The Effect of Market Timing Based on Share Prices and Interest Rates on Capital Structure in the Twentieth and Twenty-First Centuries

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Abstract

Kayhan and Titman (2007) develop a comprehensive model attempting to account for the most prevalent explanations for the capital structure choice. Over the period from 1967 to 2003, they provide considerable evidence of economically significant choices consistent with trade off theories, and pecking order behavior. However, their main interest is in testing for market timing decisions by managers. They develop measures of yearly and long-term market timing, and show that managers requiring external funds tend to issue stock when the market-to-book ratio is high.

I replicate Kayhan and Titmans' methodology and extend it into more recent decades. My central contribution is to explicitly model whether managers time interest rates and issue debt when yields are low. I produce two measures of market timing based on Kayhan and Titmans' approach, where I interact a firm's financial deficits with T Bill yields.

I confirm Kayhan and Titmans' result that managers needing to raise external capital are more likely to issue stock if their firm's market-to-book ratio is high using their time horizon. But, when I extend their methodology further into the future, I can no longer confirm such behavior in the twenty-first century. When I add my terms for market timing based on T Bill yields, I find consistent evidence that managers do issue debt when rates are low, though the behavior is less economically significant in the twenty-first century. So, there is much weaker evidence of marketing timing by managers based on both share prices and interest rates in recent decades.

EFMA Classification Codes: 140, 230, 120, 570

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1. Introduction

I replicate and extend an important study by Kayhan and Titman (2007) that focuses on market timing behavior by managers when raising external capital. In their comprehensive modeling they try to jointly account for the most prevalent explanations the capital structure choice. They provide considerable evidence of economically significant corporate choices consistent with trade off theories, and also with pecking order behavior. However, their main interest is in testing for market timing actions by managers. They extend the earlier efforts of Shyam-Sunder and Myers (1999), Baker and Wurgler (2002) and Frank and Goyal (2003). Shyam-Sunder and Myers propose a financial deficit measure to exam how firms raise capital in years when they require external financing. Baker and Wurgler interact the financial deficit measure with firms' market-to-book ratios and provide evidence that managers tend to issue equity when they need outside funding and their share prices are high. Kayhan and Titman disaggregate the measure of Baker and Wurgler into two components, that they dub yearly and long-term timing. The yearly timing measure is the covariance of a firm's financial deficits with the market-to-book ratio over the most recent and five previous years, and long-term timing is the product of the average of the two terms over that period. They confirm that managers needing external funds tend to sell stock when the market-to-book ratio is high in the period from 1967 to 2003. Both of their timing measures are statistically significant, but the economic significance of the long-term timing measure is somewhat higher.

I reproduce Kayhan and Titmans' methodology and extend it into more recent decades. My central contribution is to explicitly model whether managers time interest rates and issue debt when yields are low. I produce two measures of interest rate timing based on Kayhan and Titmans' methodology, where I interact the financial deficits with T Bill yields.

I confirm their strong, economically significant findings that firms tend to move toward target capital structures over the five-year period, which is consistent with trade-off theories of capital structure. Profitability is negatively correlated with debt issuance, as suggested by the pecking order theory, where managers with insufficient internal funds turn to bonds for external financing. I also confirm a negative relationship between historical stock returns and leverage as suggested by Welch (2004). My major difference with Kayhan and Titmans' results is that financial deficits are not statistically related to debt issues, though the relationship has strong economic explanatory power for firms with positive deficits. The most interesting result is when I extend their modeling into the twenty-first century, then I can no longer confirm that managers are timing the market based on their firms' market-to-book ratios.

My major contribution is to develop yearly and long-term market timing measures based on T Bill yields to explicitly examine whether managers issue debt when they require external funds and interest rates are low. I provide strong evidence that managers tend to issue debt when treasury yields are low, and this relationship holds throughout the entire sample period. However, the economic significance is much higher in the tweny-first century than the twentieth.

Overall, I supply significant support for market timing based on both the market-to-book ratio and interest rates in the twentieth century. But, in the twenty-first century these relationships are much weaker. In the later period, there is no longer convincing evidence of timing that depends upon stock prices and the timing based on T Bill yields is much less economically significant.

The remainder of the paper is arranged as follows. In the next section I summarize the literature on capital structure theory and evidence in support of the propositions. I then explain Kahyan and Titmans' methodology and hypotheses and my extensions of their modelling. In the fourth section, I describe the collection of data and present the univariate statistics for the sample. Next, I present statistics on the historical evolution of stock prices, interest rates and security issuance, and show the correlation between these measures. I discuss the empirical results in section 6. Finally, I summarize my findings and present conclusions.

2. Capital Structure Theory and Evidence

Kahyan and Titman (2007) undertake a detailed study of competing capital structure theories. Their methodology is based on prior work by Shyam-Sunder and Myers (1999), Baker and Wurgler (2002) and Frank and Goyal (2003). In their modeling, Kahyan and Titman try to simultaneously capture elements of three widely discussed theories of capital structure.

The earliest approaches to explain capital structure are based on trade-off theories. Robichek and Myers (1966) proposed the static trade-off theory, which evolved out of arguments about the works of Modigliani and Miller (1958, 1963). Robichek and Myers suggest that there is a trade-off between the value of the tax shield created by the tax deductibility of interest payments and potential costs of bankruptcy. The other widely-discussed trade-off theory involves agency conflicts within a firm. Jensen and Meckling (1976) argue that managers prefer to employ equity financing, which provides them with a free-hand to consume perquisites and build internal empires. On the other hand, Jensen (1986) and Stulz (1990) contend that increasing debt in the capital structure can help to overcome some of these problems and discipline the managers. But, higher leverage tempts stock holders to exploit their limited-liability to the detriment of bondholders. So, the optimal capital structure is a trades-off among the agency costs among manages, stockholders and bondholders. Leary and Roberts (2005) and Hennessy and Whited (2005) provide support for the notion that firms move, perhaps slowly, toward a target capital structure.

The second major argument about capital structure choice is the pecking order theory proposed by Myer (1984), which focuses on floatation cost of securities in primary markets. Myers notes that retained earnings are the least expensive source of capital, so managers should finance new investments up to the limit of these internally generated funds. If more capital is

required, managers should first resort to debt financing, because bonds are much less expensive to issue than equity. A firm should only sell stock to finance new ventures as a last resort, because of the higher floatation costs of equity. Myers and Majluf (1984) also note that in the presence of information asymmetry, stock plaements signal corporate weakness and bond issues signal strength. They provide significant evidence that share prices decline following primary market equity issues and rise when firms issue bonds.

