternative explanation for the results observed. The pecking order theory predicts that firms with a high debt ratio will finance post-ERTA investments in capital equipment using more equity issuance than firms with a low debt ratio; this in turn leads to the prediction that high-(low-) debt firms will exhibit a negative(positive) relationship between debt ratio and changes in debt-related tax shields scaled by expected operating earnings following the passage of ERTA. Since changes in debt tax shields scaled by expected operating earnings are the dependent variable used in tests of the debt securability and substitution effects, these tests are repeated with control for debt ratio. This control yields similar results except that high-debt firms exhibit no debt securability effect and a weaker substitution effect relative to low-debt firms.

Finally, to improve the power of the tests conducted in this research, results are compared between firms receiving greater and lesser investment-related tax shield benefits under the provisions of ERTA. These tests find that the firms receiving a greater ERTA benefit show the more significant substitution effect between changes in debt and investment-related tax shields following ERTA.

This dissertation offers several significant contributions to the literature relating taxes to a firm's investment and financing decisions. First, time-series tests are used to test the debt securability and substitution effects rather than the cross-sectional tests that have been previously reported. These time-series tests allow control for confounding variables such as firm-specific differences in agency costs and costs of bankruptcy and financial distress(Dammon and Senbet[1988]). Second, this dissertation recognizes that the substitution effect is only of concern to firms with a reasonable probability of losing the deductibility of tax shields; this has not been considered in other published tests of the substitution effect. Third, the models developed in this dissertation allow a separation of the debt securability effect from the tax shields substitution effect; models used in prior empirical research did not attempt to separate these effects. Finally, this dissertation uses the work of Dammon and Senbet[1988] to develop propositions and hypotheses; this is the only theoretical work to recognize the interaction between the income effect(Hite[1977]) and the substitution effect(DeAngelo and Masulis[1980]) and to endogenize the investment decision.

This dissertation contributes to tax accounting knowledge by providing evidence that firms respond to changes in the tax laws as predicted by theory. Specifically, all firms show a positive relation between changes in debt and investment-related tax shields following the enactment of ERTA as predicted by the debt securability hypothesis, while firms with a reasonable probability of losing the immediate tax deductibility of tax shields show an incremental negative relation between changes in the two classes of tax shields as predicted by the substitution effect. These results should prove useful to policy makers, legislators and capital market participants in predicting the effect of a change in the tax laws (1) on individual firms and their market valuations and (2) on economy-wide corporate debt levels.

The rest of this dissertation is organized as follows. Section 2 reviews the prior literature relating taxes to investment and financing decisions and develops the propositions and models to be used to test assertions from this literature. Section 3 describes the relevant tax law changes of ERTA. Section 4 develops empirical surrogates used to test hypotheses developed from the propositions of section 2 and reports the results of tests of these hypotheses. Finally, Section 5 summarizes the findings and offers possible avenues for further research.

II. LITERATURE REVIEW AND MODEL SPECIFICATION

2.1. Modigliani and Miller and Static Tradeoffs

In 1958, Modigliani and Miller(MM hereafter) revolutionized the finance literature by demonstrating that the value of a firm is independent of its capital structure. Their demonstration rests on the assumption of perfect capital markets. More precisely, they assume that individuals are price takers, there are no taxes or transaction costs, information is perfect and costless, there is no bankruptcy, and individuals can borrow and lend on the same terms as firms. In this world, any difference between the value of two firms that differ only in their choice of debt/equity structure will be arbitraged away by individuals borrowing or lending on personal account.

In 1963, MM relax the assumption of no corporate taxes. With all other assumptions intact, MM show that firms will maximize value if they employ 100% debt financing. Since interest expense on debt is deductible in computing taxable income and since bankruptcy costs are assumed away, the value of the firm will increase as more debt rather than equity financing is employed. Hite[1977] shows that, with MM[1963] assumptions, the firm's weighted average cost of capital will decrease as more debt is employed. This will lead to an increase in the firm's optimal capital investment and increased output. This increased output will give rise to an increase in the operating income of the firm which, in turn, will cause the firm's value to increase. This increase in firm value will be in addition to that caused by the deductibility of interest payments on the debt of the corporation.

The prescription that a firm should use 100% debt financing to maximize value, of course, does not match real world practice. Thus, many explanations of which assumptions in MM are violated in actual capital markets have been offered. For the moment, explanations other than the existence of personal taxes(see subsection 2.2) and the possible loss of corporate tax shields(see subsection 2.3) will be discussed.

Myers[1984] and Bradley, Jarrell and Kim[1984] offer good summaries of the costs of excessive debt ratios not considered by MM. These costs are generally classified as costs of bankruptcy/financial distress and agency costs. Costs of bankruptcy/financial distress include fees paid to lawyers and accountants, management time spent providing information, dealing with creditors and so forth, lost business from customers and suppliers, and nonoptimal business decisions made by bankruptcy courts.

Agency costs of debt include the possibility that firms will issue debt senior to existing debt, forego positive NPV projects if the increment in firm value will only go to pay off debt(Myers[1977]), pay out the value of the firm to stockholders in dividends, or take on projects with a high risk relative to return since a good state realization will accrue primarily to stockholders while a bad state realization will lead to defaulting on the debt(Jensen and Meckling[1976]). Agency costs also consist of the costs of writing and enforcing debt covenants that prohibit the above actions.

Given these costs of debt, the finance literature by 1977 had concluded that a firm will trade off the corporate tax advantage of borrowing against the costs of borrowing. This theory is called the static tradeoff theory by Myers[1984] and is summarized as follows:

> The firm is portrayed as balancing the value of interest tax shields against various costs of bankruptcy and financial embarassment. Of course, there is controversy about how valuable the tax shields are, and which, if any, of the costs of financial embarassment are material, but these disagreements give only variations on a theme. The firm is supposed to substitute debt for equity, or equity for debt, until the value of the firm is maximized. (Myers [1984],p. 577)

The next two subsections will describe the effect of the details of the tax law regarding individuals and corporations on the static tradeoff theory described in this subsection.

2.2. The Introduction of Personal Taxes

Miller[1977] introduces the taxation of individuals into the 1963 MM framework. It is important to note that he assumes perfect markets with the exception of corporate and personal taxes. Thus, his analysis assumes that agency costs and costs of financial distress do not exist.

Miller begins by noting that agency and financial distress costs of borrowing seem small relative to corporate tax savings generated by borrowing. He thus rejects the static tradeoff theory of subsection 2.1. Miller then assumes that corporations pay a constant marginal tax rate and that individuals pay tax on interest received from corporations while paying no tax on dividend or capital gain income. In this setting of certainty with taxation, corporations will supply debt until a general equilibrium is reached at which the total amount of debt issued allows the marginal corporate tax advantage of deductible interest payments to equal the marginal individual tax disadvantage of corporate bond income relative to equity income. Miller shows that this equilibrium will occur when the corporate tax rate equals the marginal personal tax rate on bond income. The value of the individual taxpaying firm is again independent of its choice of capital structure as in MM[1958]. More importantly, Miller's model predicts a general equilibrium amount of debt which will be less than 100% debt financing by every firm.

In the next subsection, the literature that combines the static tradeoff theory, Miller's conclusions, and details of the corporate tax rules will be discussed. The conclusions of this literature will be a central focus of the remainder of this dissertation.

2.3. The Introduction of Details of the Corporate Tax Code

DeAngelo and Masulis[1980] modify Miller's assumption of perfect markets with the exception of corporate and personal taxes in two ways: a different assumption about personal taxation is made and more detailed provisions of corporate tax rules are introduced into the model. DeAngelo and Masulis assume a two period model. At time t=0 firms make their leverage decisions and individuals make their portfolio decisions. At time t=1 the true state of nature becomes known and corporations distribute their after-tax cash flows to debt and equity holders.

DeAngelo and Masulis assume that there are only three marginal tax brackets for individuals. These mutually exclusive and exhaustive tax brackets are as follows:

$(1-Tpd) > (1-Tpe)(1-Tc)$; Bracket B1

$(1-Tpd) = (1-Tpe)(1-Tc)$; Bracket B2

$(1-Tpd) < (1-Tpe)(1-Tc)$; Bracket B3

where Tpd is the individual tax rate on interest income,
Tpe is the individual tax rate on equity income,
and Tc is the cross-sectionally constant corporate tax rate

Under the further assumptions that Tpe is less than Tpd and that investors are risk-neutral with homogeneous beliefs, DeAngelo and Masulis show that the following equilibrium relationship holds:

$Pe > Pd > Pe(1-Tc)$ implies that the marginal investor for debt securities will be in Bracket B1;
$Pd = Pe(1-Tc)$ implies that the marginal investor for debt securities will be in Bracket B2;
$Pd < Pe(1-Tc))$ implies that the marginal investor for debt securities will be in Bracket B3

where Pd and Pe are the market prices at time $t=0$ for one dollar of expected before-personal-tax debt or equity cashflow at time $t=1$.

If no taxes on personal equity income is assumed, then Bracket B1(B3) is that in which investors have a tax rate on debt income less (greater) than the corporate tax rate. Further, Bracket B2 is that in which investors have a tax rate on debt income equal to the corporate tax rate(i.e. Bracket B2 investors are the marginal investors in corporate debt in Miller's model).

With regards to the corporate tax rules, DeAngelo and Masulis assume that corporations either pay a constant tax rate on positive taxable income or pay no taxes if taxable income is less than or equal to zero. Debt-related tax shields and investment-related tax shields such as depreciation are used to reduce taxable income. Further, corporations may use tax credits to reduce their tax owed with credits limited to a percentage of a firm's tax liability before credits. It is also assumed that tax-loss carrybacks and carryforwards and markets for transferring tax losses do not exist. Given these assumptions, four possible corporate tax situations may result:

1. Earnings before interest, taxes and depreciation (EBITD) can be less than debt service requirements. In this case, the firm defaults and owes no corporate tax while the benefit of all depreciation and other investment-related tax shields, some debt tax shields and all tax credits are lost.

2. EBITD can be greater than or equal to debt service requirements and less than the sum of debt and investment-related tax shields. In this case, the corporation owes no tax but loses the benefit of some investment-related tax shields and all tax credits.

3. The corporation's EBITD are high enough to cause a tax liability but the limits on the deductibility of tax credits do not permit all tax credits to be utilized.

4. The corporation's EBITD are high enough to cause a tax liability and full use of tax credits. In this case, the corporation fully uses all tax deductions and credits.

A numerical example follows. Assume that a corporation has \$5,000 depreciation, \$10,000 debt tax shield, and a \$1,000 tax credit. Assume that the tax code allows a firm to write off tax credits equal to 90% of tax liability before credits and that the corporate tax rate is 50%. The earnings corresponding to the four partitions above are:

1. If EBITD are less than \$10,000, the corporation will default and all depreciation and credits are unutilized.

2. If EBITD range from \$10,000 to less than \$15,000, the corporation will owe no tax but loses some depreciation deductions and the full \$1,000 credit.

