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THE IMPACT OF CAPITAL STRUCTURE CHANGE
ON FIRM VALUE, SOME ESTIMATES*

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ABSTRACT

This study develops a model based on current corporate finance theories which explains stock returns associated with the announcement of issuer exchange offers. The major independent variables are changes in leverage multiplied by senior security claims outstanding and changes in debt tax shields. Parameter estimates are statistically significant and consistent in sign and relative magnitude with model predictions. Overall, 55 percent of the variance in stock announcement period returns is explained. The evidence is consistent with tax-based theories of optimal capital structure, a positive debt level information effect, and leverage induced wealth transfers across security classes.

INTRODUCTION

There is an extensive theoretical literature concerning optimal capital structure.¹ However, there is little empirical evidence of a relation between changes in capital structure and firm value. In the best known test of an optimal capital structure model, Miller-Modigliani (15) reported evidence of a positive relationship between firm value and leverage which they attributed to a debt tax shield effect. Their results are suspect, however, because of statistical problems they encountered when attempting to adjust for differences in the firms' asset structures. Since only regulated firms were examined, there is also some concern that their empirical findings were caused by the regulatory environment in which these firms operate. No strong evidence of a relation between a firm's value and the size of its debt tax shield has been uncovered since the Miller-Modigliani study.

This study estimates the impact of a change in debt level on firm values. Two forms of capital structure change are examined: issuer exchange offers and recapitalizations. The results indicate that both stock prices and firm values are positively related to changes in debt level and leverage; senior security prices are negatively related to these capital structure change variables. This evidence is consistent with models of optimal capital structure and with the hypothesis that debt level changes release information about changes in firm value.

I. EXCHANGE OFFER SAMPLE

In an issuer exchange offer, one or more security classes is given the right to exchange part or all of their present holdings for a different class of firm securities. Most exchange offers are open for an initial period of one month, although many are extended for additional weeks. The terms of exchange typically involve a package of new securities of greater market value in terms of pre-exchange offer announcement prices than those to be tendered. The difference in value is considered a pre-announcement exchange offer premium. Most exchange offers specify a maximum number of securities that can be exchanged and a maximum duration for the offer, and many offers are contingent upon acceptance by a minimum number of securityholders.

Recapitalizations are distinguishable from exchange offers by the fact that all the securityholders of the affected class must, in general, participate in the recapitalization. Moreover, recapitalizations occur at a single point in time. Usually a plan of recapitalization must be approved by a majority of the securityholders who are directly affected.²

Unlike most other forms of capital structure changes, exchange offers and recapitalizations (hereafter jointly termed EOs) involve little or no cash inflow or outflow from the firm. This makes them especially well suited for analyzing the impacts of capital structure changes because the firms' asset structures are essentially unaltered.³

The sample of EOs analyzed in this paper consists of all those which occurred in the U.S. during the period 1963-1978 and which satisfied these criteria:

(a) The dates of the initial announcement and subsequent offer-terms announcement are known and the common stock was listed on the NYSE or the ASE on the announcement date.

(b) The EO changed the amount of debt or preferred stock outstanding, so that more than one major class of firm securities (i.e., common stock, preferred stock, or debt) is altered.⁴

(c) No other major asset structure or capital structure change announcements were made within one week of the primary EO announcements.⁵

(d) Cash and other asset distributions associated with the EO did not exceed 25 percent of the value of the securities retired in the offer.

(e) The EO was successfully completed.

Of the 237 exchanges which met the first two criteria, 133 remained after the entire screening process.⁶ The sample consists of 14 recapitalizations and 119 EOs, of which 15 were oversubscribed, with ten of these oversubscribed offers made to common stockholders. Very few offers were significantly oversubscribed, strongly suggesting that after the announcement, any EO premiums which exist are economically insignificant.

Two significant announcements, known here as the primary announcements, are associated with the EO process: the initial EO announcement, which always occurs, and the subsequent announcement of offer terms or revisions in terms, which occurs in about 40 percent of the sample.⁷ The essential EO terms are: the exchange ratio of new security for old, the description of the security to be issued if it is not currently outstanding,⁸ and the maximum number of securities to be exchanged.⁹ Table 1 displays the daily returns of equally weighted portfolios of common stocks centered around the two primary EO announcement dates. Since the announcement can occur after trading closes on day 0, the announcement period is defined as days 0 and 1. The remaining time series of portfolio returns covering trading days -40 to -1 and +2 to +41 is defined as the comparison period.

TABLE 1

COMMON STOCK PORTFOLIO DAILY RETURNS SURROUNDING EO ANNOUNCEMENTS*		
EVENT DAY	INITIAL ANNOUNCEMENTS	TERMS ANNOUNCEMENTS
	N = 133	N = 52
	PORTFOLIO DAILY RETURNS (%)	PORTFOLIO DAILY RETURNS (%)
-20	0.21	0.75
-19	-0.12	0.13
-18	0.27	0.61
-17	-0.28	0.44
-16	0.55	-0.72
-15	0.15	-0.15
-14	0.13	0.15
-13	0.15	0.83
-12	0.07	0.25
-11	0.23	0.07
-10	-0.46	-0.29
-9	-0.17	-0.21
-8	0.19	0.16
-7	-0.47	0.64
-6	0.33	-0.02
-5	-0.19	0.27
-4	0.33	-0.10
-3	0.14	0.22
-2	0.09	0.81
-1	-0.04	0.15
0	5.61	2.84
+1	1.49	1.26
+2	0.13	0.19
+3	0.03	0.69
+4	0.23	0.34
+5	-0.15	-0.60
+6	-0.29	0.24
+7	-0.11	-0.60
+8	0.06	0.58
+9	-0.22	-0.13
+10	0.32	0.29
+11	-0.23	0.04
+12	0.28	-0.27
+13	0.08	-0.40
+14	-0.76	-0.01
+15	0.26	0.37
+16	0.02	0.10
+17	0.44	0.13
+18	0.27	-0.35
+19	-0.15	-0.25
+20	0.24	-0.77
+21	0.65	0.56
Comparison Period:		Comparison Period:
Mean Portfolio Daily Ret. = .05%		Mean Portfolio Daily Ret. = .07%
Standard Deviation = .29%		Standard Deviation = .42%
Announcement Period:		Announcement Period:
Mean Portfolio Daily Ret. = 3.55%		Mean Portfolio Daily Ret. = 2.05%
Standard Deviation = 2.91%		Standard Deviation = 1.12%

* Note that only half the comparison period is included in the table.