Several important studies compare the pecking order and trade-off theories. Shyam-Sunder and Myers (1999) follow firms for ten years after their initial public offering (IPO), and present evidence supporting pecking order behavior. However, their use of such a lengthy time horizon results in a very small sample. Frank and Goyal (2003) fail to confirm the strength of the pecking order results for all types of firms. They find that large companies seem to exhibit behavior that is consistent with the pecking order, but that small growth firms do not. Fama and French (2002) find that more profitable firms tend to employ lower leverage, suggesting that they finance growth with retained earnings, which is consistent with the pecking order theory. Like Frank and Goyal (2003), Fama and French (2002) and De Jong, Verbeck and Vermijmeren (2010) find that the pecking order predictions do not hold for the smaller growth firms.

The third major theory of capital structure is market timing, where the choice to issue equity is driven by market conditions. When stock prices are high firms should raise capital through equity issues. Numerous studies provide evidence that firms execute secondary market stock issues when share prices are high: Taggart (1977), Marsh (1982), Asquith and Mullins (1986), Korajczyk, Lucas and MacDonald (1991), Jung, Kim and Stulz (1996) and Hovakimian, Opler and Titman (2001). While Loughran and Ritter (1995), Pagano, Panetta and Zingales (1998) and Alti (2006) find that incidents of IPO increase when share prices are high. The work

by Baker and Wurgler (2002) is an important attempt to control for the actual financing requirements of firms, and how they respond to these shortfalls. They analyze timing behavior in the period following a firm's IPO. They interact the financial deficit measure with firms' market-to-book ratios and provide evidence that managers tend to issue equity when they need outside funding and their share prices are high. However, Leary and Roberts (2005) and Hovakimian (2006) both suggest that this evidence of timing is transitory, and that market-to-book ratios are more likely to reflect investment opportunity sets instead of over-priced equity.[1] Kayhan and Titman (2007) develop a more general framework, which is not dependent on following an IPO. They examine the choices of firms over five-year periods. They also disaggregate Baker and Wurglers' timing measure into two components, the yearly and long-term timing measures. Kayhan and Titman present evidence supporting the effect of marketing timing behavior on firms' capital structures. Dong, Loncarski, Horst and Veld (2012), employ Canadian data, and find that the level of financial constraint impacts market timing choices, where managers of constrained firms are unable to raise capital through equity issues when their stock prices are high.

While most of the academic research on market timing has focused on stock placements, there is a long-standing popular presumption that firms are more likely to issue debt when rates are low. Taggart (1977), Marsh (1982) and Barry, Mann, Mihov and Rodriguez (2009) provide evidence of high levels of debt issues when rates are low by historical standards. Popular press articles by Zeiler (2011), Chemey (2014), Platt and Renninson (2015) and in *Money News* (2012)

[1] There is also some interesting international evidence that market timing has, at best, a fleeting impact on capital structure choice. Mendes, Kayo and Basso (2005), Hőgfeldt and Oborenko (2005), and De Bie and De Haan (2007) fail to confirm market timing behavior in single-county studies of Brazil, Sweden and the Netherlands respectively. Bruinshoofd and De Haan (2012) also cannot verify the effects of timing efforts on capital structure in the UK or in continental European countries. Dong, Loncarski, Horst and Veld (2012), who study Canadian firms, make an interesting argument that equity ownership is more concentrated outside of the United States, making it difficult to profit from market imperfections when making secutity issues.

note that in the years after the "great recession" in 2007 and 2008, American corporations issued record amounts of debt in response to sustained and extraordinary low interest rates.

3. Modelling and Hypotheses

A financial deficit measure is central to the earlier work of Shyam-Sunder and Myers (1999), Baker and Wurgler (2002) and Frank and Goyal (2003). The variable captures all new external financing by a firm over some period, which is the sum of new equity and debt issues. These authors use this measure to test the pecking order and market timing theories, it is important because they wish to confirm whether a firm issues equity in years when it needs external funding and its stock price is high.

To calculate the financial deficit, Baker and Wurgler define the book value of equity as the value of assets minus liabilities and preferred stock[2], and then they also treat the values of convertible debt and deferred taxes as equity accounts. The definition of the book value of debt is then the value of assets less the figure above for the book value of equity. New debt financing is defined as the one-period change in the value of debt. New equity financing is the one-period change in the defined book value of equity minus the change in retained earing over the same period.

Baker and Wurgler use the financial deficit variable (FD) to develop a market timing measure to show whether a firm raises equity capital in a year when it's market-to-book ratio (M/B) is high and it requires external funding. Kayhan and Titman (2007) make an advance upon their variable by breaking it into two components, the yearly timing and long-term measures. Their measures are taken over a period from the current year to the five prior years. Yearly timing is defined as:

[2] If the value of preferred stock (PSTK) is not reported in Compustat, I use the redemption value of preferred stock (PSTKRV) when available. If neither value is reported, I set the value of preferred stock to $0.

Yearly Timing (YT M/B)= $[(\sum_{s=0}^{t-1} FD_S * M/B_s)/t] - \left(\overline{FD} * \overline{M/B}\right) = \widehat{cov}(FD, M/B)$

This is essentially the covariance between the financial deficit variable and the market-to-book ratio over the period. This measures the extent to which a firm raises capital when it needs outside financing and its market-to-book ratio is high compared to recent years. The long-term timing measure is defined as:

Long-Term Timing (LT M/B)= $[(\sum_{s=0}^{t-1} M/B_s)/t) * (\sum_{s=0}^{t-1} FD_S)/t)] = \left(\overline{FD} * \overline{M/B}\right)$

Which is the product of the averages of the financial deficit measure and the market-to-book ratio over the current and five prior years. Kayhan and Titman argue this long-term measure is closer to a test of the pecking order as suggested by Shyam-Sunder and Myers (1999) and Frank and Goyal (2003), where managers act as though their cost of equity capital is inversely related with their market-to-book ratio. This encourages managers to raise capital with equity instead of debt if the market-to-book ratio is high enough.