3. If EBITD range from \$15,000 to less than \$17,222, the corporation will owe tax but will reduce this tax by partial use of its \$1,000 credit. However, part of the tax credit will be lost. At earnings of \$17,222 the corporate tax before credits will be \$1,111. The full tax credit will just be completely used, since it will be limited to \$1,000(\$1,111 tax due before credits times 90%).

4. If EBITD are greater than or equal to \$17,222, all tax shields and all tax credits will be fully utilized.

Given these assumptions about corporate tax rules, DeAngelo and Masulis demonstrate that the value of an individual firm will be affected by the amount of debt employed in its capital structure. The firm is subject to an asymmetrical tax code and faces the risk of losing the value of some tax shields in years of low operating income. Hence, the probability of losing the deductibility of tax shields increases and the expected corporate tax advantage from borrowing declines as leverage is added to the capital structure or as the tax law changes to allow more generous investment-related tax shield deductions such as depreciation; this is called the debt and investment-related tax shields substitution effect. If agency and financial distress costs of debt are zero, then equilibrium for an individual firm will be attained when the marginal disadvantage of the possibility of losing debt-related and investment-related tax shields equals the marginal net tax advantage of employing debt in the capital structure. If agency and financial distress costs exist, then equilibrium will obtain when the marginal disadvantage of the sum of these agency and financial distress costs plus the possibility of losing tax shields equals the marginal net tax advantage of borrowing. DeAngelo and Masulis[1980] offer the following intuitive explanation of their theoretical model:

> Thus, for relatively low levels of leverage the marginal value of debt is positive because there is a relatively high probability that additional debt can be fully utilized to reduce the firm's tax liabilities and this corporate tax reduction outweighs the higher personal taxes paid on the additional debt. For relatively high levels of leverage, the marginal value of debt is negative because the tax shield substitutes imply a relatively high probability that the potential corporate shield from additional debt will be

> partially or totally lost while an additional personal tax liability for holding debt is incurred. (DeAngelo and Masulis[1980], p. 18)

Four implications of the above results should be clarified. First, since a net marginal tax advantage to borrowing must exist to compensate for leverage related costs, marginal investors must fall in Bracket B1 in which $(1-Tpd)>((1-Tpe)(1-Tc)$. Second, the model assumes that investment is held fixed while debt is allowed to vary. If investment and financing decisions are allowed to change simultaneously the model of DeAngelo and Masulis may not hold. Recalling the work of Hite[1977], a concurrent increase in debt and output would raise operating income; the possibility would then exist that the probability of losing investment-related tax shields would decrease at the same time that the net tax advantage to borrowing increased. Third, if the assumption of no tax loss carrybacks or carryforwards is relaxed, the model of DeAngelo and Masulis would still hold. Carryback provisions would not eliminate the probability of losing tax shields since the carryback loss may exceed taxes paid in the carryback period. Carryforward provisions would merely shift the probability of losing tax shields problem forward since future leverage decisions would be affected by the non-debt tax shield(i.e. the tax loss carried forward) being carried into future tax years. Finally, if the assumption of no resale market for tax losses through leveraged leasing, mergers and spinoffs is relaxed, the probability of losing tax shields becomes zero in frictionless markets and the irrelevance theorem of Miller[1977] would again obtain(Ross[1985]).

Dammon and Senbet[1988] offer a more complete model of the relationship between taxes and corporate financing and investment decisions by integrating the work of Hite[1977] and DeAngelo and Masulis[1980]. The major departure from the assumptions of DeAngelo and Masulis lies in the fact that Dammon and Senbet allow investment to change simultaneously with changes in financing decisions. Further, Dammon and Senbet allow for a progressive personal tax structure with many possible tax rates rather than the three bracket assumption in DeAngelo and Masulis.

Dammon and Senbet's model is based on two building blocks: an income effect and a substitution effect. The income effect has been described previously (Hite[1977]). It states that as a firm's cost of capital decreases either due to the corporate tax deductibility of debt or increases in investment-related tax shields due to changes in the corporate tax laws, the firm will increase its investment in capital and consequently output and operating income will increase.

The substitution effect is described by DeAngelo and Masulis[1980]. It states that with investment and output held constant, increases in investment-related tax shields will lead to decreases in debt. The cause of this phenomenon is the possibility of losing tax shields in certain states of nature.

Combining these two effects, Dammon and Senbet[1988] show that in a static tax law setting taxes will simultaneously affect the investment and financing decisions of the firm. The marginal value of debt is shown to be equal to the corporate tax saved from deducting interest expense over the firm's taxpaying states minus additional personal taxes paid due to receipt of interest and equity-related income over the firm's nondefault states. It is impossible for the firm's value to be independent of its debt/equity structure since the possibility of losing the benefits of the tax deductibility of leverage-related and investment-related tax shields increases as debt is added to the capital structure; this is the substitution effect of DeAngelo and Masulis[1980]. Further, the marginal value of investment in capital is shown to be equal to the pre-tax marginal product of capital over all state outcomes minus personal taxes owed when this marginal product is distributed to securityholders minus corporate taxes owed on this marginal product over states in which corporate taxes are owed. Since the marginal value of capital is a function of the firm's bankruptcy and taxpaying states of nature, it is not independent of a firm's degree of financial leverage. Again, the firm's real and financial decisions are not independent of each other due to tax laws.

Using comparative statics, Dammon and Senbet[1988] use their model to state propositions regarding the relationship between changes in investment-related and debt-related tax shields following a tax law change. The major implication of these propositions is that the conclusion of DeAngelo and Masulis that the expected corporate tax advantage of borrowing declines as investment-related tax shields increase is not necessarily valid. For example, if the tax law changes to allow more generous depreciation deductions, a firm will increase its capital investment. Output and thus taxable operating income will increase and the firm's demand for interest deductions will increase. This is the income effect. It should be noted that this argument is based on supply-side influences on output decisions; the influence of demand factors on the decision to increase output are ignored. At the same time, as the firm's depreciation deductions increase, the demand for interest deductions will decrease due to the substitution effect. "The net effect of an increase in the depreciation rate on the optimal promised face payment[of debt] is ambiguous, however, and depends upon the relative magnitude of the 'income and substitution effects'."(Dammon and Senbet[1988], p. 366).

Since the income effect predicts that output will expand at the same time that investment-related tax shields increase following a liberalization of depreciation allowed under the tax laws, it is not immediately clear how the level of depreciation relative to corporate earnings will behave. However, Dammon and Senbet[1988] prove that an increase in the depreciation rate will lead to an increase in the optimal level of investment-related tax shields as a percentage of expected operating earnings. This proof relates the change in a firm's investment decisions to depreciation rate changes. The effect on a firm's financial decisions in response to more generous depreciation rules is complicated by the fact that the income effect predicts an increase in debt employed(there is more operating income to shelter) while the substitution effect predicts a decrease in debt employed(there is an increased probability of losing debt tax shields). Thus, Dammon and Senbet[1988] can offer no proposition as to whether the optimal amount of debt will rise or fall following a liberalization of depreciation rates. However, scaling all tax shields by expected operating earnings in order to neutralize the income effect leaves only the substitution effect to consider and the formal proposition resulting from the theoretical literature summarized above that is to be tested in this dissertation can be stated as:

> P1 An increase in the depreciation rate due to changes in the tax laws will lead to an increase in the ratio of investment-related tax shields to expected earnings and to a decline in the ratio of debt-related tax shields to expected earnings. In other words, the substitution effect will be observed if tax shields are scaled by expected earnings to control for the income effect of Hite[1977].

Tests of proposition P1 are tests of the predictions of both Dammon and Senbet[1988] and DeAngelo and Masulis[1980] since scaling all tax shields by expected earnings effectively holds inve-`.ent fixed.

In order to test proposition P1, the model represented by equation (1) can be estimated:

$$DIFFINT = a_0 + B_1 \, DIFFNDTS \qquad (1)$$

where DIFFINT is a measure of changes in debt tax shields scaled by expected operating earnings and DIFFNDTS is a measure of changes in investment-related tax shields scaled by expected operating earnings resulting from a given tax law change. The substitution effect predicts a negative sign on the coefficient B_1.

2.4. Factors to be Controlled for in Tests of the Substitution Effect

In the statement of proposition P1 and equation (1), the income effect is controlled for by scaling all tax shields by expected operating earnings. In this section, three other factors described in the financial economics theoretical literature that should be controlled for in tests of proposition P1 are described: the debt securability effect(Scott[1977]), the probability that a firm will lose the immediate deductibility of tax shields and the pecking order theory of finance(Myers[1984]). These factors must be controlled for in order (1) to rule out alternative explanations of any observed relation between changes in debt and investment-related tax shields and (2) to ensure that the relation advanced by proposition P1, if observed, is not caused by variables highly correlated with changes in investment-related tax shields(Kinney[1986]).

The debt securability effect results from the fact that fixed assets are normally used as collateral for corporate debt (Scott[1977]). The theoretical underpinning of the debt securability effect effect lies in the fact that lenders can reduce the agency costs of debt if fixed assets can be used to collateralize debt. Since time-series tests of proposition P1 involve the relation between changes in debt and investment-related tax shields, the debt securability effect must be controlled for in the design of tests of proposition P1. Proposition P1 is based on the substitution effect and asserts that a negative relation will exist between changes in debt and investment-related tax shields, both scaled by expected operating earnings, after the passage of a tax law increasing depreciation and similar deductions allowed. However, the debt securability effect predicts a positive relation between changes in the two classes of tax shields since the increased investment in fixed assets resulting from liberalized depreciation and other investment-related tax shields can be used to collateralize increases in debt. Thus, the debt securability effect must be controlled for if the substitution effect underlying proposition P1 is to be identified. Examination of equation (1) highlights this fact: the substitution effect predicts a negative sign for the coefficient B_1 while the debt securability effect predicts a positive sign.

It can be expected that only certain firms will consider the substitution effect advanced by the models of Dammon and Senbet[1988] and DeAngelo and

Masulis[1980]. This argument is intuitively plausible. Firms with little or no possibility of losing tax shields use all the depreciation, interest expense and so forth that they can to reduce taxes; however, they are unable to acquire sufficient tax shields to drive their taxable income to zero and no substitution effect is predicted. The subset of firms considered by DeAngelo and Masulis and Dammon and Senbet, on the other hand, are able to acquire sufficient shields to drive their taxable income to(or close to) zero in many years. Since these firms face a higher probability of losing tax shields, the negative relationship between debt and investment-related tax shields predicted by the substitution effect will be more likely. This consideration has been ignored in previous research.

Given that firms with consistently positive taxable income are under little or no danger of losing the tax advantages of tax shields and that the substitution effect between debt and investment-related tax shields is thus inapplicable, the debt and investment-related tax shields relation for these firms simply represents the debt securability effect. Since the debt securability effect is common to all firms with fixed assets, the effect estimated for those firms with little or no risk of losing the tax benefits of tax shields can be used as an estimate of the same effect for firms with a great probability of losing the tax benefits of tax shields. To the extent that the debt securability effect is controlled, the substitution effect between debt and investment-related tax shields can be isolated and empirically tested.