In constructing this table, stock daily returns for offers decreasing leverage, which comprise a third of the portfolio, have been adjusted by multiplying all these stock returns by a -1 so that all portfolio returns will exhibit the effects of a positive leverage change. Thus the stock price adjustments associated with increasing leverage are not offset by those for decreasing leverage. Masulis (13) presents evidence supporting this adjustment.

The announcement's average impact is determined by comparing the announcement and comparison period's mean portfolio daily returns found at the bottom of Table 1. These returns are adjusted for the sign of the leverage change. The initial and terms announcements period mean daily returns are 3.55 and 2.05 percent (representing strictly positive adjusted returns for 87 and 71 percent of the stocks, respectively); these returns are both significantly different from the corresponding comparison period mean daily returns.¹⁰ This indicates that the market did not fully anticipate the size or timing of the EO announcements.¹¹

In the following analysis, the returns for the two primary announcements are summed together. The distribution of primary announcement period stock returns ranges from -35.3 to +50.0 percent. Significantly, 90 percent of these returns have the same sign as the associated leverage change. Table II summarizes important capital structure characteristics of the EO sample and presents common stock announcement period returns by type of capital structure change.

II. AN ECONOMIC MODEL OF THE EFFECTS OF EXCHANGE OFFERS ON THE VALUES OF FIRMS' COMMON STOCK

Changes in firm value associated with EOs are assumed to be caused by (1) changes in debt tax shields, (2) changes in expected leverage costs, and (3) implicit information disclosures of revisions in firm earnings expectations. If the senior securities were riskless, the impact on firm value of a debt level change could be measured directly by the change in the common stock's value. With risky senior securities, however, a change in common stock market value is not equivalent to a firm valuation change; changes in senior security values must also be considered. These changes

TABLE II

DISTRIBUTION OF EXCHANGE OFFERS BY TYPE OF CAPITAL STRUCTURE CHANGE

TYPE OF CAPITAL STRUCTURE CHANGE	NO. OF OFFERS	MEAN CHANGE IN FACE VALUE OF DEBT	MEAN CHANGE IN LIQUIDATION VALUE OF PREFERRED STOCK	MEAN INITIAL COMMON STOCK MARKET VALUE	MEAN INITIAL LEVERAGE	PRIMARY ANNOUNCEMENT PERIOD RETURNS FOR PORTFOLIO OF COMMON STOCK
Debt Issued/ Common Stock Retired	52	\$14.8 million	\$0 million	\$70.1 million	.55	13.97 %
Common Stock Issued/ Debt Retired	9	-9.7	0	43.9	.78	-9.91
Debt Issued/ Preferred Stock Retired	24	52.4	-38.7	431.7	.46	3.53
Preferred Stock Issued/ Debt Retired	9	-8.3	8.2	52.8	.70	-7.72
Preferred Stock Issued/ Common Stock Retired	10	0	14.3	247.5	.57	8.29
Common Stock Issued/ Preferred Stock Retired	23	0	-8.0	68.2	.49	-2.57
TOTAL	126	-	-	-	.55	-

in the value of debt or preferred stock are attributable to convertibility and incomplete protective covenants in the senior securities as well as to weak enforcement of the "absolute priority rule" in bankruptcy and reorganization proceedings, as discussed shortly.

A. Relationship between Common Stock Returns and Capital Structure Changes

Security price adjustments are assumed to eliminate EO premiums. Thus, the market value of securities purchased is assumed to equal the market value of cash and securities issued based on post-announcement prices.¹² It follows from this and Modigliani-Miller's proposition I that an EO-induced change in firm value, ΔV , should equal the sum of its security price changes multiplied by their original number of securities outstanding minus any cash disbursements to tendering securityholders, ΔA ,

$$(1) \quad \Delta V = n_s \Delta s + \sum_j n_j \Delta s_j - \Delta A$$

where Δs = change in common stock share price, Δs_j = change in senior security prices, and n_j = original number of the j^{th} class of securities.

Rearranging eq. (1) in terms of Δs and dividing by the pre-announcement market value of the firm's common stock, S , yields

$$(1a) \quad \frac{\Delta s}{s} = \frac{\Delta V}{S} + \frac{\Delta A}{S} - \frac{\sum_j n_j \Delta s_j}{S}$$

where $S = s n_s$. Interpreting eq. (1a), an EO affects the per share stock price by (i) changing the market value of the firm, (ii) making cash disbursements to tendering securityholders,¹³ and (iii) altering the prices of firms'

senior securities. These three effects will be considered in turn.

B. Corporate and Personal Tax Implications
of Changing Firm Debt

Any capital structure adjustment which alters the level of outstanding debt also alters corporate and securityholder tax liabilities due to the change in debt interest payments and the creation or extinction of an original issue discount or premium. This section examines these two debt related tax features.

Following Miller (14), assume that all debt payments are deductible at the corporate level¹⁴ and that there exists a uniform corporate tax rate τ_c and a constant marginal personal tax rate which differs across investors, where tax rates are proportional to income and strictly less on equity income τ_{PS} than on debt income τ_{PD} . Miller demonstrates that an exchange of debt for equity securities at the market exchange rate results in the following change in firm market value (due solely to the interest tax effects of a change in outstanding debt):¹⁵

$$(2) \quad \Delta T_1^* = \alpha \Delta D < \tau_c \Delta D$$

where $\alpha = 1 - \frac{(1 - \tau_c)(1 - \tau_{PS}^\mu)}{(1 - \tau_{PD}^\mu)}$ and the superscript μ represents the marginal securityholders. Interpreting eq. (2), the change in the value of a firm's interest tax shield equals the marginal tax benefit per dollar of debt multiplied by the change in the present value of its future interest payments. The α term is less than τ_c since the marginal personal tax disadvantage of debt relative to equity returns is reflected in the relative prices of

debt and equity claims, offsetting all or part of the corporate tax advantage of debt.