I extend Kayhan and Titmans' modeling approach, by including two additional market timing measures to explicitly test whether managers requiring external funding tend to raise capital by issuing debt when interest rates are low. I use T Bill yields (T Bill) as my proxy for the interest rate environment. For the T Bill rate for each observation, I calculate the mean of the twelve-monthly T Bill rates corresponding to the firm's fiscal year. I then develop market timing variables along the line employed by Kayhan and Titman. My measure of yearly timing based on T Bill rates for is:

Yearly Timing (YT T Bill)= $[(\sum_{s=0}^{t-1} FD_S * T\ Bill)/t] - \left(\overline{FD} * \overline{T\ Bill}\right) = \widehat{cov}(FD, T\ Bill)$

And, the long-term timing measure is defined as:

Long-Term Timing (LT T Bill)= $[(\sum_{s=0}^{t-1} T\ Bill)/t) * (\sum_{s=0}^{t-1} FD_S)/t)] = \left(\overline{FD} * \overline{T\ Bill}\right)$

After calculating the financial deficit and timing measures for each observation, Kahyan and Titman use a two-stage approach in their testing. In the first-stage, they estimate an equation

to determine the target leverage for each firm-year. Then, in the second-stage, they test how their explanatory variables are related to the firms' change in leverage over a five-year period.

They employ the following equation to estimate target leverage in the first-stage:

$$L_t = \alpha + \beta_1 M/B_{t-1} + \beta_2 PPE_{t-1} + \beta_3 EBITD_{t-1} + \beta_4 R\&D_{t-1} + \beta_5 R\&D\ NR_{t-1} + \beta_6 SE_{t-1} + \beta_7 SIZE_{t-1} + \Sigma\delta\ Indust + \varepsilon_t$$

Previous research suggests that these independent variables describe much of a firm's capital structure choice. The dependent variable, L_t, is the firm's book-value debt to asset ratio, where the definition of debt is given above. All of the explanatory variables are lagged one year (t-1). M/B is the market-to-book ratio, which is a proxy for the firm's investment opportunity set. Following Baker and Wurgler (2002), I drop firms with market-to-book ratios greater than ten. PPE is net property, plant and equipment scaled by total assets, which is a proxy for asset tangibility. EBITD is earnings before interest and taxes and after depreciation scaled by total assets, which is the proxy for firm profitability. R&D is research and development expenses scaled by sales, and R&D NR is a dummy variable set to one for firms that do not report R&D. SE is selling expenses scaled by revenues. SIZE is the natural log of sales. The Indust are a set of dummy variables based on the Fama French fifty industry categorization. I employ a Tobit model where predicted values are restricted to a range between zero and one. The variables M/B, EBITD, SE and R&D are traditionally negatively correlated with financial leverage, and PPE, SIZE and R&D NR are expected to be positively related.

I use a broad sample of firms over my aggregate period from 1967 to 2022 to estimate the target leverage using their specification. All firms with assets less tha $10M are dropped from the sample. I eliminate all firms that have book-value leverage ratios less than zero or greater than one. I cull all firms with a market-to-book ratio greater than ten. I also winsorize

the ratio of EBIT to assets at the upper and lower 1%, and the ratios of selling expenses and R&D to revenues at the upper 1%. To eliminate outliers, I conduct a preliminary OLS regression, and remove all observations that have residuals with a Cook's D value higher than one, and/or an R-Student value with an absolute value greater than three.[3] After these adjustments, the sample contains 165,459 firm-year observations.[4]

The second-stage model that Kahyan and Titman (2007) use to test their hypotheses is

$$\text{Chng Lev}_{t,t-5} = \alpha + \lambda_1 \text{FD}_{t,t-5} + \lambda_2 \text{FD Pos}_{t,t-5} + \beta_1 \text{YT M/B}_{t,t-5} + \beta_2 \text{LT M/B}_{t,t-5} + \mu_1 \text{Log Stk Ret}_{t,t-5} + \mu_2 \text{EBITD}_{t,t-5} + \mu_3 \text{Lev Def}_{t-5} + \mu_3 \text{Chng Target}_{t,t-5} + \Sigma\delta \text{ Indust} + \varepsilon_t$$

The subscripts, t,t-5, indicate that the variables are averages or changes from five years prior to the present year. The dependent variable, Chng Lev, is the change in the leverage ratio, the book value of liabilities to assets, over the five years. FD is the average of the external financial deficit measure through the period. FD Pos is the product of FD and a dummy variable set to one when FD is positive. YT M/B, the yearly timing measure based on the market-to-book ratio, is the covariance between FD and the market-to-book ratio during the period. LT M/B, the long-term timing measure, is the product of average FD and average market-to-book ratio. Log Stk Ret is the natural logarithm of one plus the five-year cumulative stock return. EBITD is the sum of earnings-before-interest-and-taxes and before depreciation scaled by the sum of the book values of debt and equity. Lev Deficit is the difference between leverage and target leverage at year t-5. Chng Target is the difference between target leverage between t-5 and t. Indust is a set of industry dummy variables based on the Fama-French fifty industry classification.

Kahyan and Titman predict that the financial deficit measure, particularly when it is positive, should be positively correlated with the change in leverage. This would support the

[3] See Welsch (1980) for more details on these procedures.
[4] This sample is considerably larger than that used to test the second-stage equations, mainly because in this specification, firms are not required to have a minimum of six consecutive observations.

pecking order theory. Market timing stories suggest that firms should issue equity when the market-to-book ratios are high, so the timing measures should be negatively related with the dependent variable. They argue that their yearly timing value is a better indicator of timing behavior than Baker and Wurglers' measure. The long-term stock return should also have a negative parameter estimate because Welch (2004) notes that the portion of equity in leverage should increase as share prices rise.[5] If firms move toward their target leverage. the leverage deficit measure should be negatively related to the change in leverage. And, if the target leverage increases over the five years, the change in the target should be positively related to the dependent variable.

To test for explicit evidence of market timing based on the levels of interest rates, I add my measures of timing based of the relation of the financial deficit with T Bill rates to their model as follows

$$\text{Chng Lev}_{t,t-5} = \alpha + \lambda_1 \text{FD}_{t,t-5} + \lambda_2 \text{FD Pos}_{t,t-5} + \beta_1 \text{YT M/B}_{t,t-5} + \beta_2 \text{LT M/B}_{t,t-5} + \beta_3 \text{YT T Bill}_{t,t-5}$$
$$+ \beta_4 \text{LT T Bill}_{t,t-5} + \mu_1 \text{Log Stk Ret}_{t,t-5} + \mu_2 \text{EBITD}_{t,t-5} + \mu_3 \text{Lev Def}_{t,t-5}$$
$$+ \mu_3 \text{Chng Target}_{t,t-5} + \Sigma\delta \text{ Indust} + \varepsilon_t$$

Where YT T Bill, the yearly timing measure based on the T Bill yield, is the covariance between FD and the T Bill yield during the period. LT T Bill, the long-term timing measure, is the product of average FD and average T Bill yield. If managers are timing debt issues based on changes in interest rates, these measures should be negatively correlated with changes in leverage.