To evaluate the effectiveness of controlling for the debt securability effect and the probability of losing tax shields, a comparison of the model without such controls(i.e. equation (1)) to the model with such controls is desired. This second model used to test the substitution effect is developed as follows. Firms are divided into two groups based on the probability of losing the deductibility of tax shields. The first group consists of firms paying little or no taxes, i.e. firms with a great probability of losing the deductibility of tax shields. The second group contains firms consistently paying taxes at a high rate, i.e. firms with little risk of losing the tax advantages of tax shields. The model represented by equation (2) shown below integrates the two groups of firms and is used to separate the debt securability effect from the debt and investment-related tax shields substitution effect:

$$DIFFINT = a_0 + a_1 * D + B_1 * DIFFNDTS + B_2 * D * DIFFNDTS \quad (2)$$

where D is a dummy variable with D=1 indicating firms with a high probability of losing the deductibility of tax shields and D=0 indicating firms with a low risk of losing this deductibility. The variables representing changes in tax shields (DIFFINT and DIFFNDTS) are defined following equation (1).

The effect of equation (2) is to estimate the debt securability effect, B_1, which is common to all firms with fixed assets regardless of firms' status of tax shield deductibility. To the extent that the debt securability effect is controlled by B_1, B_2 simply represents the debt-related and investment-related tax shields substitution effect for firms with a reasonable probability of losing the immediate deductibility of tax shields. B_2 is predicted to have a negative sign.

Myers[1984] offers the pecking order theory of financing as an alternative to the static tradeoff theory presented in subsection 2.1. The pecking order of finance is as follows: firms fund capital expenditures by first drawing down cash and other liquid assets. If external financing is required, riskless debt is initially issued. This is followed by risky debt, hybrid securities and, as a last resort, common equity. "In this story, there is no well-defined debt-equity mix, because there are two kinds of equity, internal and external, one at the top of the pecking order and one at the bottom. Each firm's observed debt ratio reflects its cumulative requirements for external finance." (Myers[1984], p. 581)

The theoretical underpinnings of this theory come from Myers and Majluf[1984]. Myers and Majluf begin with a world of perfect and efficient capital markets except that managers have inside information about the true value of the firm that investors do not. Managers are assumed to act in the interests of the current stockholders(called "old" stockholders in the analysis that follows). In this world, managers will issue new equity in order to raise cash whenever equity is overvalued relative to its true value; the old shareholders will benefit by this action. If equity is undervalued, managers will never issue equity since the old stockholders will be worse off having given away a portion of this undervaluation to the new stockholders.

New stockholders, of course, will figure out this strategy and will assume that the issue of equity signals that the equity is overvalued. To this point, the Myers and Majluf theory predicts that equity will never be issued.

When the possibility of positive net present value(NPV) capital investments is added to the theory, it becomes more interesting. Assume that a firm's common equity is undervalued by N and the firm has the opportunity to invest in a project with a positive NPV of y. Further assume that the firm must issue equity to fund the project. If $N < y$, then managers will issue the equity required to finance the project; if $N > y$, then managers will forego the positive NPV project rather than issue the undervalued equity. This can be shown by example. If a project has an NPV of $1.2 and a cost of $10 and the currently issued common stock of the firm without the project sells for $10 but is really worth $12, then managers will pass up the project in the interest of current stockholders. If the project is not taken on, the current stockholders will eventually own $12 worth of equity. If the project is accepted, the current stockholders will own one-half of a firm that will eventually be worth $23.20($12 true value of current equity plus $10 raised by new equity issues plus $1.2 of positive NPV), or $11.60 worth of equity. Managers in this case will only take on a project if its NPV exceeds the $2 undervaluation of current equity.

Myers[1984] argues that the above cost of equity issuance will cause firms to fund new capital investments with cash, then riskless debt and then risky debt before equity is resorted to, i.e. the pecking order theory has been theoretically justified. The reason that cash and riskless debt are used first to raise funds is that their undervaluation is zero. If other sources of finance must be resorted to, the undervaluation problem that causes managers to bypass some positive NPV projects is reduced by issuing "the safest possible securities-strictly speaking, securities whose future value changes least [i.e. debt issues] when the manager's inside information is revealed to the market." (Myers[1984], p. 584). Eventually, though, a firm will exhaust its debt capacity and equity will be issued. Investors will be willing to purchase the new equity since they will reason that the equity is being issued due to the exhaustion of a firm's debt capacity rather than overvaluation of the equity.

Given the pecking order theory and the theory of Myers and Majluf[1984], it might well be asked why firms would ever issue equity. Myers responds to this concern with two arguments. First, in some cases the NPV of the project will exceed the undervaluation of the then currently outstanding equity(i.e. the $N < y$ case above). Second, he asks the reader to:

> put yourself in investors' shoes. If you know the firm will issue equity only when it is overpriced, and debt otherwise, you will refuse to buy equity unless the firm has already exhausted its 'debt capacity'-that is, unless the firm has issued so much debt already that it would face substantial additional costs in issuing more. Thus investors would effectively force the firm to follow a pecking order. (Myers[1984], p. 585).

Myers' theory thus predicts that firms with a higher debt ratio will use less cash and more common equity issues to finance capital expenditures than firms with a lower debt ratio. Further, since high-debt firms are using equity issues to finance capital expenditures, these firms should show a decrease in their debt to total assets ratio following such financing. These predictions technically apply only to firms when their debt capacity crosses the exact margin at which equity financing becomes necessary. Empirically, however, predictions of the pecking order theory can be tested by comparing the financing behavior of high and low debt ratio firms.

If the prediction that high-debt firms use more equity financing to fund capital investments undertaken in response to an increase in depreciation allowed under the tax laws is supported by empirical tests, a direct implication for the tests of proposition P1 exists: decreases in debt-related tax shields scaled by expected operating earnings should be larger for firms with a high debt ratio in response to an increase in depreciation allowed under the tax laws. This prediction rests on the fact that high-debt firms would be using equity to finance new capital investments. Due to liberalized depreciation rules, non-debt tax shields as a percentage of expected operating earnings would rise and expected operating earnings would rise for all firms due to the income effect(Dammon and Senbet[1988]). At the same time, the use of equity by high-debt firms to finance new capital investments encouraged by liberalized depreciation rules would cause gross debt tax shields to remain constant and debt tax shields as a percentage of increased expected operating earnings to fall. This statement would not hold for low-debt firms, since gross debt tax shields would rise rather than remain constant for low-debt firms crossing into low-risk debt issuance. Since decreases in the dependent variable in equations (1) and (2), debt tax shields scaled by expected operating earnings, are expected to be larger for high-debt firms, debt ratio should be controlled for in tests of the substitution effect.

For example, assume that a firm has expected operating earnings of $10 on a capital base of $60 of capital equipment before a tax law change liberalizing depreciation and uses $6 of depreciation and $4 of interest expense to drive its tax liability to zero. Further assume that $60 of new capital equipment is purchased after a tax law change liberalizing depreciation and that this investment raises expected operating earnings to $20 and depreciation expense to $13. If the firm is a high-debt firm that has exhausted its debt capacity and must use equity issuance to finance the capital investment, investment-related tax shields scaled by expected operating earnings would increase from 60% to 65% while debt tax shields scaled by expected operating earnings would fall from 40% to 20%. This decrease in debt tax shields scaled by expected operating earnings is more negative than if the firm were a low-debt firm that had not run out of debt capacity and thus increased its debt to yield $7 of interest expense in order to drive its tax liability on $20 of expected operating earnings to zero. Such a low-debt firm would have a decrease in debt tax shields scaled by expected operating earnings that is identical to that observed with no consideration of debt ratio as a confounding factor. If debt ratio is not controlled for, the high-debt firm would appear to have a larger substitution effect even though pecking order theory effects rather than the substitution effect explain the results.

In order to implement controls for debt ratio, sample firms are divided into high-debt and low-debt subsamples. For each subsample, the model represented by equation (3) is tested:

$$DIFFINT = a_0 + a_1 * D + B_1 * DIFFNDTS + B_2 * D * DIFFNDTS + B_3 * DBTRAT \quad (3)$$

where DBTRAT is a firm's debt ratio prior to a tax law change liberalizing depreciation and all other variables are defined following equation (2).

In equation (3), the coefficient B_1 (debt securability) should have a positive sign and the coefficient B_2 (the substitution effect) should have a negative sign for all firms. The coefficient B_3 represents the relationship between debt ratio and changes in debt tax shields following a tax law change liberalizing investment-related tax shield write-offs. For tests using low-debt firms, the pecking order theory predicts a positive sign on B_3. Very low-debt firms would use no debt(i.e. cash) to finance capital expenditures while moderately low-debt firms would use debt to finance capital expenditures; as the latter firms' debt ratios increased their debt would become more risky and the interest rate charged by lenders would rise. Consequently, within the subset of low-debt firms that have not crossed into equity issuance, larger debt ratios will be associated with greater changes in debt tax shields scaled by expected operating earnings. For example, assume that low-debt Firms A, B and C all increase their investment in capital equipment by \$20(from \$40 to \$60) following a tax law change, and that all three firms' expected operating earnings increase from \$10 to \$15. Prior to the tax law change, Firm A had

$.10 interest expense, Firm B had $2 interest expense and Firm C had $5 interest expense. Firm A, the very low debt firm, maintains its interest expense at $.10. Firm B increases its interest expense to $4, while Firm C which has to pay a higher interest rate on its riskier debt increases its interest expense to $11. These figures are consistent with the pecking order theory as long as none of the firms crosses into equity issuance to finance capital expenditures. Firms A, B and C have changes in debt tax shields scaled by expected operating earnings of -.33%, 6.7% and 23.3%, respectively, and a positive relationship between changes in debt tax shields and debt ratios is exhibited for these low-debt firms.

The coefficient B_3 should have a negative sign in tests using high-debt firms. For high-debt firms, a higher debt ratio would imply an increased possibility of crossing into equity issuance to fund capital expenditures resulting from liberalized depreciation write-offs. For example, assume that high-debt Firms D and E both increase their investment in capital equipment by $20(from $40 to $60) following a tax law change, and that both firms' expected operating earnings increase from $10 to $15. Prior to the tax law change, Firm D had $8 interest expense and Firm E had $9 interest expense. Firm D increases its interest expense to $9 and Firm E, having exhausted its debt capacity, must issue equity and maintains its interest expense at $9. These figures are consistent with the pecking order theory's contention that high-debt firms will issue equity to fund capital expenditures if their debt ratio becomes very high. Firms D and E have changes in debt tax shields scaled by expected operating earnings of -20% and -30% and a negative relationship between changes in debt tax shields and debt ratios is exhibited for this sample of high-debt firms.

2.5. Prior Empirical Results

The above hypotheses involve predictions that can be tested using time-series changes in the depreciation rate and other investment-related tax shields allowed for tax purposes. Time-series tests are preferable to cross-sectional tests as they would control for differences between firms on dimensions such as the agency costs of debt and costs of financial distress. Despite this fact, Dammon and Senbet[1986] report that "to our knowledge, however, no such empirical study has yet been conducted."(p. 21).