A second, less familiar, corporate tax deduction is associated with debt originally issued at a substantial discount (or premium) from its face value. The difference between the new debt's face value ΔC and market value ΔD on the first trading day following its issuance is considered a tax-deductible expense (or taxable income) to the issuing corporation and taxable income (or a tax deductible expense) to the acquiring bondholders. Before 1969 the firm realized the tax deduction (or income) in the year the debt was issued unless voluntarily choosing deferral. Since 1969 this expense (or income) cannot be realized immediately but must be allocated equally over the debt issue's life, thereby decreasing the size of this tax shield.¹⁶ Consequently, since 1969 the value of an original issue discount tax deduction equals the product of the marginal tax benefit of debt and the present value of an annuity whose yearly payment consists of the annualized portion of the original issue discount:¹⁷

$$(2a) \quad \Delta T_2^* = \alpha \left[\frac{\Delta C - \Delta D}{N} \right] \left[\frac{1 - (1 + i_D^*)^{-N}}{i_D^*} \right]$$

where N = number of years to maturity of the debt issue and i_D^* = the debt issue's market interest rate.

The change in firm value caused by the debt level change equals the sum of the present values of the debt interest payment and original issue discount tax deductions multiplied by the marginal value to the firm of a dollar of tax deductions,

$$(2b) \quad \alpha \Delta T = \Delta T_1^* + \Delta T_2^*$$

Prior to 1969, the original issue discount was treated as income to the acquiring bondholder in the year of issue, with the result that the two bracketed terms in eq. (2a) simplified to $\Delta C - \Delta D$, so that eq. (2b) equaled $\alpha \Delta C$. Importantly, $\alpha \Delta T$ represents the total change in firm value due to a debt tax shield change, ΔT , which generally exceeds the associated change in common stock value because senior security prices are also positively related to $\alpha \Delta T$ through its effect on firm leverage.

C. Optimal Capital Structure

Miller argues that firms will alter their capital structures in the aggregate until α is zero, rendering the leverage decision irrelevant to the individual firm.¹⁸ DeAngelo-Masulis (5) demonstrate that when Miller's model is modified to allow for nondebt corporate tax shields and leverage related costs, firms will not be motivated to supply debt to the capital market until α is driven to zero. Specifically, DeAngelo-Masulis show that, with the introduction of investment related tax shields, the debt tax shield cannot always be fully utilized, so that the marginal tax savings of debt α in eq. (2b) is replaced by the expected marginal tax effect. In their model, the expected marginal tax effect of debt is

$$\alpha^* = \alpha P_F + \gamma P_N$$

where P_F = probability of full corporate tax shield utilization; P_N = probability of partial utilization of the corporate tax shield under solvency; $1 - P_F - P_N$ = probability of insolvency (where the marginal tax effect of debt is zero); and $0 > \gamma \equiv \left[1 - \frac{(1 - \tau_{PS}^u)}{(1 - \tau_{PD}^u)} \right]$ = marginal tax loss from an excess tax shield. Thus, when nondebt tax shields exist, firms issue debt in the

aggregate only until the expected marginal tax advantage of debt α^* for each firm is driven to zero.¹⁹

DeAngelo-Masulis show that with the introduction of debt related costs (e.g., bankruptcy and agency costs), a firm's optimum debt level is determined at the point where the expected marginal tax effect α^* just equals the expected marginal cost of leverage b , so that α^* is always positive. If $\alpha^* > b$, a firm could increase its value by increasing its debt; and, if $\alpha^* < b$, its value could be increased by decreasing debt, since b is a positive and monotonically increasing and α^* is a positive and monotonically decreasing function of debt.

D. Implicit Information Effect of Capital Structure Changes

Under our previous assumptions, rational investors should be able to predict when value maximizing firms will make major changes in debt level, except when there are unanticipated changes in firms or their environments. The large average size of the EO announcement price changes presented in Table 1 indicates that they were not fully anticipated, suggesting that management had new information of changes in the firm's expected before-tax earnings prospects, nondebt tax shields, or leverage costs.²⁰ Since no major changes in the bankruptcy laws or tax code occurred over the period of this study, debt changes, which alter a firm's tax shield, are most likely to be positively related to unanticipated changes in before-tax earnings prospects. When these earnings changes are converted to an after-corporate tax basis, the tax-plus-leverage-cost effect of a debt level change must be adjusted to incorporate the earnings induced change in the expected marginal tax effect. This information related tax effect is positively related to the change in debt level due to the positive relationship between changes in earnings and P_F . In general, this adjusted tax-plus-leverage-cost effect will be a

positive function of a debt level change. Thus a change in debt will cause a like change in firm market value due to both information and tax-plus-leverage-cost effects. As a first approximation, the sum of these firm valuation effects is assumed proportional to the debt level change, which yields

$$(2c) \quad \delta\Delta T = \alpha^*(\Delta T) - b(\Delta T) + \theta(\Delta T)$$

where

$0 < \theta \equiv$ information effect of a debt level change

$0 < \delta \equiv$ combined effects of a debt level change.

It is noteworthy that without the symmetry in information and tax-plus-leverage-cost effects, a firm could change its market value by changing its debt level, and then exactly undoing that change in debt.²¹

E. Cash Payments and Changes in Firm Value

Accounting for the limited cash or asset distributions to tendering securityholders ΔA which represent cash outflows from the firm and the firm valuation effects of a change in debt defined in eq. (2c), we obtain the total change in firm market value:

$$(3) \quad \Delta V = \delta\Delta T - \Delta A$$

Substituting eq. (3) into eq. (1a) yields:

$$(1b) \quad \frac{\Delta S}{S} = \frac{\delta\Delta T}{S} - \frac{n\ell\Delta\ell}{S} = \frac{\delta\Delta T}{S} - \cancel{\frac{\Delta\ell}{\ell}}$$

where $\cancel{\frac{\Delta\ell}{\ell}} = n\ell\ell$, which expresses the stock's rate of return as a function of the firm valuation impact of a change in debt level and the change in the market

prices of senior securities. The numerator in the second term can be reinterpreted as the pre-announcement market value of the senior securities multiplied by the announcement rate of return.

F. Wealth Transfers Across Security Classes

When a capital structure change has no impact on individual senior security prices, the second term in eq. (1b) is zero. This is inconsistent with the observed price impacts for firms' convertible and nonconvertible debt and preferred stock reported in Masulis (13). When the senior securities are risky, the second term in eq. (1b) will usually be nonzero since senior security prices are affected both by changes in firm market value and changes in leverage.²²

Senior securities are risky under convertibility or a positive probability of bankruptcy. In the latter case, senior security prices are affected by changes in firm value and also by changes in the level of outstanding senior security claims, if either the protective covenants of the senior security issues fail to strictly preclude increases in the number of securities of equal or senior standing without full compensation, or, in reorganizations, courts choose not to adhere strictly to the "absolute priority rule" in the adjudication of senior securityholder rights.²³ In either case, EOs increasing leverage cause transfers of wealth from debtholder and preferred stockholder to common stockholder, while EOs decreasing leverage cause opposite transfers of wealth.