4. Data and Univariate Statistics

[5] The effect should be more pronounced when using a market-price measure of leverage than one based on book-value.

I collect the annual accounting data from the Compustat database until 2022. The data on stock returns are derived from CRSP. Monthly Treasury Bill rates are taken from the database of the Federal Reserve Bank of St. Louis.

Following Kayhan and Titman (2007), I eliminate firms from regulated industries and the financial sector (SIC codes 4000-4999 and 6000-6999 respectively). Firms with a value of assets less than $10M are also culled. And observations with market-to-book ratios greater than ten are eliminated. Firms with book value measures of leverage greater than one are also removed.[6] In Kayhan and Titmans' methodology, a firm must have at least six years of consecutive annual observations to be included in the sample.

This results in a final sample of 88,293 firm-year observations. The years in the sample range from 1967 to 2022. The univariate statistics for the regression variables and other measures of interest are shown in Table 1. The average of the book-value debt-to-asset ratio is about 45%. The financial deficits range between 0.22 and -.40. The average firm in the sample is below its target leverage by -2% to -3% five years before the current observation. The target leverage also increases by 1.50% to 2% over the period.[7] Market-to-book ratios average about 130%,[8] and average T bill rates over the entire period are about 4.25%.

5. History of Market Prices, Interest Rates and Security Issuance

It is informative to consider the historical relationship between stock prices, interest rates and security issues. Table 2 contains univariate statistics and correlation coefficients between five variables over the 56-year period from 1967 to 2022: (1) T Bill rates, (2) M/B is the annual median market-to-book ratio for all firms in the sample in each year, (3) New Eq Iss is the ratio of new equity issues to the book

[6] This means that firms with negative book value of equity are eliminated.
[7] Kayhan and Titman also find that the typical firm is under levered five years prior to the observation, and that target leverage rises over the period and the magnitudes are similar to those I present.
[8] Again, these are truncated at an upper value of ten.

value of total assets, again, for all firms in the annual samples, (4) New Debt Iss is the ratio of new debt issues to total assets, and (5) Tot Ex Funds is the ratio of all new issues to assets. The T bill rate is the average of the monthly rates during the calendar year. The other four measures are based on the Compustat data for the firms in my sample for each fiscal year.

The univariate statistics are shown in Panel A of Table 2. Because these are annual figures for a large sample, the medians and medians are not very divergent. As expected, debt issues are much more common than stock placements. Median sales of new debt are about 4% of asset value and equity issues about 1%. The standard deviation of the annual level of debt issues is greater than for equity issues over the 56 years, but the coefficient of variation for stock placements is considerably higher. The standard deviation of T Bill rates is also much higher than that for the market-to-book ratios. There are also a few years where median new equity issues are negative, which is a result of stock repurchases.

Panel B of Table 2 contains the Pearson correlation coefficients and the associated P-values for these variables over the 56 years. T Bill rates and market-to-book ratios are negatively correlated, which seems sensible. It is interesting that the market-to-book ratio is negatively correlated with all of the security issuance variables, including new equity placements. On the other hand, the T Bill rate is positively related to all of the issuance measures. The correlation between debt and equity issues is positive, but is not statistically significant.

Figure 1 provides a graphical representation of the relationship between T Bill yields and market-to-book ratios. In Table 2, the correlation coefficient is positive. The results shown in Figure 1 confirm the negative correlation seen in Table 2. But, the relationship clearly changes through time. Before (roughly) 1990, the two series move up-and-down in basically opposing directions. Then after 1990, the market-to-book ratio rises fairly steadily while the T Bill rate declines.

Figure 2 shows the relationship between the market-to-book ratio and the amount of new equity issues. The two series do vary significantly over time. But, the negative long-term relationship seems to result from the long-term rise in the market-to-book ratio, and the corresponding slide in stock issues

following 1990. In Figure 3 the positive relationship between the T Bill rates and new debt issues seems clear, both evidently decline over time from about 1980.

6. Empirical Results

Because Kayhan and Titman (2007) use panel data, and are concerned that the standard errors of the estimates are not independent and are not independently and identically distributed, they employ a bootstrapping method to estimate the standard errors. However, they also note that Petersen (2005) suggests that clustering the error terms by firm also provides appropriate standard errors, and they confirm this in untablated results. Therefore, in estimating the second-stage regression results, I cluster the error terms by firm.

Again, to eliminate outliers, I estimate preliminary OLS regressions for each specification of the second-stage models, and then remove all observations that have residuals with a Cook's D value higher than one, and/or an R-Student value with an absolute value greater than three.

In Panel A of Table 3, I replicate the study by Kayhan and Titman (2007) using their timeframe (1967-2003). My sample is slightly smaller than theirs; they have 52,653 observations for 5,584 firms compared to my sample of 51,918 observations for a slightly larger number of firms, 5,643. The model explains about 32% of the variation in the change in leverage.[9] All of the estimated parameters have the predicted signs.

My estimates for four of the variables, Log Stk Ret, EBITD, Lev Deficit, and Chng Target, are very similar to their results. All four of these variables are highly economically significant. The influences of the leverage deficit and the change in target are especially strong, which Kayhan and Titman argue provides robust support for the trade-off theories.

For the other four variables, my results are somewhat different from those of Kayhan and Titman. They take the financial deficit from earlier work by Shyam-Sunder and Myers (1999), Baker and Wurgler (2002) and Frank and Goyal (2003). This variable is intended to test the pecking order

[9] Kayhan and Titman (2007) do not report an r^2 for their estimated model.

theory. If managers default to debt issues when outside capital is needed, FD should be positively related with increases in debt in capital structure. Kayhan and Titman find a very significant positive relationship for these variables, while I find none. Despite the lack of statistical significance, when the financial deficit is positive (FD Pos), it has a very strong, economically significant impact on the change in leverage. So, my results seem to cast, at least, some doubts on the pecking order story as encapsulated in this variable.

Like Kayhan and Titman, I find significant negative relationships between both the yearly and long-term timing variables and the change in leverage. But, their estimated T values for these parameter estimates are considerably larger than mine. Similar to their findings, the result for the long-term timing variable is more robust than the yearly measure. These results support the market timing story where firms issue equity when they require outside funding and their market-to-book ratio is high. Though they suggest that the greater strength of the long-term timing measure may be more indicative of pecking order behavior.

In Panel B of Table 3 I employ all of the available data, from 1967 to 2022 to estimate Kayhan and Titmans' model. The results are strikingly different. The parameter estimates on Log Stk Ret, EBITD, Lev Deficit, and Chng Target, are similar to those from in Panel A. But, the results for the financing deficit and timing measures are strikingly dissimilar.