Several cross-sectional tests relating to the substitution effect proposed by DeAngelo and Masulis[1980] have been published. The earliest tests were those of Bowen, Daley and Huber[1982] and Boquist and Moore[1984]. The latter tests offer methodological improvements over the former and found that "at the industry level, we find, at best, weak evidence in support of the thesis[i.e. the substitution effect], while testing at the firm level...yields results significantly contrary to the tax shield hypothesis." (Boquist and Moore[1984], p. 8).

The most complete and widely cited study offering evidence bearing on the DeAngelo and Masulis substitution hypothesis is that of Bradley, Jarrell and Kim[1984](BJK hereafter). BJK first test if there are significant between industry (two-digit SIC code) differences in debt ratios relative to within industry differences using ANOVA. Debt ratios are estimated as the 1962-1981 sum of the book value of long-term debt divided by the sum of the book value of long-term debt plus market value of equity over the same years. The BJK sample consists of 851 firms in 25 industries. The variation in debt ratios is larger between than within industries with 54% of the cross-sectional variation in debt ratios explained by industry classification.

BJK proceed to test the debt securability effect and the investment-related and debt-related tax shields substitution effect by regressing their measure of debt ratio for each of 821 firms in 25 industries on a measure of investment-related tax shields. They also include independent variables representing firm-specific variability of earnings and agency costs of debt. Investment-related tax shields are represented by the 1962-1981 sum of annual depreciation charges plus investment tax credits divided by the 1962-1981 sum of earnings before interest, taxes and depreciation(EBITD). Variability of earnings is represented by the standard deviation of the first difference in annual EBITD plus nonoperating income scaled by total assets from 1962-1981. It is predicted that variability of earnings will show a negative relation to debt ratio since (1) lenders are less willing to lend to a firm with high variability because the probability of low operating income in certain years increases the risk of debt and (2) firms with volatile operating earnings are more likely to lose the benefits of tax shields in certain years. The 1972-1981 sum of annual advertising and R&D expense divided by the 1972-1981 sum of annual net sales is used to represent the securability of debt and the substitution effect. It is predicted that advertising and R&D expense will show a negative relationship to debt ratio since (1) firms with high advertising and R&D expense will have a larger proportion of their value represented by growth opportunities rather than by collateralizable fixed assets and thus the debt securability effect will be weaker for these firms, and (2) if advertising and R&D expense are viewed as non-debt tax shields, the DeAngelo and Masulis theory would predict an inverse relation between these expenses and debt ratio.

The results for all of the regressions in BJK are similar and the most general results are reported in Table 1. Advertising and R&D expense shows a significantly negative relationship to debt ratio as predicted by agency cost of debt, debt securability and substitution effect arguments. Variability of earnings also shows a significantly negative relationship to debt ratio as predicted by substitution effect and bankruptcy and financial distress cost arguments. Investment-related tax shields, however, show a significantly positive relation to debt ratio. BJK conclude that this is direct evidence against the substitution effect and in support of the debt securability hypothesis. It is argued that this conclusion is not warranted since BJK fail to control for the fact that the substitution effect should only be relevant for firms with a reasonable probability of losing tax shields as discussed previously.

Dhaliwal, Trezevant and Wang[1989] replicate the

Bradley, Jarrell and Kim[1984] study with controls for the debt securability effect and the probability of losing tax shields similar to those introduced in equation (2). Their results indicate that a significant debt securability effect exists for all firms and that the substitution effect exists for the subset of firms with a reasonable probability of losing the immediate deductibility of tax shields.

2.6. Summary

This section began by reviewing the theoretical literature modeling the links between taxes and the investment and financing decisions of the firm. With hindsight, a clear line of theory development can be discerned. This development proceeds from an environment of perfect markets in which investment and financing decisions are independent to an environment of imperfect markets in which investment and financing decisions must be made simultaneously. With perfect markets, Modigliani and Miller[1958] show that the value of the firm is independent of leverage. Relaxing the assumption of no corporate taxes results in the prescription that firms should employ 100% debt financing (Modigliani and Miller[1963]). The introduction of agency costs and costs of bankruptcy/financial distress leads to the static tradeoff models summarized by Myers[1984]. Miller[1977] relaxes the assumptions of no corporate or personal taxes in a world of certainty and shows that the value of a firm is again independent of its financial structure. DeAngelo and Masulis[1980] extend Miller's model by introducing the substitution effect between debt and investment-related tax shields and are able to show that each firm has a unique value-maximizing financial structure. Dammon and Senbet[1988] generalize the model of DeAngelo and Masulis[1980] by introducing the income effect discussed in Hite[1977] and making the investment decision endogenous; this generalization does not change the fact that each firm will have a unique interior optimum financial leverage structure. Finally, Myers[1984] offers a pecking order theory as a competitor to the static tradeoff theory developed by other researchers. Myers' theory predicts that capital structure will be the result of a firm's cumulative requirements for outside financing rather than the result of trading off various costs and benefits of debt financing.

The basic proposition resulting from this literature that is to be tested in this dissertation states that if depreciation and similar deductions allowed increase under a tax law change, then a negative relationship between changes in investment-related tax shields and debt-related tax shields will be observed following the tax law change. This proposition is a statement of the substitution effect which has not received prior empirical support.

Four factors that should be controlled for in testing the substitution effect were identified. The income effect(Hite[1977]) could be controlled for by scaling changes in debt-related and investment-related tax shields by expected operating earnings. The fact that only firms with a reasonable chance of losing tax shields should be concerned with the substitution effect was shown to be a factor that should be controlled for. The debt securability effect was a third factor that should be controlled for, since it predicts a relationship between changes in debt-related and investment-related tax shields opposite to that predicted by the substitution effect. The pecking order theory of finance (Myers[1984]) dictates that debt ratio is a further control variable in testing the substitution effect. The section concluded with a statement of the models to be used to test the tax shields substitution effect and to implement these controls.

The next section describes the features of the Internal Revenue Code relevant to tests of the response of corporate investment and financing behavior to changes in the tax laws. Changes in tax laws resulting from the Economic Recovery Tax Act of 1981 will be especially important.

III. RELEVANT TAX LAWS

3.1. Corporate Tax Rules

On August 13, 1981, President Reagan signed into law the Economic Recovery Tax Act of 1981(ERTA hereafter). Four changes in the corporate tax rules affected investment-related tax shields and thus must be included in empirical tests of the substitution effect: changes in cost recovery rules, R&D credits, net operating loss rules and corporate tax rates.

3.1.a. Changes in Cost Recovery Rules

Congress replaced the pre-1981 depreciation system with the Accelerated Cost Recovery System(ACRS). The intent was to replace a complicated system with a simpler system which provided additional investment stimuli. The primary benefit of the new system was the short lives allowed for depreciation purposes. Realty was to be depreciated over a fifteen-year life while personalty was to be recovered over a three-year or five-year life with few exceptions. For personalty placed in service from 1981 to 1984, the 150% declining-balance method over the prescribed life was permitted; the 175% declining-balance method was planned for property placed in service in 1985 while the 200% declining-balance method was specified for property placed in service after 1985. The declining-balance method provisions scheduled for 1985 and thereafter were subsequently cancelled. Personalty placed in service during any month of the year was to receive a full half-year write-off in the year placed in service. Finally, real property other than low-income housing placed in service after 1980 was allowed the 175% declining-balance method with a switch to straight-line when optimal; the 200% declining-balance method was specified for low-income housing.

Personalty placed in service after 1981 was eligible for Section 179 expensing treatment. This specified that up to $5,000(rising to $7,500 in 1984 and $10,000 in 1986) of the cost of personalty placed in service in a year could be expensed immediately rather than depreciated over several years. The depreciable base of assets on which Section 179 expensing was taken was to be reduced by the Section 179 expense taken.

Finally, the rules for taking the investment tax credit(ITC) were changed to conform with the new ACRS lives. For personalty eligible for the ITC, a 6% of cost credit was allowed for assets with three-year lives while a 10% credit was allowed for other personalty. Real estate remained ineligible for the ITC. The amount of used property eligible for the ITC in a tax year was raised and recapture rules were liberalized.

Gravelle[1982] examines the effects of the ACRS depreciation and ITC provisions of ERTA. Effective marginal tax rates on post-ERTA investments in fixed plant and equipment by industry are estimated by Gravelle. These rates are computed in three steps. First, asset composition by industry is estimated. Next, the effective marginal tax rate for each asset is estimated as (the pre-tax return on an asset minus its after-tax return) divided by (the pre-tax return on an asset). Finally, under the assumption that increments of new investment in an industry have the same asset composition as estimated in step one, a weighted average tax rate on marginal investment is calculated using the data estimated in steps one and two. The results of this analysis will be used later to compare the substitution effect between firms with greater and lesser decreases in marginal tax rates on new capital investments due to ERTA provisions and are reported in Table 2.

3.1.b. Introduction of the R&D Credit

In order to stimulate spending for research and development, ERTA provided for a tax credit for R&D expenditures. This provision was new and applied to expenditures after June 30, 1981. The credit was equal to 25% of the excess of R&D expenditures in a given tax year over the average of annual R&D expenditures during a specified base period. If the taxpayer's first taxable year to which the new R&D credit applied began in 1980 or 1981, the base period was the preceding taxable year. If the second taxable year to which the new R&D credit applied began in 1981 or 1982, the base period was the two preceding taxable years. For other taxable years, the base period was the three preceding taxable years. In no case could the credit exceed 25% of one-half of current year R&D expenditures. Finally, the credit was nonrefundable and any excess credit was subject to the same carryback/carryforward provisions as a net operating loss as described in subsection 3.1.c.

3.1.c. Changes in Net Operating Loss Carryforward Rules and Corporate Tax Rates

While the models of section 2 assume that net operating losses(NOLs) cannot be used by corporations to reduce taxes paid in other years, any empirical tests must account for the fact that NOLs can be carried back to recover taxes paid or carried forward to reduce future taxes. The new law liberalized the carryforward provisions, extending the number of years that an NOL could be carried forward from seven to fifteen years. NOLs continued to have a three-year carryback provision under ERTA.

In general, ERTA changed corporate tax rates in a very minor way. Only the tax rates on the first $50,000 of corporate taxable income were reduced. The reduction totaled 2%; a 1% reduction for the 1982 tax year and a 1% reduction for the 1983 tax year. The maximum annual tax saving was $1,000.

3.2. Individual Tax Rules

In a study of responses of firms to changes in corporate tax laws, concurrent relevant changes in the rules for taxation of individual investors cannot be ignored. Four changes in these rules are detailed: a decline in rates, liberalized Individual Retirement Account(IRA) provisions, repeal of the interest and dividend exclusion, and provisions designed to aid the ailing savings and loan and utility industries.

3.2.a. Lowering of Individual Tax Rates

ERTA decreed a significant reduction in personal tax rates. First, rates were to be reduced by approximately 23% over a four year period. In 1981 rates were reduced by allowing a 1.25% credit of taxes owed. For tax-year 1982 rates were reduced by 10%, for tax-year 1983 there was an additional 10% rate reduction and for tax-year 1984 there was a final rate reduction of 5%. Tax rates by 1984 would range from 11% to 50% rather than the 14%

to 70% range in existence before ERTA. Starting in 1985, the new lower rates were indexed to avoid bracket creep caused by inflation.