The sign of the change in nonconvertible senior security (debt or preferred stock) prices is predicted to be opposite the change in the dollar value of outstanding senior security claims (whether face value of debt or involuntary

liquidation value of preferred stock).²⁴ This prediction also holds for the convertible senior securities, holding constant the value of the conversion right. Defining leverage as the face value of debt plus involuntary liquidation value of preferred stock, all relative to the firm's market value, $L \equiv C/V$, it can generally be shown that the sign of the change in outstanding senior claims is the same as the sign of the leverage change.²⁵ Thus, individual senior security price changes are predicted to be of opposite sign to the leverage change. Further, as a first approximation these price changes will be assumed proportional to percentage changes in leverage. Under these assumptions senior security price changes can be treated as functions of the percentage change in leverage and the security's price elasticity with respect to a change in firm leverage, $\epsilon_{\ell} \equiv \frac{\Delta \ell}{\ell} / \frac{\Delta L}{L}$. Substituting the senior security's price elasticity for its price change in eq. (1b), we obtain:

$$(1c) \quad \frac{\Delta S}{S} = \frac{\delta \Delta T}{S} - \epsilon_{\ell} \frac{\Delta \ell}{S} \frac{\Delta L}{L}$$

Thus it follows that common stock price changes are proportional to percentage changes in leverage and to the initial number of senior securities outstanding.

This elasticity formulation has the advantage of not requiring the often unavailable changes in market values of the firms' outstanding senior securities. Eq. (1c) also assumes that these prices can be affected not only by changes in debt claims but by changes in preferred stock claims as well, since preferred stockholders often receive new securities in reorganizations at the same time that the debtholders are not fully compensated for the claims relinquished in terms of the market values of securities received.²⁶ This formulation also assumes that leverage elasticities are approximately independent of a firm's leverage ratio.

Defining $\Delta L/L$ in terms of actual capital structure variables yields²⁷

$$(4) \quad \frac{\Delta L}{L} = \left[\frac{\Delta C}{C} - \frac{\Delta V}{V} \right] / \left[1 + \frac{\Delta V}{V} \right]$$

Now substituting eq.(3) into eq.(4) we obtain

$$(4a) \quad \frac{\Delta L}{L} = \left[\frac{\Delta C}{C} - \frac{(\delta \Delta T - \Delta A)}{V} \right] / \left[1 + \frac{(\delta \Delta T - \Delta A)}{V} \right]$$

This equation states that the percentage change in leverage is affected by the change in the market value of the firm as well as the change in senior security claims.²⁸

Since different classes of a firm's senior securities experience varying wealth transfer effects depending upon their seniority, convertibility, and covenant protection, their price elasticities will also vary. Thus the market value of a firm's senior securities \mathcal{L} is separated into major security classes comprised of short-term debt D_1 , nonconvertible debt with covenant protection against new debt issues of equal or senior priority without compensation D_2 ,²⁹ nonconvertible debt without this covenant protection D_3 , convertible debt D_4 , and preferred stock P .

G. Statistical Model

Since an efficient capital market capitalizes the effects of an unanticipated capital structure change at the initial announcement rather than at the effective date of the change, the dependent variable in eq. (1d) below is defined as the primary announcement period stock return.³⁰ After separating classes of senior securities and introducing an error term, we obtain the following statistical model of a common stock's return on the occurrence of an EO announcement:

$$(1d) \quad \text{Ret} = B_0 + \delta_1 \Delta \text{DEBT}_1 + \delta_2 \Delta \text{DEBT}_2 - \epsilon_1 D_1^* - \epsilon_2 D_2^* - \epsilon_3 D_3^* \\ - \epsilon_4 D_4^* - \epsilon_p P^* + \tilde{e}$$

where

$$\text{RET} = \frac{\Delta S}{S} \quad B_0 = \text{expected "normal" or nonannouncement return on common stock}$$

$$\Delta \text{DEBT}_1 = \frac{\Delta T}{S}, \Delta T < 0 \quad \delta_1 = \text{average firm valuation effect per dollar decrease in debt}$$

$$\Delta \text{DEBT}_2 = \frac{\Delta T}{S}, \Delta T > 0 \quad \delta_2 = \text{average firm valuation effect per dollar increase in debt}$$

$$D_i^* = \frac{D_i}{S} \left(\frac{\Delta L}{L} \right) \quad \epsilon_i = \text{price elasticity of } D_i \text{ for } i = 1, 4$$

$$P^* = \frac{P}{S} \left(\frac{\Delta L}{L} \right) \quad \epsilon_p = \text{price elasticity of } P$$

$$\Delta L/L = (\Delta C/C - (\delta \Delta T - \Delta A)/V) / (1 + (\delta \Delta T - \Delta A)/V) = \text{percentage change in leverage}$$

$$\tilde{e} = \text{stochastic error term}$$

The statistical model defined in eq. (1d) yields estimates of the valuation effects on both firm and senior securities arising from changes in a firm's debt level and leverage, respectively. The effects of these two major changes can be subdivided as follows: Firm valuation effects--(a) net tax, (b) leverage cost, (c) information; and Senior security valuation effects--(a') wealth transfers due to incomplete protective covenants, (b') wealth transfers due to weak enforcement of the "absolute priority rule" in bankruptcy/reorganization proceedings, (c') conversion rights.