Kayhan and Titman argue that when the financial deficit is positive (FD Pos) it should be positively related to the change in leverage in the pecking order theory. It is interesting that despite the statistical significance of FD Pos, its economic significance is weaker than when using data from the earlier period.

In Kayhan and Titmans' sample, both of the timing measures, YT M/B and LT M/B, are significantly negatively related to the change in leverage, and they have a considerable economic influence on the independent variable. But, when the later data is included in the sample, the statistical significance disappears. LT M/B is still significant at the 10% confidence level, but the economic effect is

much weaker than in the earlier period. So, while I confirm Kayhan and Titmans' findings of some market timing efforts by managers in their sample period, when I add the subsequent data, there is little significant evidence of this behavior.

Next, I add my measures of yearly and long-term timing based on the level of T Bill yields. YT T Bill and LT T Bill to Kayhan and Titmans' specification. If managers are timing bond issue during periods of low interest rates, these variables should be negatively related to changes in leverage. The results are shown in Table 4. Again, the two panels represent the two periods shown in Table 3; Kayhan and Titmans' sample period in Panel A and my aggregate sample, from 1967 to 2022 in Panel B. The results for all of the variables included in Kayhan and Titmans' models for both periods are virtually identical to those in Table 3. But, the measures of yearly and long-term market timing associated with T Bill rates are not statistically significant and have only very weak economic effects.

However, the results in Tables 3 and 4 suggest the managerial behavior is clearly very different in the years after Kayhan and Titmans' tests. Therefore, in Table 5, I separate the sample into two periods; one in the twentieth century (corresponding roughly with Kayhan and Titmans' sample), and the other in the twenty-first century. I then test my model specifications for these two timeframes.

The results are given in Table 5. Managerial behavior seems strikingly different in these two periods. Again, the parameter estimates on Log Stk Ret, EBITD, Lev Deficit, and Chng Target, are roughly comparable between the two sample periods, and with those in Tables 3 and 4. The positive relationship of positive financial deficits with the change in leverage is statistically significant in the twenty-first century, but not in the earlier period. Though its economic significance is, again, higher in the earlier time.

In the twentieth century, YT M/B is statistically significant, and has a notable economic effect on the change in leverage, as Kayhan and Titman predict. But, in the twenty-first century, there is no evidence of market timing by managers based on the levels of their firms' market-to-book ratios. This is not surprising given the results seen in Tables 3 and 4.

When the sample is bifurcated in this manner, evidence of market timing based on interest rates is far more evident. In the twentieth century, both YT T Bill and LT T Bill are statistically significant,[10] though the former at only the 10% confidence level. The economic significance measures suggest that in the earlier period, variation in LT T Bill has a far more powerful impact on the change in leverage than does YT M/B. As mentioned above, in the twenty-first century, all evidence of market-timing based on the market-to-book ratios disappears, but support for the effect of LT T Bill on leverage changes persists. Though the economic significance is far weaker than in the earlier period.

I replicate the earlier study by Kayhan and Titman (2007) on marketing timing behavior by managers. I then extend their methodology by adding terms to test for evidence that managers also time debt issues when interest rates are low. During their study period, from 1967 to 2003, I confirm their result that managers that need to raise external capital are more likely to issue stock if their firm's market-to-book ratio is high. But, when I extend their methodology further into the future, I can no longer confirm such behavior in the twenty-first century. When I add my terms for market timing based on T Bill yields, I find fairly consistent evidence that managers do issue debt when rates are low, though the behavior is less economically significant in the twenty-first than the twentieth century. So, there is much weaker evidence of marketing timing behavior by managers in recent decades. The reasons for this change are clearly an interesting subject for future research.

7. Summary and Conclusions

In the big picture, my findings accord with those of Kayhan and Titman (2007). To quote them, "The results … support the view that firms behave as though they have target debt ratios, but their cash flows, investment needs, and stock price realizations lead to significant deviations from these targets."

The economic significance of the estimates suggests that explanatory variables based on the target leverage ratio have a very powerful impact on changes in capital structure, which supports the

[10] Clearly, there must be some profound effects in the years from 2000 through 2003 that cause this result to be so different than that in the Kayhan and Titman sample period. This is the time of the 9/11 terrorist attacks, the dot.com crash and the subsequent recession.

notion of moving toward a target capital structure based on some trade-offs. The powerful negative impact of past profitability on leverage changes confirms earlier finding of Titman and Wessels (1988) and other, which can be interpreted as evidence of pecking order behavior. Historical stock returns are also negatively correlated with leverage, which fits with the conjectures of Hovakimian, Opler and Titman (2001) and Welch (2004).

Earlier, Shyam-Sunder and Myers (1999), Baker and Wurgler (2002) and Frank and Goyal (2003) propose a measure of financial deficit, to try to confirm if firms issue debt when they require outside financing to confirm the pecking order hypothesis. My results for this variable differ from those of Kayhan and Titman. I cannot confirm a significant relationship using their sample years (1967 to 2003), though the economic significance measures suggest a considerable impact on changes in leverage. But, in the subsequent years, I find a significant, though less economically pronounced impact, when the financial deficit is positive.

Kayhan and Titmans' main advance is to refine variables to test for evidence of market timing by managers, to see if they raise equity capital when the market-to-book ratio is high. My main contribution is to develop similar measures to specifically test whether managers tend to raise capital when interest rates are low. When I replicate Kayhan and Titmans' model, I confirm their evidence of marketing timing in adjustment to capital structure as market-to-book ratios rise and fall. However, when I look at later years, into the twenty-first century, this behavior seems to disappear.

When I include my own measure of market timing based on variation in interest rates, I find statistically significant evidence of such managerial behavior in the aggregate sample and in samples with data for both the twentieth and twenty-first centuries. However, the economic significance measure suggests the effect is considerably stronger in the earlier time period, corresponding roughly to the years that Kayhan and Titman study.