A second provision provided that the highest marginal tax bracket be reduced from 70% to 50% effective January 1, 1982. Prior to 1982, earned income was subject to a maximum 50% rate while unearned income(e.g. dividends and interest) was subject to a maximum 70% rate. Maximum long-term capital gains rates were affected by this provision and fell from 28% to 20%.

Finally, Congress wanted to make sure that investors would not postpone the sales of long-term capital gain assets until 1982 to capture the new 20% maximum tax rate. Thus, the 20% maximum rate on long-term capital gains became effective for sales occurring after June 9, 1981 rather than after December 31, 1981. It should be noted that the models of DeAngelo and Masulis[1980] and Dammon and Senbet[1988] initially assume a tax rate of zero on long-term capital gains. However, these models are shown to hold if the tax rate on long-term capital gains is less than the individual tax rate on interest income. The ERTA rules satisfy this minimum requirement.

3.2.b. Liberalized Individual Retirement Account(IRA) Rules

IRAs are self-directed retirement plans which grow on a tax-deferred basis. Initial contributions to IRAs are used to reduce taxable income in the year of contribution, while the contributions and earnings on those contributions are not taxed until the taxpayer draws down the IRA balance.

ERTA made IRA provisions applicable to any taxpayer with earned income rather than only to taxpayers not participating in pension plans. Maximum annual contributions were liberalized, increasing from the lesser of $1,500 or 15% of earned income to the lesser of $2,000 or 100% of earned income. Keogh plans, which are similar in consequence to IRAs but restricted to self-employed taxpayers, had their contribution limits doubled under ERTA.

3.2.c. Repeal of Dividend and Interest Exclusion and Industry-specific Provisions

The new law did away with a $200($400 on a joint return) interest and dividend exclusion for tax years after 1981. The exclusion was replaced with a $100($200) dividend exclusion.

In the high interest rate environment of 1981, the financial health of many savings and loans and public utilities was fragile. ERTA thus established provisions in individual taxation rules to benefit these industries.

Individuals were permitted a lifetime exclusion of

$1,000($2,000 on a joint return) of interest earned on qualified savings certificates. These one-year certificates were to be issued by savings and loans institutions between September 30, 1981 and January 1, 1983 and were to bear interest at 70% of the rate paid on 52-week U.S. Treasury Bills.

The new law also permitted public utilities to establish plans that allowed shareholders to choose to receive their dividends in newly issued stock rather than cash. Normally such distributions are taxable income to individuals. However, under the public utility dividend reinvestment provision of ERTA, taxpayers choosing the stock alternative could exclude up to $750 per year ($1,500 on a joint return) of the stock dividends from income. The stock received would have a zero dollar basis for gain on sale calculation. This provision was in effect for distributions made in calendar years 1982 through 1985.

3.3. Summary

This section has summarized provisions of ERTA that are relevant to the design of empirical tests of the theory and models of section 2. The next section states formal hypotheses to be tested, describes empirical surrogates chosen and sample selection procedures for empirical testing of these hypotheses, and reports the results of the statistical analysis of the results of these empirical tests.

IV. HYPOTHESES, SAMPLE SELECTION AND TEST RESULTS

In this section, issues in the design of empirical tests of the propositions and predictions of section 2 will be considered. Choice of empirical surrogates and sample selection will be described. At the same time, propositions and predictions will be turned into hypotheses and results of tests of these hypotheses will be reported.

4.1. Tests Using Equations (1) and (2)

Equations (1) and (2) are to be used to test the relation between firms' changes in debt-related and investment-related tax shields in response to ERTA with controls for the income effect(equation (1)) and the income effect, the debt securability effect and the probability of losing tax shields(equation (2)). Variables that must be operationalized to implement equations (1) and (2) are changes in debt-related and investment-related tax shields, the probability of losing the benefit of tax shields and expected earnings. These variables are assigned empirical proxies after a formal statement of the hypothesis to be tested; this hypothesis is based on changes in the tax law introduced by ERTA and the work of Dammon and Senbet[1988] and DeAngelo and Masulis[1980] and is stated in alternative form:

> H1 For firms facing a reasonable probability of losing the benefits of tax shields, there was a negative relationship between changes in investment-related tax shields as a percentage of expected earnings and changes in debt tax shields as a percentage of expected earnings after the passage of ERTA(i.e. after 1980).

The liberalized depreciation and investment tax credit (ITC) deductions and the research and development (R&D) credit allowed under the Economic Recovery Tax Act(ERTA) of 1981 will be used as empirical surrogates for investment-related tax shields in testing hypothesis H1. Two other corporate provisions of ERTA that must be considered are extended NOL carryforwards and changes in corporate tax rates. The increase in the NOL carryforward period from seven to fifteen years will be ignored based on the assumption that the present value of tax benefits that might occur in years eight through fifteen is of a small magnitude. Changes in corporate tax rates will also be ignored in empirical tests since the maximum tax savings involved were very small(i.e. $1,000 per year).

Porcano[1984] offers evidence that the decision to treat ACRS depreciation, ITC and R&D credit changes as debt tax shield substitutes and incentives to new investment while ignoring changes in corporate tax rates and NOL carryforwards is appropriate. In 1982, Porcano surveyed Fortune 1000 firms to determine expected increases in fixed asset investment as a result of specific ERTA provisions. For those firms responding that their investment would increase as a result of ERTA, the weighted mean percentage increases in investment were: 5.33% due to the R&D credit, 2.97% due to liberalized depreciation, 1.43% due to ITC changes, 0.18% due to extended NOL carryforwards, and 0.26% due to decreases in corporate tax rates.

An important issue in these time-series tests is the time period over which to measure changes in investment-related tax shields and other relevant variables. It is probable that firms responded to the investment stimuli offered by ERTA over several years, increasing their capital stock and adjusting debt employed based on general economic conditions, interest rates and expectations about future tax law changes. Furthermore, it can be argued that measures of variables will be more representative of pre-ERTA and post-ERTA values if their values from several annual observations are used. At the same time, the use of several years to calculate response to ERTA is undesirable since the extended time frame allows too many confounding factors to arise. Based on these considerations, changes in investment-related tax shields, debt employed and other variables will be measured using changes in these variables from 1979/1980 to 1981/1982. In order to check the sensitivity of the results reported in this section to the sample time period selected, the tests reported are repeated using changes from 1980 to 1981 and using changes from 1978/1979/1980 to 1981/1982/1983. The results of these sensitivity tests are reported in section 5.

Hypothesis H1 requires a measure of investment-related tax shields. These shields can be defined in terms of depreciation, ITC, R&D credits, and lease expense. Specifically, the difference between the sum of these shields from 1979/1980 to 1981/1982 divided by expected earnings for the same time periods will be used to measure changes in investment-related tax shields after ERTA. Depreciation expense will be estimated as depreciation expense reported on the income statement for 1979/1980(1981/1982), plus or minus any increases or decreases in the deferred taxes balance sheet account from January 1, 1979 to December 31, 1980(January 1, 1981 to December 31, 1982) grossed up by the maximum federal plus state statutory corporate tax rate of .485 (Fullerton[1984]). This measure is used to account for the fact that depreciation expense for tax purposes differs from that reported in the financial statements; the measure assumes that all timing differences between taxable income and GAAP income inferred from changes in the deferred taxes balance arise from the use of different depreciation methods for tax purposes. Investment tax credits for 1979/1980 and 1981/1982 will be grossed-up by dividing the ITC in each time period by the the maximum statutory corporate tax rate of .485. Grossing-up of the credit is more appropriate since a dollar of depreciation is less valuable than a dollar of ITC. This results from the fact that credits offset the corporate tax burden dollar for dollar. Grossing-up of credits for empirical tests is specifically recommended by Dammon and Senbet[1986]. The R&D credit will be approximated by multiplying 25% times a firm's annual R&D expense for 1981/1982 minus average R&D expense over the statutory base period described in subsection 3.1.b. The credit will be grossed-up by the maximum statutory corporate tax rate of .485. Since the R&D credit was newly introduced under ERTA, the measure of the credit for the 1979/1980 time period will be zero. Lease expense is considered an investment-related tax shield since it is a substitute for depreciation expense for firms that choose to lease rather than buy plant, property and equipment. Leasing tax shields will be measured as net rental expense or income in 1979/1980 and 1981/1982, with net rental income reported as a negative investment-related tax shield. Since it can be argued that rent expense was less directly affected by ERTA than depreciation deductions, ITC and research and development credits, the tests described in this section are repeated in section 5 excluding net rent expense as a component of investment-related tax shields.

A surrogate is needed for expected operating earnings. In order to control for changes in the general economy, the following measure of expected operating earnings will be employed. Actual operating earnings (i.e. earnings before interest, taxes and depreciation) over the pre-ERTA test period will represent expected operating earnings for this period. Expected operating earnings after ERTA will be measured as actual operating earnings before ERTA plus (the post-ERTA increase in net plant, property and equipment(PPE) times pre-ERTA operating earnings/pre-ERTA net PPE). It is thus implicitly assumed that a firm earns a constant (operating income/net PPE) return over time. This measure is preferred over a random walk model or using actual post-ERTA operating earnings as expected operating earnings since these actual earnings will be affected by many exogenous factors such as the general health of the economy. Additionally, the use of actual 1981/1982 operating earnings as expected operating earnings would ignore the fact that there is an inevitable lag between new capital investment that increases capacity and its full impact on operating earnings (Chirinko[1986]).

An example of the importance of expected earnings follows. Assume that a firm has operating earnings of \$10 before ERTA and uses \$6 of depreciation on equipment costing \$60 and \$4 of interest expense to exactly offset operating earnings. Further assume that the firm doubles its capital investments to \$120 after ERTA, leading to the expectation of a doubling in operating earnings to \$20. This \$20 is calculated as \$10 pre-ERTA operating earnings plus (the \$60 increase in investment times 10/60). Depreciation will be some number greater than \$12 since the new investment will generate greater depreciation than under pre-ERTA rules(i.e. depreciation on the incremental \$10 operating earnings will exceed \$6); for this example, assume that total depreciation increases to \$13. Finally, assume that the firm adjusts its debt to yield \$7 interest expense in the expectation of exactly offsetting expected operating earnings after depreciation and before interest. In this example, investment-related and debt tax shields have both increased in absolute magnitude contrary to the prediction of DeAngelo and Masulis[1980], while investment-related tax shields as a percentage of expected operating earnings have increased (from 60% to 65%) at the same time that debt tax shields as a percentage of expected operating earnings have decreased (from 40% to 35%) as predicted by Dammon and Senbet[1988].

In addition to measures of investment-related tax shields and expected operating earnings, tests of hypothesis H1 require a measure of changes in debt tax shields. The measure that will most closely match theory will be change in interest expense as a percentage of expected operating earnings from 1979/1980 to 1981/1982, which is a direct substitute for investment-related tax shields in sheltering operating income(Dammon and Senbet[1986]).

The debt securability effect predicts a positive relation between changes in debt and investment-related tax shields following the passage of ERTA. Empirical surrogates for debt and investment-related tax shields needed to test this prediction are the same as those used to test hypothesis H1.