Analysis of the properties of eq. (1d) shows that the model rules out tax, leverage cost, and information effects in EOs involving only common and preferred stock; and implies a relatively small leverage change resulting in a small wealth transfer effect for EOs involving only preferred stock and

debt since these EOs generally involve no change in outstanding senior claims, leaving only a firm value change to cause a leverage change. Since the average size of debt adjustment is twice as large for debt increases as for debt decreases (as seen in Table II), the average valuation effect per dollar change in debt is likely to be larger for the former.³¹ For this reason, separate estimates of δ for these two cases are specified.³² By multiplying the numerator and denominator of the dependent variable by n_s , it becomes clear that eq. (1d) involves a common denominator S that acts as a deflator for firm market value which otherwise causes large variability in the sample values and could cause serious heteroscedasticity of the error term. Additionally, a number of the independent variables are also defined in terms of ΔL , which includes as a component $\delta \Delta T$. Since δ is an unknown, estimation of eq. (1d) involves an iterative process of initially setting $\delta = .48$, the marginal corporate tax rate, and then replacing the previous values of δ by their directly estimated values $\hat{\delta}_1$ and $\hat{\delta}_2$ after each estimation. This iterative process continues until δ_1 and δ_2 converge to $\hat{\delta}_1$ and $\hat{\delta}_2$, respectively.³³

H. Model Predictions

The stock's announcement period rate of return is comprised of two components: an expected "normal" rate of return, represented by the intercept term, and the abnormal announcement effect, hypothesized to be a function of debt level change and leverage change variables.³⁴ Under our theoretical framework, this abnormal effect is composed of tax, leverage costs, and information as well as wealth transfer effects of a capital structure change. The coefficients of the debt level change variables δ_1 and δ_2 capture the sum of three effects: (1) a debt tax shield effect, predicted to be a

positive fraction less than the marginal corporate tax rate of .48, and larger for debt increases than decreases; (2) an expected leverage cost effect, predicted to be a negative value; and (3) an information effect concerning the changes in a firm's earnings prospects, predicted to be positively related to changes in the firm's debt tax shield. These firm valuation effects are measured by the two debt level change coefficients, one for debt level decreases and one for debt level increases, where the later coefficient is predicted to be larger.

The two associated wealth transfer effects are measured by the price elasticities of senior security classes' market value and the percentage changes in leverage. The major classes of nonconvertible debt are predicted to have non-positive price elasticities, with the smallest ϵ_1 being the short-term debt since it can quickly be renegotiated at an interest rate reflecting any change in its riskiness. The price elasticity of the nonconvertible protected debt ϵ_2 is predicted to be less negative than that of the nonconvertible unprotected debt ϵ_3 because these latter debt issues are of equal, rather than senior, standing to any new debt issued. Since convertible debt shares the effects experienced by common stock, its price elasticity ϵ_4 should be less negative than that of the unprotected nonconvertible debt ϵ_3 and can actually be positive.³⁵ The preferred stock's price elasticity ϵ_p can be positive or negative since it includes both convertible and nonconvertible issues.³⁶ These predictions are summarized at the top of Table III. Each of the three senior security valuation effects discussed in the previous section is measured by a specific coefficient estimate: the price elasticities of the unprotected nonconvertible debt measure (a'), the protected nonconvertible debt and short-term debt measure (b'), and the convertible debt and preferred stock measure (c'), though they can also be

affected by (a) and (b). These wealth transfer effects differ according to the type of capital structure change occurring, as described in Masulis (13).

I. Sources and Limitations of Capital Structure Data

Firms' initial capital structures are described by the pre-announcement market values³⁷ of the following security classes: common stock, nonconvertible and convertible preferred stock, short-term debt, long-term debt separated into convertible and nonconvertible and protected and unprotected categories. The principle sources for these data were the most recent quarterly and annual reports, Moody's Industrials, Utilities, Bank and Finance and Transportation manuals, EO prospectuses, and firm 10-K reports filed with the SEC. Standard and Poors' NYSE Daily Stock Record and ASE Daily Stock Record provided market prices for the firms' common and preferred stocks; the Wall Street Journal, The Bank and Quotation Record, the National Stock Summary and the National Bond Summary supplied data on the firms' senior securities; and the University of Chicago's Center for Research in Security Prices' daily stock return tape furnished rates of return for the firms' common stock. Primary announcement dates were drawn from EO prospectuses, press releases, Wall Street Journal, Wall Street Journal Index, 8-K reports, Standard & Poors Corporation Records and Moody's Industrial Manual News Reports. A summary of the protective covenants of outstanding major debt issues is generally available in the EO prospectuses.

The data used to describe firms' capital structure changes includes (a) changes in face values of long-term debt; (b) original issue discounts

and premiums on debt issued and redeemed; and (c) changes in involuntary liquidation value of preferred stock. The principle sources for these variables were the Wall Street Journal, firm press releases, Moody's News Reports, firm 8-K reports filed with the SEC, EO prospectuses and firm annual reports.

These data have a number of limitations. To the extent that any of the debt tax shield assumptions described in footnote 14 are violated, the corporate tax advantage of debt will be overstated, thus downward biasing the estimated debt level change effect.³⁸ Debt face values and preferred stock liquidation values were used when market prices were unavailable; this will generally cause a downward bias in the associated price elasticities since the securities' market values are generally less than their face values.³⁹ Offer expenses have been excluded from the model due to lack of data. Omission of this variable may be important given that these expenses averaged 4.6 percent of the market value of the securities issued in the few cases where this information was available. Since the data on firms' initial capital structures are based on balance sheet figures prepared at various points in the year prior to the EO commencement, it can be seriously outdated in a few cases.

One final but important data limitation involves the lack of any market forecast of impending capital structure changes, which forces us to assume that the market assessed the likelihood of such changes as having zero probability. If the market does have even limited predictive ability, the stock's announcement period return will only capture the impact of the unanticipated portion of the capital structure change, downward biasing the absolute value of the dependent variable and regression estimates. The subsequent statistical results should be interpreted with these data limitations in mind.

TABLE III
REGRESSION ESTIMATES OF EQ. (1d)

Independent Variables	B ₀	DEBT ₁	DEBT ₂	D ₁ *	D ₂ *	D ₃ *	D ₄ *	P*	Summary Statistics
Mean	1.000	-.026	.130	-.021	-.020	-.0006	.0001	.004	R ²
Variance	.000	.010	.023	.015	.007	.0005	.0003	.001	
Regression Coef. & Summary Stat.	B ₀	δ ₁	δ ₂	ε ₁	ε ₂	ε ₃	ε ₄	ε _p	Standard Error of Residuals
Predictions	.003	δ ₁ < δ ₂ < 0	δ ₂ < 0 > ε ₁	> ε ₁	> ε ₂	> ε ₃	< ε ₄		
Entire Sample N = 133	.002 (.011)	.27 (.083)	.36 (.059)	-.11 (.116)	-.36 (.119)	-1.15 (.261)	-.57 (.516)	.26 (.474)	.54 21.00 .00790
Stock Returns w. Market Return Subtracted Out N = 133	.002 (.011)	.26 (.081)	.35 (.058)	-.10 (.113)	-.39 (.116)	-1.22 (.468)	-.53 (.503)	.39 (.463)	.55 22.44 .00759
Oversubscriptions and Cash Distri- butions Excluded N = 119	-.006 (.011)	.23 (.081)	.35 (.066)	-.22 (.113)	-.31 (.139)	-1.00 (.464)	-.44 (.548)	.70 (.493)	.55 16.38 .00686
Recapitalizations Excluded N = 119	-.001 (.012)	.24 (.086)	.39 (.068)	-.08 (.124)	-.39 (.144)	-1.27 (.512)	-.57 (.544)	.26 (.536)	.55 19.20 .00831
Stock Returns of Opposite Sign to Leverage Δ Excl. N = 120	-.001 (.011)	.26 (.081)	.45 (.061)	-.07 (.120)	-.37 (.119)	-1.18 (.473)	-.47 (.525)	.17 (.536)	.60 24.44 .00732