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Figure 1
Historical T Bill Yield and Market to Book Ratio

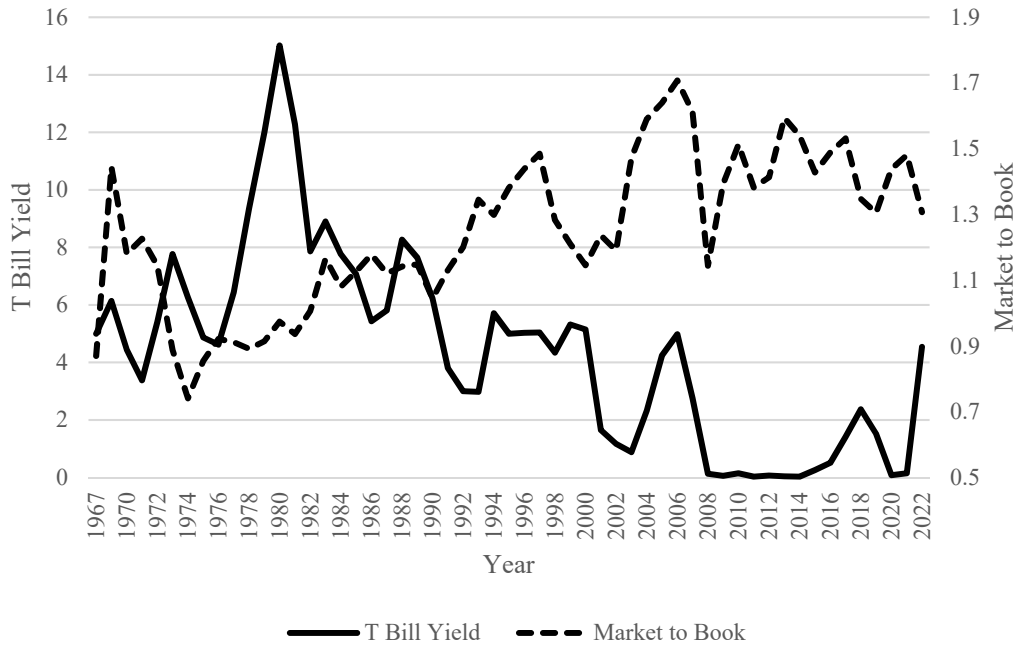

Figure 2
Market to Book Ratio and New Equity Issues

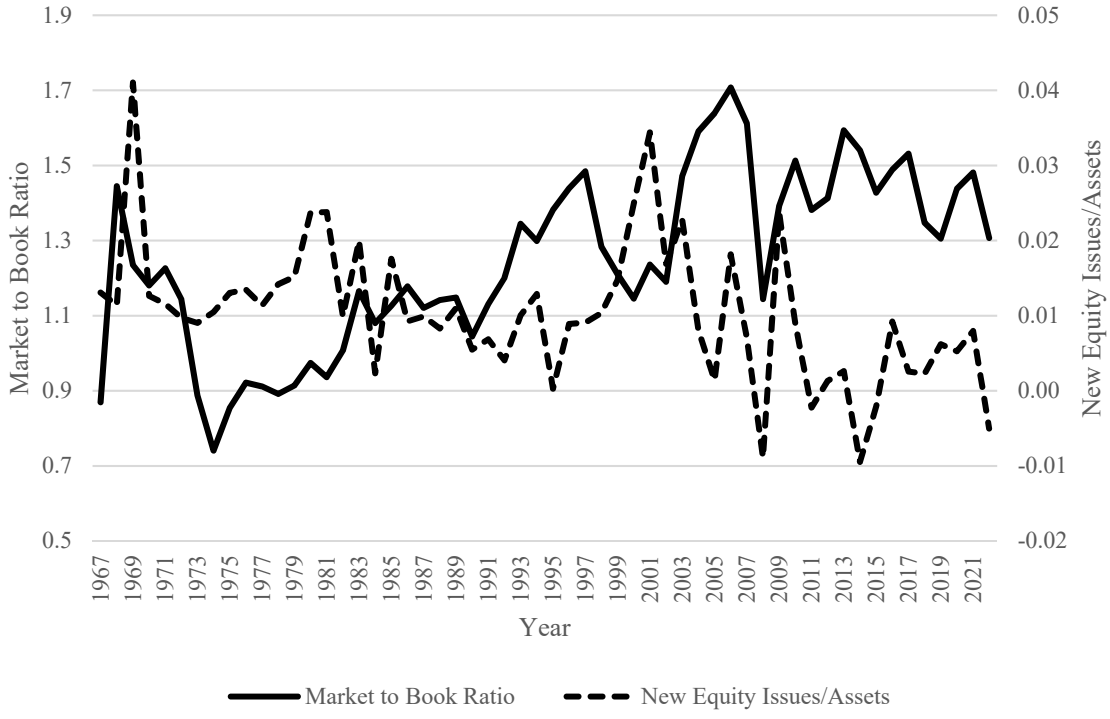

Figure 3
T Bill Yields and New Debt Issues

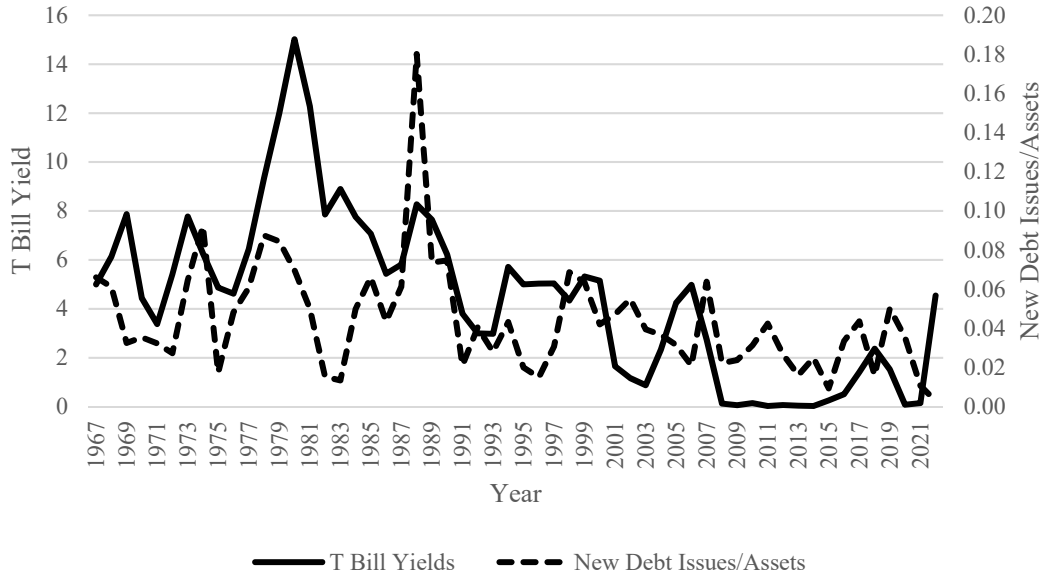

Table 1

Univariate Statistics

Chng Lev – Change in ratio of the ratio of the book value of liabilities to assets between year t and t-5. FD – Total external financial deficit between year t and t-5. FD Pos – The product of FD and a dummy variable set to one when FD is positive. YT M/B - The covariance between FD and the market-to-book ratio between year t and t-5. LT M/B – The product of average FD and average market-to-book ratio between year t and t-5. YT T Bill - The covariance between FD and the T Bill yield between year t and t-5. LT T Bill – The product of average FD and T Bill yield between year t and t-5. Log Stk Ret – The five-year cumulative stock return between year t and t-5. EBIT – The sum of earnings-before-interest-and-taxes scaled by the sum of the book values of debt and equity between year t and t-5. Lev Deficit – Is the difference between leverage and target leverage at year t-5. Chng Target- is the difference between target leverage in year t and target leverage in year t-5.
LEV - The annual ratio of the book value of liabilities to assets. M/B - The annual market-to-book ratio. The annual T Bill yield.