The time-series tests of the relation between changes in debt and investment-related tax shields after the passage of ERTA must control for the probability that a firm is in danger of losing tax shields. It is predicted that firms that consistently pay high taxes will show a significantly positive relation between post-ERTA changes in debt-related and investment-related tax shields since investment-related tax shields serve as a surrogate for the securability of debt with collateralizable assets; this positive relation should not be diluted by the probability of losing tax shields since this set of firms is consistently paying high taxes. Since firms that pay low taxes face a higher chance of losing tax shields, the negative relation between post-ERTA changes in the two classes of tax shields predicted by hypothesis H1 should reduce the positive relationship between changes in tax shields induced by securability.

The surrogate measure to control for the possibility of losing tax shields will be the firm's average effective tax rate measured as the 1979/1980 sum of federal, state and foreign taxes paid divided by the 1979/1980 sum of earnings before interest, taxes and depreciation(EBITD). EBITD is the correct scalar since a firm's effective rate before taking advantage of the tax shields offered by investment-related and interest tax shields is of concern. The average effective tax rate is used since firms will pay attention to their overall tax burden rather than only the marginal tax rate on new investment when considering the substitution effect.

In order to implement the preceding empirical surrogate, the sample firms are partitioned into two groups based on a selected effective tax rate cutoff. This cutoff is chosen so that observations with effective tax rates lower than the cutoff rate will represent firms with a great risk of losing the deductibility of tax shields. In tests of the models represented in equations (2) and (3), these firms are classified into the group whose appropriate dummy variable is coded as D=1. Firms with effective tax rates greater than the cutoff would be firms with little probability of losing the deductibility of tax shields and are coded D=0. The results reported later in this section are based on coding firms in the lower 25% of the effective tax rate distribution as D=1 and firms in the upper 75% of the effective tax rate distribution as D=0. In order to check the sensitivity of the results reported in this section to the effective tax rate cutoff chosen, the tests reported are repeated using the lower 50%/upper 50% and lower 25%/upper 50% of the effective tax rate distribution to code the dummy variable representing the probability of losing tax shields as D=1 or D=0; the results of these sensitivity tests are reported in section 5.

The COMPUSTAT Annual Data Files are the source used to obtain the data necessary to compute the empirical surrogates defined in this section. Initially, 2327 firms are available for the sample. All firms with a fiscal year ending other than December 31 are removed from the sample in order to synchronize measurement of response to ERTA provisions. This reduces the sample size to 1482 firms. Firms with a one-digit SIC Code of "6"(banks, insurance companies, financial institutions and REITS) are also removed since the majority of the data required is not reported for these firms; this reduces the sample size by 347 firms to 1135 firms available for analysis.

For each of the 1135 firms, the variables required for tests of hypotheses are calculated. Any firms with missing data required to compute these variables are removed from the sample; this reduces the sample size by 362 firms to 773 firms. To avoid extreme outliers, any firm whose change in debt tax shields scaled by expected operating earnings or change in investment-related tax shields scaled by expected operating earnings increased by more than 100% or decreased by more than 90% from 1979/1980 to 1981/1982 is removed from the sample. This removes 80 firms from the sample; 41(35) firms have an investment-related tax shields change of greater than 100%(less than -90%) and 17(3) firms have a debt-related shields change of greater than 100%(less than -90%).

Sixteen firms are deleted based on two criteria(e.g. both debt-related and investment-related tax shields increased by more than 100%). In section 5, sensitivity results are reported for testing the sample data with no screening for outliers. The final sample consists of 693 firms.

In order to improve the power of the tests of equation (2), these tests can be run separately for firms receiving greater ERTA benefits and firms receiving lesser ERTA benefits. Empirical measures of variation in ERTA benefits received by industry are obtained from Gravelle[1982]. Table 2 summarizes Gravelle's results. The empirical measure of relative benefits received from ERTA by industry is calculated as the decrease in effective tax rate on marginal post-ERTA investment scaled by effective tax rate on marginal pre-ERTA investment. Industries with a greater than 50% decline in effective tax rate assuming 6% inflation are mining, construction, transportation, communication, radio/TV, motor vehicles, aerospace, and electric, gas and sanitary services. These industries will represent those receiving the greater investment-related tax shield benefit from ERTA. The remaining industries-agriculture, oil production, manufacturing, trade and non-residential services-will represent those receiving a lesser investment-related tax shield benefit from ERTA. In the sample of 693 firms identified above, firms in industries classified as receiving greater ERTA benefits by Gravelle[1982] numbered 235, while 458 firms could be classified as being in industries receiving lesser ERTA benefits.

Table 3 reports descriptive statistics for data used in the construction of empirical surrogates. The general pattern that emerges is that firms receiving the greatest benefit from the depreciation and ITC provisions of ERTA were more capital intensive, had higher debt ratios and paid less taxes.

Table 4 reports the regression results of testing hypotheses H1 using equations (1) and (2) for all firms (Panel A), firms receiving a greater ERTA benefit (Panel B) and firms receiving a lesser ERTA benefit (Panel C) using the lower 25% versus the upper 75% of the effective tax rate distribution to classify firms as subject to/not subject to the substitution effect. The first observation to be made is that the coefficient on the debt securability and substitution effects(B_1) using equation (1) is very insignificant and the unadjusted R^2 of equation (1) is less than .001; this is true for all firms, firms receiving a greater ERTA benefit and firms receiving a lesser ERTA benefit. This is not surprising, since the debt securability effect and the tax shields substitution effect which are both represented in the coefficient B_1 may cancel each other out.

To the extent that the debt securability effect is controlled by the research design of equation (2), B_2 represents the debt-related and investment-related tax shields substitution effect for firms with a reasonable probability of losing the benefits of tax shields. The coefficient B_2 is negative and statistically significant at the .01 level for all firms combined and for firms receiving greater and lesser ERTA benefits. Further, the debt securability effect when separated from the substitution effect(B_1 in equation (2)) is significantly positive at the .018, .054 and .005 levels for all firms combined, firms receiving greater ERTA benefits and firms receiving lesser ERTA benefits, respectively. Since the scaling of debt tax shields and investment-related tax shields by expected operating earnings has neutralized the income effect, these results are consistent with the predictions of Dammon and Senbet[1988], DeAngelo and Masulis[1980], the debt securability effect and the tax shields substitution effect(hypothesis H1). The results thus far imply that (1) all firms were subject to the effects of debt securability when adjusting their interest expense in response to post-ERTA increases in investment-related tax shields and (2) the firms with a reasonable probability of losing the deductibility of tax shields considered the substitution effect in adjusting interest expense in response to the post-ERTA increase in investment-related tax shields to a greater extent than firms with little probability of tax shield loss. It should be noted that these conclusions do not include statements regarding the intercept differences associated with the dummy variables; these terms are not readily interpretable since they apply only to firms with no change in investment-related tax shields in response to ERTA.

Three conclusions can be drawn from the overall results reported in Table 4. First, the research design of equation (2) appears to have successfully separated the debt securability effect from the debt and investment-related tax shields substitution effect and provides an appropriate test of theory. The improved research design of equation (2) is also evidenced by the increase in the explanatory power of the model, R^2. R^2 increases from .0004, .001 and .002 to .061, .138 and .022 using all firms, firms receiving greater ERTA benefits, and firms receiving lesser ERTA benefits, respectively. Second, the results show that the debt securability effect, if not controlled for, completely obscures the debt and investment-related tax shields substitution effect. The final conclusion to be drawn from the results reported in Table 4 is that the firms receiving the greater ERTA benefits had the most significant substitution effect (significance level .0001 versus .009 for firms receiving a lesser ERTA benefit) and the largest R^2 (.138 versus .022). In order to determine if the regression parameters of equation (2) differ significantly between the samples of firms receiving greater and lesser ERTA benefits, a Chow test of equal regression parameters is performed using the three sets of regression parameters(a_0, a_1, b_1 and b_2) reported in Table 4. The F-score associated with the test of the null hypothesis that the parameters are equal is 7.74 and the null is rejected.

4.2. Tests Controlling for the Pecking Order Theory

It was shown in section 2 that if high-debt firms use more equity to finance new investments as predicted by the pecking order theory, then debt ratio should be controlled for. Two empirical variables must be operationalized to test the prediction of the pecking order theory that firms with a higher pre-ERTA debt ratio used more equity financing to fund post-ERTA investments: percentage of equity used to fund post-ERTA investments and changes in debt ratios from pre-ERTA to post-ERTA years. Percentage of equity financing will be measured as changes in common stock at par plus changes in paid in capital in excess of par from December 31, 1980 through December 31, 1982, divided by the sum of capital expenditures for 1981/1982. The numerator will generally measure the market value of common equity issued in 1981 and 1982. Pre-(post-)ERTA debt ratio will be measured as the sum of interest-bearing debt for 1979/1980 (1981/1982) divided by the sum of total assets for 1979/1980 (1981/1982). These measures of pre-ERTA and post-ERTA debt ratios will be used to compute the change in debt ratio after the passage of ERTA defined as debt ratio for 1981/1982 minus debt ratio for 1979/1980.

The sample firms are divided into two groups consisting of companies in the highest 25% and the lowest 75% of the distribution of debt ratios. The percent of financing of capital expenditures in 1981/1982 with equity is then compared for the two groups of firms using a t-test of differences in means between the two groups. Further, the change in debt ratio from 1979/1980 to 1981/1982 is computed for each group of firms and a t-test of differences in mean changes in debt ratios between the two groups of firms is conducted.

Myers'[1984] pecking order theory predicts that high-debt firms will (1) use greater equity financing of capital expenditures and (2) have a larger decline in their debt to total assets ratio after such financing; these high-debt firms will be those more likely to have run out of cash and debt capacity in the pecking order of financing sources. This explanation is based on trends that should be observed when comparing high-debt and low-debt firms since an individual given high-debt firm may find its debt ratio increasing until its debt capacity is exhausted and it is forced to use equity financing.

Results of tests of the preceding predictions are presented in Table 5. Panel A reports the percentage of 1981/1982 capital expenditures financed by equity issues for firms in the highest 25% and lowest 75% of the 1979/1980 debt ratio distribution. As predicted by the pecking order theory, the firms with a higher debt ratio use more equity financing(.007 significance) than low debt-ratio firms. Panel B reports the change in the debt to total assets ratio for firms in the highest 25% and lowest 75% of the 1979/1980 debt ratio distribution. As expected, the firms in the upper 25% of this distribution show a significantly greater decrease in debt ratio from 1979/1980 to 1981/1982 that is significant at the .0003 level. These results support the pecking order theory for the sample firms used in this research.