Note: The standard errors appear in parentheses below the estimated coefficients.

III. MODEL ESTIMATION AND HYPOTHESIS TESTING

A. Initial Model Estimation

The first row of parameter estimates in Table III is based on the entire sample of 133 EOs using ordinary least squares. Note the close correspondence between the size and relative magnitudes of the estimates and the model predictions.⁴⁰ The regression coefficients associated with the two debt level change variables are both positive and statistically significant, as predicted, with the increasing debt coefficient exceeding the decreasing debt coefficient. Interestingly the t statistic for the difference between the two debt coefficients is not statistically significant.⁴¹ Estimated price elasticities of the non-convertible protected and unprotected debt are, as predicted, negative and statistically significant at the 5 percent level. The short-term debt was the only variable predicted to have a nonzero regression coefficient which was statistically insignificant; however, this is also the price elasticity predicted to have the smallest magnitude of all the nonconvertible issues.

Overall, the model explains a large portion of the variation in common stock announcement period returns, as indicated by a coefficient of determination of .54. The model's F statistic is also highly significant.⁴² It should be recognized that if the capital structure change is partially anticipated, the magnitudes of these estimated effects will be understated even though their relative sizes will be unaffected.

The most notable properties of the parameter estimates are (a) the positive and statistically significant debt level change coefficients, and (b) the large price elasticity of the unprotected nonconvertible debt relative to the elasticities of the protected nonconvertible and convertible debt.⁴³ The first result is consistent with our model of optimal capital structure where there are tax plus

leverage cost and information effects of debt level changes. The second result is consistent with leverage induced wealth transfers associated with incomplete protective covenants.

B. Alternative Model Estimates

In order to assess the regression coefficients' stability, the model was reestimated using alternative sample criteria and another definition for the dependent variable, yielding the results which follow. If common stock announcement period returns are affected by varying market-wide effects, subtracting out the market return (which assumes the stocks' betas equal one) should improve the model's accuracy. In this formulation, the estimated intercept is predicted to be zero. The results of carrying out this regression are shown in the second row of estimates in Table III and are essentially identical to those in row one, although the summary statistics appear slightly improved. Again, the intercept is not statistically different from zero.

The sample includes EOs with cash distributions less than 25 percent of the value of the securities issued. Since any cash distribution involves an asset structure change, inclusion of these observations could induce misspecification bias. The sample also includes a few oversubscribed EOs, where it is likely that post-announcement EO premiums exist. Since this is inconsistent with eq. (1), the model could be misspecified for this subsample. To avoid these potential misspecification problems, the model was reestimated excluding these EOs, yielding the third row of estimates in Table III. A comparison with the previous cases indicates little change in coefficient magnitudes or statistical significance, except that short-term debt price elasticity has become larger in magnitude and statistically significant. Thus including these EOs appears to introduce no significant bias in the estimates. Further, in comparing the summary statistics, the decreased number of observations causes little loss in the model's explanatory power. An additional check for model misspecification error consisted of dropping the remaining 13 recapitalizations to assess

whether these events impart economically different effects on these firms' securities. Given the slight change in the magnitude or statistical significance of the model estimates presented in the fourth row of Table III, recapitalizations don't appear to differ from pure EOs in their effects on the prices of the firm and its securities.

Although the model predicts that leverage increases cause positive and leverage decreases cause negative common stock returns, 13 of the 133 EOs did not conform to this qualitative prediction. Studying the omitted observations for any patterns which would suggest model misspecification uncovered no obvious commonality. Inaccurate announcement dates and/or prior insider information leaks most likely caused these anomalous announcement returns. If so, these 13 observations reflect large errors (of both positive and negative sign) in the dependent variable, which decreases the efficiency of the estimates. Thus the regression equation was reestimated excluding these observations. Care should be taken in interpreting this regression's coefficient of determination since it must be higher than in the previous cases by construction.

Estimation of eq. (1d) with the refined sample yields the fifth row of estimates in Table III. Overall, the model explains a large portion of the announcement return's variance as indicated by the increase in the coefficient of determination to .60. The signs of the estimated coefficients are again consistent with the model predictions and the coefficients of the debt level change variables and the price elasticities of the long-term nonconvertible debt issues are significant at the 5 percent level. In contrast to the earlier estimates, the estimated coefficient of .45 associated with debt increases is substantially larger than the previous estimates. However, the difference in the two debt level change coefficients is again statistically

insignificant. Since part of the capital structure change is likely to be anticipated by the market, these estimated debt level change effects should be viewed as lower bounds for their actual size.

In summary, exclusion of announcement period market returns, small cash distributions, recapitalizations, and a small number of EOs with apparent errors in announcement dates cause no significant effect on the signs and relative magnitudes of the parameter estimates. This evidence indicates that these estimates are robust to limited changes in sample size and composition.

IV. CONCLUSION

This paper studied the valuation effects of leverage altering capital structure changes. Issuer exchange offers and recapitalizations were analyzed because they do not involve simultaneous asset structure changes (in the form of cash inflows/outflows). A linear model was developed to estimate firm valuation effects from stock announcement returns and actual capital structure changes, and then was estimated using ordinary least squares. The result was a statistically significant regression equation having parameter estimates consistent with model predictions and explaining more than half the cross-sectional variation in stock announcement returns.