	Median	**Mean**	**Std Dev**	**Minimum**	**Maximum**
Chng Lev	0.01669	0.02324	0.15862	-0.82051	0.93417
FD	0.00005	0.00086	0.00652	-0.39368	0.22450
FD Positive	0.00005	0.00102	0.00572	0.00000	0.22450
YT M/B	-0.0008	-0.01877	0.37988	-38.22142	9.19814
LT M/B	0.01087	0.23740	2.02048	-50.66305	105.78994
YT T Bill	0.00280	0.04783	1.13198	-53.49707	70.59458
LT T Bill	0.02728	0.35827	2.32819	-48.04943	138.56045
Log Stk Ret	0.00073	0.06745	1.34838	-10.48520	16.89286
EBITD	0.12645	0.12363	0.08127	-0.65377	0.39330
Lev Deficit	-0.02770	-0.02048	0.15471	-0.57579	0.86793
Chng Target	0.01644	0.02205	0.07607	-0.55512	0.54720
Lev	0.45235	0.45518	0.19303	0.00207	0.99978
M/B	1.24023	1.49325	1.03215	-0.80681	9.98399
T Bill	4.45000	4.17307	3.38077	0.02417	14.65083

The sample has 88,293 observations.

Table 2

Annual univariate statistics and Pearson correlation coefficients for T Bill yields, market-book-ratios, and new equity and debt issues T Bill yield for 1967 to 2022

T Bill - The average T Bill rate for each calendar year. M/B – The median market-to-book ratio for all firms in the sample for each fiscal year. New Eq Iss – The median ratio of new equity issues to total assets for all firms in the sample for each fiscal year. New Debt Iss - The median ratio of new debt issues to total assets for all firms in the sample for each fiscal year. Tot Ex Funds - The median ratio of all new external funds to total assets for all firms in the sample for each fiscal year.

Panel A
Univariate Statistics

	Median	Mean	Std Dev	Minimum	Maximum
T Bill	4.75400	4.43750	3.42157	0.03000	15.02000
M/B	1.23079	1.24684	0.23392	0.74083	1.70773
New Eq Iss	0.00981	0.01037	0.00929	-0.00947	0.04105
New Debt Iss	0.04008	0.04403	0.02845	0.00290	0.18021
Tot Ex Funds	0.04780	0.05440	0.03148	-0.00212	0.18852

Panel B
Pearson Correlation Coefficients

	T Bill	M/B	New Eq Iss	New Debt Iss	Tot Ex Funds
T Bill	1.00000	-0.64885	0.41069	0.45666	0.53395
		<0.0001	0.0017	0.0004	<0.0001
M/B		1.00000	-0.26724	-0.42881	-0.46643
			0.0465	0.0010	0.0003
New Eq Iss			1.00000	0.18008	0.45801
				0.1842	0.0004
New Debt Iss				1.00000	0.95689
					<0.0001
Tot Ex Funds					1.00000

P-Values are shown below the coefficient estimates.
56 annual observations.

Table 3

Empirical Results
Effects of Yearly and Long-Term Timing for the Market-to-Book Ratio
On Changes in Financial Leverage

$$\text{Chng Lev} = \alpha + \lambda_1 \text{ FD} + \lambda_2 \text{ FD Pos} + \beta_1 \text{ YT M/B} + \beta_2 \text{ LT M/B} + \mu_1 \text{ Log Stk Ret} + \mu_2 \text{ EBITD} + \mu_3 \text{ Lev Deficit} + \mu_4 \text{ Chng Target} + \Sigma\delta \text{ Indust} + \varepsilon$$

Chng Lev – The dependent variable is the change in ratio of the book value of liabilities to assets between year t and t-5. FD – Total external financial deficit between year t and t-5. FD Pos – The product of FD and a dummy variable set to one when FD is positive. YT M/B - The covariance between FD and the market-to-book ratio between year t and t-5. LT M/B – The product of average FD and average market-to-book ratio between year t and t-5. Log Stk Ret – The natural logarithm of one plus the five-year cumulative stock return between year t and t-5. EBITD - The sum of earnings-before-interest-and-taxes and before depreciation scaled by the sum of the book values of debt and equity between year t and t-5. Lev Deficit – Is the difference between leverage and target leverage at year t-5. Chng Target- is the difference between target leverage in year t and target leverage in year t-5. Indust - A set of industry dummy variables based on the Fama-French fifty industry classification.
The equation is estimated by ordinary least squares with errors clustered at the firm level.

	Panel A Kayhan & Titman Period 1967 - 2003			**Panel B Aggregate Period 1967 - 2022**		
	Parameter Estimate	**T Value**	**Economic Significance**	**Parameter Estimate**	**T Value**	**Economic Significance**
FD	-0.04253	-0.02	-0.00594	-0.10521	-0.54	-0.02951
FD Positive	3.02257	1.51	0.41600	0.97681	3.63***	0.24445
YT M/B	-0.01961	-2.89***	-0.18210	-0.00399	-1.39	-0.06527
LT M/B	-0.00927	-3.85***	-0.33018	-0.00149	-1.81*	-0.12947
Log Stk Ret	-0.00438	-4.40***	-0.27855	-0.00789	-9.96***	-0.45805
EBITD	-0.29081	-19.04***	-0.95434	-0.20277	-17.79***	-0.70920
Lev Deficit	-0.42029	-57.49***	-2.76628	-0.40284	-69.39***	-2.68205
Chng Target	0.72044	50.10***	2.29880	0.64765	60.15***	2.12015
Avg Chng Lev		0.01959			0.02037	
Obs		51,918			87,405	
Clusters		5,634			8,019	
R Square		0.3234			0.3010	