Table 6 reports the results of testing the model represented by equation (3) for low-debt firms(Panel A) and high-debt firms(Panel B); as before, low-(high-) debt firms are those in the lower 75%(upper 25%) of the 1979/1980 debt ratio distribution. For low-debt firms, the debt securability effect remains significantly positive at the .001 level and the substitution effect for firms with a reasonable probability of losing the benefits of tax shields remains significantly negative at the .037 level. The relationship between debt ratio and changes in debt tax shields scaled by expected operating earnings is significantly positive(.0001 significance); this result confirms the prediction of the pecking order theory that this coefficient should be positive for tests using low-debt firms. For high-debt firms, the debt securability effect becomes negative at the .136 significance level; the most likely cause for this result is that lenders consider the quality of the collateral offered by fixed assets to be lower for high-debt firms that are more likely to default on their debt obligations. The substitution effect for high-debt firms facing a reasonable probability of losing the benefits of tax shields is negative at the .186 significance level. A probable cause of the decreased significance in the substitution effect for high-debt firms is that they are already reducing their debt due to low debt securability (the coefficient B_1 is negative) and pecking order effects (the coefficient B_3 is negative); the substitution effect would thus be less important to these firms since they are reducing their debt tax shields anyway for non-tax reasons. Finally, the slope coefficient on B_3 is negative(.197 significance) for the subsample of high-debt firms which supports the contention of the pecking order theory that firms with a high debt ratio will show a decrease in debt tax shields scaled by expected operating earnings following the enactment of ERTA.

The primary conclusion of this subsection is that the results reported in subsection 4.1 generally remain intact after controlling for predictions of the pecking order theory. However, debt securability does not appear to exist for high-debt firms. Furthermore, the pecking order theory received empirical support from the tests of firms' responses to the provisions of ERTA.

4.3. Summary of Results

This section began by testing for the debt securability and substitution effect combined with no control for the probability of losing tax shields, ERTA benefits received, or debt ratio. The significance of the coefficient on the combined effect was non-existent.

The inclusion of a dummy variable representing the probability of losing tax shields(i.e. effective tax rate) indicated that a significant debt securability effect existed for all firms and that a significant debt and investment-related tax shields substitution effect existed for firms with a low effective tax rate. Further analysis indicated that these results were stronger for firms receiving greater ERTA benefits and that the results remained intact with control for pecking order theory effects except that the debt securability effect did not appear to exist for high-debt firms. In other words, the debt securability hypothesis, the pecking order theory and the debt and non-debt tax shields substitution hypothesis were supported by empirical tests using changes in debt and investment-related tax shields in response to the Economic Recovery Tax Act of 1981.

The preceding conclusions should be considered partial equilibrium statements since there is no control for the effect of changes in individual tax rules brought about by ERTA. Such controls were not implemented for several reasons. Individual rates on both interest income and equity income decreased under ERTA. The decreased rate on interest income would increase the demand for debt securities while the decreased rate on dividend and capital gain income would decrease the demand for debt securities relative to equity securities. Measurement of the net effect on demand for corporate debt is problematic. Further, the market for corporate debt and equity may be segmented into clienteles with low-bracket investors holding debt and high-bracket investors holding equity which makes determination of general equilibrium very difficult if not intractable (Fullerton[1984]). Based on these considerations, the effect of changes in individual tax rules were not considered in the tests reported in this section. In addition, the model of Dammon and Senbet[1988] used to generate the hypotheses tested in this dissertation ignores the fact that as output increases due to the income effect, the prices obtained for this output would decrease. If this factor was considered, the income effect would be diminished and noise would be reduced in the measurement of expected earnings used in tests of the models respresented by equations (1), (2) and (3).

In the following section results of sensitivity analyses are reported. These analyses will indicate that the results reported in this section are robust to alternative specifications of models, variable definitions and time periods tested.

V. SENSITIVITY ANALYSIS

In order to determine if the results reported in the prior section were robust to changes in model specifications, variable definitions, screening criteria and time periods, several sensitivity analyses were performed. The results of performing these analyses are reported in this section.

5.1. Alternative Specification of Investment-related Tax Shields

If tests of equation (2) are repeated excluding net rent expense as a component of investment-related tax shields(DIFFNDTS), two substantive differences occur in the results. First, changes in investment-related tax shields as a percentage of expected operating earnings from 1979/1980 to 1981/1982 decrease from .071, .079 and .067 to .062, .078, and .052 for all firms, firms receiving a greater ERTA benefit and firms receiving a lesser ERTA benefit, respectively. Second, the debt securability effect coefficient decreases in significance from .018, .054 and .005 to .154, .108 and .078 for all firms, firms receiving a greater ERTA benefit and firms receiving a lesser ERTA benefit, respectively. Other results remain very similar to those reported in the previous section.

5.2. Alternative Screenings of Sample Firms

Chow tests were used to see if there were significant differences between the regressions using all data and regressions based on (1) including only firms whose net plant, property and equipment divided by total assets ratio was greater than 20% in 1979/1980, and (2) including only firms whose investment-related tax shields scaled by expected earnings increased from 1979/1980 to 1981/1982. The first screen would assure that only firms whose value is largely represented by fixed assets in place are represented in the sample, while the second screen assures that only firms whose response to ERTA matches the predictions of Dammon and Senbet[1988] are included in the sample. These tests were conducted for the screened (using criteria (1) and (2)) and unscreened samples of all firms, firms receiving greater ERTA benefits and firms receiving lesser ERTA benefits. Tests of equal regression parameters between the screened and unscreened samples yielded very insignificant F-scores and thus the null hypothesis that the regression parameters were equal between screened and unscreened samples could not be rejected. Therefore, the screening to eliminate firms with small ratios of net plant, property and equipment to total assets and negative changes in investment-related tax shields after the passage of ERTA was pursued no further.

5.3. Alternative Time Period and Effective Tax Rate Cutoff Specifications

The tests in section 4 were repeated using the measure of the test variables from 1981 to 1983 minus their measure from 1978 to 1980, and using their value in 1981 minus their value in 1980. The use of 1981 versus 1980 measures yielded very similar results, while the use of 1981 to 1983 versus 1978 to 1980 measures yielded weaker results. It is probable that the weaker results in the latter case arose from the extended time frame allowing too many confounding factors to arise. It could also be argued that the weaker results provide evidence that firms had essentially completed their response to ERTA during 1981 and 1982. Evidence supporting the latter explanation is provided by Kinney[1989].

Since no prior knowledge is available for the selection of an effective tax rate to partition the sample such that firms with a tax rate lower than the selected rate would represent firms with high risks of losing the deductibility of tax shields, several effective tax rate cutoffs were used. Besides the lower 25%/upper 75% partition of the effective tax rate distribution used for tests whose results are reported in section 4, the lower 50%/upper 50% and lower 25%/ upper 50% partitions were tested. Results were essentially identical for all three partitions.

5.4. Alternative Specification of Model (2)

In this research design, a dummy variable approach is used since it matches the theory used to generate predictions. A continuous variable measuring effective tax rate would be inappropriate since this would imply that two firms with very high effective tax rates would not face the same essentially non-zero probability of losing the deductibility of tax shields. For example, assume that Firm A has an effective tax rate of 45% and Firm B has an effective tax rate of 46%. The assumption of this research is that neither firm would be subject to the substitution effect, while the use of a continuous effective tax rate variable would imply that the firm with a 45% tax rate would be more subject to the substitution effect. Nevertheless, if a continuous effective tax rate measure is used rather than a dummy variable approach in testing equation (2), the substitution effect is significant at the .009, .006 and .138 levels for all firms, firms receiving a greater ERTA benefit and firms receiving a lesser ERTA benefit, respectively.

As an alternative to comparing the results of tests of equation (2) between firms receiving greater and lesser ERTA benefits, the ERTA benefit effect was controlled for with respect to effective tax rate by coding dummy variables within each ERTA benefits subsample and testing equation (2) for all firms combined. The debt securability effect increases in significance(magnitude) from the .018 to the .002 level(.058 to .079) while the substitution effect increases in significance(magnitude) from the .009 to the .0002 level(-.108 to -.162).

5.5. Alternative Screenings for Outliers

If tests of equation (2) for firms receiving greater and lesser ERTA benefits are performed with no screening for outliers the results become erratic. However, if only the four most extreme outliers on changes in debt and investment-related tax shields scaled by expected operating earnings are removed from the sample using the rule delete firms whose change exceeds +-300%(this removes one firm with investment-related shields change of less than -300%, two firms with debt shields change of less than -300% and one firm with debt shields change of greater than +300%), the results remain similar to those reported in section 4 with one exception: the coefficient on the substitution effect (significance level .585) using equation (2) becomes insignificant for firms receiving a lesser ERTA benefit. Other results remain statistically significant in the same direction at the .055 level or less.

5.6. Conclusions from Sensitivity Analysis

This section reported the results of repeating the tests of section 4 using alternative specifications of time periods, empirical surrogates, models and screening criteria. The results reported previously appeared very robust with only two respecifications affecting these prior results to a significant degree.

First, if the data is not screened for outliers on the continuous variables interest expense as a percentage of expected operating earnings and investment-related tax shields as a percentage of expected operating earnings, the regression results testing the models represented by equations (2) and (3) become erratic. This is to be expected in regression analysis. However, if only the four most extreme outliers in the sample of 773 firms are removed the results are very similar to those using more stringent screening criteria.

Second, while the results using variables measured as changes from 1980 to 1981 and 1979/1980 to 1981/1982 are very similar, the results using changes from 1978/1979/1980 to 1981/1982/1983 are erratic. It is hypothesized that two possible causes for this result are (1) the confounding factors that arise during a six-year testing period and/or (2) the possibility that firms had essentially completed their adjustments in debt-related tax shields and investment-related tax shields in response to ERTA by the end of 1982.

Overall, the results reported in section 4 received further support from the respecified tests reported in this section. The next section will summarize this dissertation, offer conclusions that can be drawn from the results and suggest areas of further research.

VI. CONCLUSION

This dissertation examines the response of corporations to the liberalized depreciation, investment tax credit and research and development credit provisions of the Economic Recovery Tax Act(ERTA) of 1981. Two theories from the financial economics literature are used to generate predicted responses to ERTA. The substitution effect advanced by DeAngelo and Masulis[1980] and Dammon and Senbet[1988] predicts that there will be a negative relationship between changes in investment-related tax shields scaled by expected operating earnings and changes in debt-related tax shields scaled by expected operating earnings following the passage of ERTA. This negative relationship should exist since the increased investment-related tax shields offered under ERTA would increase the probability of losing the immediate tax deductibility of debt-related tax shields if debt tax shields were not reduced. The debt securability effect described by Scott[1977] predicts that there will be a positive relationship between changes in investment-related tax shields scaled by expected operating earnings and changes in debt-related tax shields scaled by expected operating earnings following the enactment of ERTA. This positive relationship should exist since the increased investment in fixed assets encouraged by ERTA would allow firms to borrow more using their new fixed assets as collateral for debt.

A major contribution of this dissertation is the design of an appropriate model to empirically separate the debt securability effect from the debt-related and investment-related tax shields substitution effect. Firms' effective tax rate is used to measure the probability of losing the benefit of tax shields. COMPUSTAT firms are partitioned into two groups based on the probability of losing the benefit of tax shields. The group of firms with little probability of such loss would not be concerned with the tax shields substitution effect and is used as a control group to estimate the debt securability effect. The debt securability effect so estimated is then separated from the tax shields substitution effect for the group of firms with a high probability of losing the deductibility of tax shields (i.e. firms concerned with the substitution effect).