Evidence was obtained indicating that (1) changes in stock prices are positively related to leverage changes; (2) changes in nonconvertible senior security prices are negatively related to leverage changes; (3) the magnitude of leverage induced nonconvertible senior security price changes is substantially greater when leverage changes involve senior securities of equal or greater seniority to those outstanding; (4) changes in firm values are positively related to changes in firm debt level; (5) lower bound estimates of

the firm valuation effect per dollar change in debt were found to be in the range of .23 to .45. This evidence was shown to be consistent with tax based models of optimal capital structure and leverage induced wealth transfers across security classes as well as with information effects concerning firm value which are positively related to changes in firm debt level.

FOOTNOTES

¹See, for example, Modigliani-Miller (16, 17), Kraus-Litzenberger (10), Scott (19), Miller (14), and DeAngelo-Masulis (5).

²There can be many alternative motivations for, and constraints against, exchange offers based on the specific feature of management's security holdings in the firm, management's labor contracts and senior securities' protective covenants, as explained in Jensen-Meckling (9) and Smith-Warner (21).

³This study uncovered no evidence of other simultaneous changes in investment decisions.

⁴If there is more than one type of EO, the direction of the leverage change induced by the offer types must be the same. This excludes, e.g., joint offers to common stockholders and debtholders to exchange their security holdings for new preferred stock.

⁵Thus announcements of new issues, redemptions or repurchases of securities, mergers, acquisitions, spinoffs, major new investments, major discoveries, new patents, and large changes in net income which exceeded 25 percent of the value of the securities tendered in the offer, as well as announcements of changes in dividend policy, attempts to go private, and impending bankruptcy which were made within one week of the EO announcement disqualified these offers from the sample.

⁶Criteria (c), (d) and (e) disqualified 38, 13, and 53 EOs, respectively. Even after "passing" this screening process, an EO must still be considered an approximation to a pure capital structure change since, in almost every case, claims to fractional shares of new securities were paid in cash, and 14 EOs in our sample did involve "small" (i.e., less than 25 percent of the new issued securities' value) cash distributions.

⁷In no case was there both a terms announcement and a revision in terms announcement.

⁸For this study the minimum description of a new security required a statement of the conversion rate if applicable, the dividend rate and involuntary liquidation value for preferred stock, and the interest coupon and maturity date for debt.

⁹The commencement and expiration dates are considered immaterial given the short average time intervals between the initial announcement and offer commencement and between commencement and expiration: the means are 8 and 7 weeks with standard deviations of 8 and 6 weeks, respectively. Masulis (12) presents evidence that the two primary announcements capture most of the information associated with EOs.

¹⁰Following the standard test for the difference in means described in Masulis (13), t statistics of 11.187 and 6.329 were obtained. Note that terms announcements follow rather vague initial EO announcements, offers which have a higher likelihood of cancellation. Thus, the significant terms announcement period return does not imply a trading rule profit opportunity.

¹¹For leverage changes in either direction, the announcement periods exhibit abnormally large common stock portfolio daily returns of the same sign as the leverage change (unadjusted for the contemporaneous market return). The last column of Table II displays average announcement returns by direction of leverage change.

¹²This assumption is consistent with the small number of full and over-subscriptions. In fact, only sixteen EOs in the entire sample were not under-subscribed. In these few cases, the market value of the securities issued is likely to exceed the market value of the securities redeemed. Consequently, the model estimates will be checked for sensitivity to the inclusion of these observations.

¹³The ΔA term enters positively since it decreases the size of the change in the value of senior securities directly caused by the EO, ΔA_n .

¹⁴The following conditions are sufficient for the market value of the change in firm's interest tax shield to equal $\tau_c \Delta D$: (i) the debt tax shield can always be fully utilized to decrease corporate taxes, (ii) the debt is strictly non-convertible, and (iii) the debt is expected to be permanent.

¹⁵In EOs of debt for outstanding equity, equityholders can also incur a capital gains liability by tendering their equity just as if they had sold their stock for cash. Furthermore, if the investor then holds 80 percent or more of the shares or voting control which he initially held, this repurchase of stock is likely to be treated as a cash dividend under Section 302 of the Internal Revenue Code.

¹⁶This revision implies that prior to 1969 the original issue discount tax shield was equal to the difference between the face value and market value of the new debt issue, $\Delta C - \Delta D$, while after 1969 it is generally less than this difference (ignoring new debt issues having small original issue discounts or premiums which are treated as debt issued at par by the IRS). See Section 368(a)(1) of the Internal Revenue Code for a more detailed discussion of this issue.

¹⁷To derive the discount rate on the annualized portion of the original issue discount under the debt tax shield assumptions stated in footnote 14, recognize that the valuation formula for the perpetuity with an infinite annual payment stream of I is $D_0 = I/i_D$. So the discount rate is equal to the annual interest payment per dollar of newly issued debt $i_D = I/D_0$. Since debt interest is generally paid semiannually, the annual debt interest rate is derived from the semiannual compounded rate:

$$i_D^* = \left[\left(1 + \frac{1}{2} I/D_0 \right)^2 - 1 \right]$$

¹⁸See DeAngelo-Masulis (6) for a rigorous proof of the irrelevance proposition and an analysis of its limitations.

¹⁹DeAngelo-Masulis derive this debt optimality condition in a one-period model assuming investor risk neutrality, homogeneous expectations about state probabilities, and the inability of corporations to costlessly transfer excess tax shields to other corporations or other periods.

²⁰Under this hypothesis, management is not motivated to release inside information nor to undertake expensive information validation procedures, as Ross (18) and Spence (22) argue. Instead management can be indifferent or opposed to information releases but finds it too costly to avoid. Vermaelen (23) has recently reported empirical evidence supportive of the Spence hypothesis in a study of issuer tender offers which are often debt financed.

²¹Another way to see that a debt change does not imply a decrease in after-tax earnings and a positive tax minus leverage cost effect is to realize that the earnings decline information also implies the existence of a costly excess tax shield.

²²Over 30 percent of the EOs involved firms with at least one debt issue rated below single A, and many smaller firms had only unrated debt issues.

²³This rule states that in any plan of reorganization, beginning with the most senior class, each class of claimants "in descending rank must receive full and complete compensation for the rights surrendered before the next class below may properly participate" (Collier on Bankruptcy (4), pp. 613-617). For further discussion of this legal issue, see Blum (2) and Blum-Kaplan (3). For further exposition of the wealth transfer hypothesis, see Fama-Miller (7, pp. 128-181), Galai-Masulis (8, pp. 64-66), and Masulis (13).