*** 99% Confidence Level ** 95% Confidence Level * 90% Confidence Level

Table 4

Empirical Results
Effects of Yearly and Long-Term Timing for both the Market-to-Book Ratio and T Bill Yields On Changes in Financial Leverage

$$\text{Chng Lev} = \alpha + \lambda_1 \text{ FD} + \lambda_2 \text{ FD Pos} + \beta_1 \text{ YT M/B} + \beta_2 \text{ LT M/B} + \beta_3 \text{ YT T Bill} + \beta_4 \text{ LT T Bill} + \mu_1 \text{ Log Stk Ret} + \mu_2 \text{ EBITD} + \mu_3 \text{ Lev Deficit} + \mu_4 \text{ Chng Target} + \Sigma\delta \text{ Indust} + \varepsilon$$

Chng Lev – The dependent variable is the change in ratio of the book value of liabilities to assets between year t and t-5. FD – Total external financial deficit between year t and t-5. FD Pos – The product of FD and a dummy variable set to one when FD is positive. YT M/B - The covariance between FD and the market-to-book ratio between year t and t-5. LT M/B – The product of average FD and average market-to-book ratio between year t and t-5. YT T Bill - The covariance between FD and the T Bill yield between year t and t-5. LT T Bill – The product of average FD and T Bill yield between year t and t-5. Log Stk Ret – The natural logarithm of one plus the five-year cumulative stock return between year t and t-5. EBITD - The sum of earnings-before-interest-and-taxes and before depreciation scaled by the sum of the book values of debt and equity between year t and t-5. Lev Deficit – Is the difference between leverage and target leverage at year t-5. Chng Target- is the difference between target leverage in year t and target leverage in year t-5. Indust - A set of industry dummy variables based on the Fama-French fifty industry classification.
The equation is estimated by ordinary least squares with errors clustered at the firm level.

	Panel A Kayhan & Titman Period 1967 - 2003			**Panel B Aggregate Period 1967 - 2022**		
	Parameter Estimate	**T Value**	**Economic Significance**	**Parameter Estimate**	**T Value**	**Economic Significance**
FD	0.84456	0.42	0.11790	-0.11167	-0.63	-0.03132
FD Positive	2.83839	1.42	0.51412	1.04170	3.58***	0.26083
YT M/B	-0.02602	-3.23***	-0.24163	-0.00338	-1.18	-0.05527
LT M/B	-0.00833	-2.99***	-0.29665	-0.00173	-2.23**	-0.15049
YT T Bill	-0.00282	-1.23	-0.07280	-0.00137	-1.64	-0.06695
LT T Bill	-0.00076	-0.83	-0.08171	0.00013	0.34	0.01294
Log Stk Ret	-0.00441	-4.42***	-0.28036	-0.00792	-9.98***	-0.45936
EBITD	-0.29123	-19.08***	-0.95576	-0.20268	-17.78***	-0.70889
Lev Deficit	-0.42051	-57.52***	-2.76773	-0.40273	-69.37***	-2.68136
Chng Target	0.72019	50.05***	2.29802	0.64770	60.08***	2.12031
Avg Chng Lev		0.01960			0.02038	
Obs		51,918			87,406	
Clusters		5,634			8,019	
R Square		0.3236			0.3010	

*** 99% Confidence Level ** 95% Confidence Level * 90% Confidence Level

Table 5

Empirical Results
Effects of Yearly and Long-Term Timing for both the Market-to-Book Ratio and T Bill Yields On Changes in Financial Leverage by Historical Period

$$\text{Chng Lev} = \alpha + \lambda_1 \text{ FD} + \lambda_2 \text{ FD Pos} + \beta_1 \text{ YT M/B} + \beta_2 \text{ LT M/B} + \beta_3 \text{ YT T Bill} + \beta_4 \text{ LT T Bill} + \mu_1 \text{ Log Stk Ret} + \mu_2 \text{ EBITD} + \mu_3 \text{ Lev Deficit} + \mu_4 \text{ Chng Target} + \Sigma\delta \text{ Indust} + \varepsilon$$

Chng Lev – The dependent variable is the change in ratio of the book value of liabilities to assets between year t and t-5. FD – Total external financial deficit between year t and t-5. FD Pos – The product of FD and a dummy variable set to one when FD is positive. YT M/B - The covariance between FD and the market-to-book ratio between year t and t-5. LT M/B – The product of average FD and average market-to-book ratio between year t and t-5. YT T Bill - The covariance between FD and the T Bill yield between year t and t-5. LT T Bill – The product of average FD and T Bill yield between year t and t-5. Log Stk Ret – The natural logarithm of one plus the five-year cumulative stock return between year t and t-5. EBITD - The sum of earnings-before-interest-and-taxes and before depreciation scaled by the sum of the book values of debt and equity between year t and t-5. Lev Deficit – Is the difference between leverage and target leverage at year t-5. Chng Target- is the difference between target leverage in year t and target leverage in year t-5. Indust - A set of industry dummy variables based on the Fama-French fifty industry classification.
The equation is estimated by ordinary least squares with errors clustered at the firm level.

	Panel A Twentieth Century 1967 - 1999			**Panel B Twenty-First Century 2000 - 2022**		
	Parameter Estimate	**T Value**	**Economic Significance**	**Parameter Estimate**	**T Value**	**Economic Significance**
FD	5.67707	1.73	0.58334	-0.13546	-0.63	-0.04895
FD Positive	3.05792	0.90	0.89756	1.20101	4.28***	0.38507
YT M/B	-0.04694	-3.02***	-0.21485	-0.00265	-1.00	-0.05667
LT M/B	-0.00041	-0.08	-0.00749	-0.00055	-0.81	-0.06326
YT T Bill	-0.00520	-1.86*	-0.12473	-0.00112	-1.52	-0.06848
LT T Bill	-0.00618	-3.79***	-0.57109	-0.00185	-3.29***	0.19552
Log Stk Ret	-0.00202	-2.05**	-0.13208	-0.01467	-14.13***	-0.72806
EBITD	-0.32044	-19.21***	-1.03983	-0.14851	-9.32***	-0.42568
Lev Deficit	-0.42462	-54.89***	-2.82537	-0.39994	-49.21***	-2.63976
Chng Target	0.75277	46.80***	2.33390	0.57217	41.84***	1.93938
Avg Chng Lev		0.01911			0.02186	
Obs		44,496			42,914	
Clusters		4,777			5,072	
R Square		0.3341			0.2979	

*** 99% Confidence Level ** 95% Confidence Level * 90% Confidence Level