Empirical results are consistent with predictions of both the substitution effect and the debt securability effect. If no attempt is made to separate the substitution effect and the debt securability effect, there is no observed relationship between changes in debt-related tax shields and changes in investment-related tax shields after the passage of ERTA. If the model developed in this dissertation is used to separate the substitution and debt securability effects, a positive relationship between changes in debt tax shields and changes in investment-related tax shields after the passage of ERTA is observed for all firms and an incremental negative relationship between changes in the two classes of tax shields is observed for firms with a reasonable probability of losing the deductibility of tax shields. This result is robust to changes in time periods tested, data screening, definitions of test variables and model specification. This overturns the findings of prior research which offered support for the debt securability effect only.

This research controls for predictions of the pecking order theory of finance (Myers[1984]) that could offer an alternative explanation for the results observed. The pecking order theory predicts that firms with a high debt ratio will be forced to fund post-ERTA investments in depreciable assets using more equity issuance than firms with a low debt ratio since the high-debt firms are more likely to have exhausted their debt capacity. This in turn leads to the prediction that high-(low-) debt firms will exhibit a negative(positive) relationship between debt ratio and changes in debt tax shields scaled by expected operating earnings following the enactment of ERTA. Since changes in debt tax shields scaled by expected operating earnings are the dependent variable in tests of the debt securability and substitution effects, these tests are repeated with control for debt ratio. The conclusions drawn from tests with no control for debt ratio remain intact except that the debt securability effect does not exist and the substitution effect is weaker for high-debt firms. Further, support for the pecking order theory of finance is offered by tests that control for debt ratio.

In order to improve the power of the tests conducted in this dissertation, results are compared between firms receiving greater and lesser investment-related tax shield benefits under the provisions of ERTA. Firms receiving a greater ERTA benefit show a more significant substitution effect between changes in debt-related and investment-related tax shields following ERTA.

The primary limitation of this dissertation is that its conclusions are partial equilibrium statements. The effects of changes in individual tax rules brought about by ERTA are not directly tested for the reasons described in subsection 4.4.

The findings of this dissertation should prove useful to policy makers, legislators and capital market participants in predicting the effect of a change in the tax laws on the decisions made by firms, the market valuations of firms and economy-wide corporate debt levels. The results of this research should also be of use to academic researchers in designing tests of the interaction between taxes and corporate investing and financing decisions.

Two extensions of this dissertation are immediately apparent. First, the theory and tests could be extended to a more general equilibrium setting in which changes in the tax rules for individuals and corporations are simultaneously considered. Second, additional determinants of the significant difference in response to ERTA between firms receiving greater investment-related tax shield benefits and firms receiving lesser investment-related tax shield benefits under ERTA could be theoretically developed and empirically tested.

APPENDIX: A
TABLES

TABLE 1

Ordinary Least Squares Regression Results of Firm Debt To Value Ratio on Non-Debt Tax Shields and Advertising plus R&D Expenses and Earnings Volatility

	ALL FIRMS	UNREGULATED FIRMS
Sample Size	821	655
Intercept	.330 (19.96)	.202 (11.24)
Non-Debt Tax Shields	.370 7.61	.423 8.51
Advertising and R&D	-2.42 -13.13	-1.34 -7.53
Earnings Volatility	-1.73 -12.33	-.806 -5.85
R-Square	.342	.236

Source: Bradley, Jarrell and Kim, Table III, pg. 873[1984]

Firm debt to Value Ratio is 20-year(1962-1981) sum of book value of debt divided by the sum of the book value of debt plus the market value of equity.

Firm non-debt tax shields are 20-year(1962-1981) sum of depreciation plus investment tax credits divided by earnings before interest, taxes and depreciation plus nonoperating income.

Firm advertising plus R&D expense is 10-year(1972-1981) sum of advertising plus R&D expense divided by sales.

Earnings volatility is the standard deviation of the first differences in earnings before interest, taxes and depreciation plus nonoperating income from 1962-1981, scaled by average annual total assets from 1962-1981.

All results reported are: line 1-coefficient in regression and line 2-the t-score associated with the coefficient.

TABLE 2

Marginal Effective Tax Rate by Industry

Industry	6% Inflation	9% Inflation
Agriculture	16.7%(29.5%)	22.5%(34.5%)
Mining	11.3%(26.7%)	15.4%(31.3%)
Oil Production	9.8%(14.1%)	11.3%(15.4%)
Construction	-10.0%(20.3%)	1.8%(27.6%)
Manufacturing	19.1%(36.8%)	24.7%(40.9%)
Transportation	3.5%(26.7%)	11.3%(32.9%)
Communication	1.8%(25.7%)	9.8%(31.3%)
Radio/TV	5.2%(31.3%)	12.7%(36.8%)
Electric,Gas and Sanitary Services	12.6%(27.6%)	19.1%(32.1%)
Trade	24.7%(40.2%)	29.5%(42.7%)
Services(non-residential)	22.5%(38.9%)	27.6%(42.1%)
Overall	16.0%(33.1%)	21.9%(37.3%)

Source: Gravelle[1982]

NOTES

1. Marginal effective rates after the passage of ERTA are reported outside parentheses. Pre-ERTA rates are reported in parentheses.

2. Gravelle[1982] does not break manufacturing down but does report that tobacco manufacturing and petroleum refining had higher rates than those reported and motor vehicles and aerospace had lower rates approximating those of Transportation.

TABLE 3

Descriptive Statistics

Variable	Mean Measure for: All Firms	Firms Greater ERTA Benefit	Firms Lesser ERTA Benefit	T-test Difference in Means
Sample Size	693	235	458	
Interest Expense/ Expected Earnings 1979/1980	.2076	.2906	.1651	9.41 .0001*
Interest Expense/ Expected Earnings 1981/1982	.2580	.3688	.2012	9.99 .0001
Non-debt Shields/ Expected Earnings 1979/1980	.4855	.5747	.4397	7.45 .0001
Non-debt Shields/ Expected Earnings 1981/1982	.5564	.6539	.5064	7.29 .0001
Tax Rate 1979/1980	.1978	.1010	.2475	-13.27 .0001
Interest Bearing Debt/Total Assets 1979/1980	.2731	.3716	.2226	14.37 .0001
Interest Bearing Debt/Total Assets 1981/1982	.2694	.3657	.2199	14.23 .0001

* P-value(two-tailed) reported in parentheses

TABLE 4

Regression Results from Using the Change in the Interest Expense as a Percentage of Operating Earnings as the Dependent Variable: Equations (1) and (2)

Panel A: Results for All Firms

	Eq.(1)	Eq.(2)
Effective tax rate used to split sample		.070
Sample Size	693	693
Model Estimates:		
Intercept(a0)	.050 12.08 (.0001)	.033 7.01* (.0001)**
Intercept(a1)		.060 6.65 (.0001)
Debt securability & Substitution Effect Combined(b1)	.013 .56 (.289)	
Debt securability effect(b1)		.058 2.10 (.018)
Substitution effect(b2)		-.108 -2.37 (.009)
R-Squared	.0004	.061

* t-score associated with coefficient

** P-values(one-tailed) reported in parentheses

TABLE 4 (Continued)

Regression Results from Using the Change in the Interest Expense as a Percentage of Operating Earnings as the Dependent Variable: Equations (1) and (2)

Panel B: Results for Firms Receiving Greater ERTA Benefits

	Eq. (1)	Eq. (2)
Effective tax rate used to split sample		.018
Sample Size	235	235
Model Estimates:		
Intercept(a0)	.080 11.31 (.0001)	.058 7.73* (.0001)**
Intercept(a1)		.086 5.64 (.0001)
Debt securability & Substitution Effect Combined(b1)	-.018 -.54 (.295)	
Debt securability effect(b1)		.059 1.62 (.054)
Substitution effect(b2)		-.293 -4.19 (.0001)
R-Squared	.001	.138

* t-score associated with coefficient

** P-values(one-tailed) reported in parentheses

TABLE 4 (Continued)

Regression Results from Using the Change in the Interest Expense as a Percentage of Operating Earnings as the Dependent Variable: Equations (1) and (2)

Panel C: Results for Firms Receiving Lesser ERTA Benefits

	Eq. (1)	Eq. (2)
Effective tax rate used to split sample		.144
Sample Size	458	458
Model Estimates:		
Intercept (a0)	.034 6.94 (.0001)	.024 3.90* (.0001)**
Intercept (a1)		.027 2.47 (.007)
Debt securability & Substitution Effect Combined (b1)	.031 1.05 (.147)	
Debt securability effect (b1)		.104 2.57 (.005)
Substitution effect (b2)		-.143 -2.38 (.009)
R-Squared	.002	.022

* t-score associated with coefficient

** P-values (one-tailed) reported in parentheses

TABLE 5
Results of Tests of the Pecking Order Theory

Panel A:

Variable	Mean Measure for: All Firms	Firms Upper 25% Debt Ratio	Firms Lower 75% Debt Ratio	T-test Difference in Means
Percent of financing of capital expenditures with equity 1981/1982	.081	.127	.066	2.72 .007*

Panel B:

Variable	Mean Measure for: All Firms	Firms Upper 25% Debt Ratio	Firms Lower 75% Debt Ratio	T-test Difference in Means
Change in Debt Ratio from 1979/1980 to 1981/1982	-.004	-.020	.001	-3.64 .0003

* P-value(two-tailed) reported in parentheses

TABLE 6

Regression Results from Using the Change in the Interest Expense as a Percentage of Operating Earnings as the Dependent Variable: Equations (1) and (3)

Panel A: Results for Firms in Lower 75% of pre-ERTA Debt Ratio Distribution

	Eq.(1)	Eq.(3)
Effective tax rate used to split sample		.135
Sample Size	520	520
Model Estimates:		
Intercept(a0)	.032 9.31 (.0001)	.004 .51* (.305)**
Intercept(a1)		.008 1.05 (.147)
Debt securability, Substitution Effect & Pecking Order Effect Combined(b1)	.044 2.31 (.011)	
Debt securability effect(b1)		.072 2.95 (.001)
Substitution effect(b2)		-.069 -1.79 (.037)
Debt Ratio(b3)		.119 3.83 (.0001)
R-Squared	.010	.052

* t-score associated with coefficient

** P-values(one-tailed) reported in parentheses

TABLE 6 (Continued)

Regression Results from Using the Change in the Interest Expense as a Percentage of Operating Earnings as the Dependent Variable: Equations (1) and (3)

Panel B: Results for Firms in Upper 25% of pre-ERTA Debt Ratio Distribution

	Eq. (1)	Eq. (3)
Effective tax rate used to split sample		.011
Sample Size	173	173
Model Estimates:		
Intercept (a0)	.108 8.83 (.0001)	.172 2.00* (.023)**
Intercept (a1)		.040 1.36 (.088)
Debt securability, Substitution Effect & Pecking Order Effects Combined (b1)	-.114 -1.80 (.037)	
Debt securability effect (b1)		-.084 -1.10 (.136)
Substitution effect (b2)		-.127 -.90 (.186)
Debt Ratio (b3)		-.156 -.85 (.197)
R-Squared	.019	.034

* t-score associated with coefficient

** P-values (one-tailed) reported in parentheses

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