²⁴Market prices of convertible preferred stock and debt can be positively related to the change in outstanding senior claims due to the effects on the values of the conversion rights.

²⁵Preferred stock-debt EOs are an exception since the terms of exchange generally involve the issuance or redemption of \$1 of debt per \$1 of preferred stock liquidation value, implying no change in leverage as defined in this paper. However, these offers can cause wealth transfers primarily between the debt and preferred stockholders where the wealth gain is realized by the security class whose claims are reduced.

²⁶However, these debtholders do receive securities of equal face value to the claims relinquished. See Altman (1) for evidence on the frequency of this type of outcome in corporate reorganizations.

²⁷Proof:

$$\begin{aligned}C &= VL \\ \Delta C &= (\Delta V)L + (\Delta L)V + \Delta L\Delta V \\ \Delta L(V + \Delta V) &= \Delta C - (\Delta V)L \\ \frac{\Delta L}{L}(V + \Delta V) &= \left[\frac{\Delta C}{C} - \frac{\Delta V}{V} \right] V \\ \frac{\Delta L}{L} &= \left[\frac{\Delta C}{C} - \frac{\Delta V}{V} \right] / \left[1 + \frac{\Delta V}{V} \right]\end{aligned}$$

²⁸Note that the δ term in (4a) must be estimated.

²⁹At the time of the EO, some sample firms had outstanding debt issues which were not protected against dilution of their prior claims on the firm's assets through issuance of new debt. Masulis (13) analyzed the EO announcement effects on portfolio daily returns of debt issues, and found larger announcement price impacts on portfolios of "unprotected" debt than on "protected" debt issues.

³⁰Implicit in this substitution are the assumptions that (i) information released in the primary announcement period is sufficient for the market to accurately predict the ultimate capital structure change; (ii) the market considers the announced change a permanent one (or sufficiently permanent to generate real effects); (iii) other significant information about the firm is not being simultaneously released; and (iv) the capital structure change information is concentrated in the primary announcement period. The 4th assumption implies minimal pre-announcement information leakage and little impact on the market's forecast of the ultimate capital structure change arising from the information released in secondary EO announcements. In fact, no pattern was observed of other changes in the firm asset or capital structure in the year prior to or following the EO.

³¹In all these regressions, the debt level change coefficient should be interpreted as the sum of the large marginal benefits derived as the firm begins to shift from a very nonoptimal capital structure to the small marginal benefits as the firm attains its more optimal position, averaged over the total change in debt. Over the sample period 1963-1978, the statutory corporate tax rate varied between 48 to 52 percent, changes in allowable tax deductions occurred, and over part of the period a personal income tax surcharge was imposed. These tax code changes imply that the expected marginal value of a dollar of debt tax shield may not have been strictly stationary over the estimation period.

³²Very similar parameter estimates were found when the regressions reported in Table III were reestimated with a single debt level change coefficient.

³³When $|\delta - \hat{\delta}|$ is less than .005, the process is assumed to have converged. A more direct but costlier estimation technique would involve using standard nonlinear methods. Using ordinary least squares can cause misstated standard errors.

³⁴The intercept B_0 represents the average two-day stock return for a non-announcement period. Assuming the Sharpe-Lintner (20) (11) CAPM, an average stock beta of one, a two-day market return of .3 percent (based on an estimate of the SP 500 over the comparison period), and a two-day riskless return of approximately zero, we obtain an estimate of .3 percent for B_0 .

³⁵Vested but unfunded pension rights are treated as senior liabilities (protected nonconvertible debt) since the passage in August 1974 of the Employees Retirement Investment Security Act (ERISA). Prior to 1974 they were considered unsecured subordinated liabilities (unprotected convertible debt).

³⁶The positive announcement returns for convertible debt observed in Masulis (13) suggest that convertible debt's elasticity is positive on average.

Masulis' (12) analysis of EO announcement rates of return for convertible preferred stock indicates that the issues experience the same effects as nonconvertible preferred stock on average, but to a lesser degree. There were not enough preferred stock issues to allow separate estimates of convertible and nonconvertible.

³⁷The trading day prior to the initial EO announcement.

³⁸Prior to the Accounting Principles Board (APB) Opinion No. 8, "Accounting for the Cost of Pension Plans" (issued in 1966), public disclosure of vested but unfunded pension liabilities was not required and consequently not always available.

³⁹If the market price of an issue of outstanding senior securities was unavailable on day -1, the most recent price up to 20 trading days prior was substituted. If no prices were available, the price of one or more other issues of securities of the same class was substituted. When issues of the same class were unavailable, a debt issue's face value was used and a preferred stock's involuntary liquidation value was used. The market value of short-term liabilities was assumed to be equal to the face value in every case.

⁴⁰As in all the estimated regressions, $\hat{\delta}_1$ and $\hat{\delta}_2$ rapidly converged to δ_1 and δ_2 .

⁴¹Given that the two debt level change variables are orthogonal by construction, the standard error of the difference of the two coefficients is equal to the square root of the sum of the two squared standard errors, i.e., .89.

⁴²To assess the economic significance of the independent variables, multiply the regression coefficients by the mean values of the independent variables as they enter eq. (1d) to obtain:

$$\begin{aligned} \text{Ret} &= B_0 + \hat{\delta}_1 \Delta \overline{\text{DEBT}}_1 + \hat{\delta}_2 \Delta \overline{\text{DEBT}}_2 - \hat{\epsilon}_1 \overline{D}_1^* - \hat{\epsilon}_2 \overline{D}_2^* - \hat{\epsilon}_3 \overline{D}_3^* - \hat{\epsilon}_4 \overline{D}_4^* - \hat{\epsilon}_p \overline{P}^* \\ .054 &= .003 + (.27)(-.026) + (.36)(.130) - (-.11)(+.021) - (.36)(+.020) \\ &\quad - (-.15)(+.006) - (-.57)(-.001) - (2.6)(-.004) \\ .054 &= .003 - .007 + .047 + .002 + .007 + .001 - .000 + .001 \end{aligned}$$

This implies that the net wealth redistribution effect explains 20.4 percent of the stock returns' mean value.

⁴³More complicated model specifications involving greater disaggregation of senior security classes were considered. However the additional price elasticity estimates were generally not significantly different from zero, nor did these specifications yield any significant improvement in the overall explanatory power of the model.

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