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Firm Leverage and Performance

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Abstract

This paper examines the relationship between deviations from firm leverage and firm performance over time. Our results indicate that overlevered and underlevered firms both adversely affect corporate profitability. We use the 1987 tax cut as an event study, to reduce endogeneity concerns.

Introduction

Modigliana and Miller's (1963) trade-off theory demonstrates that firms trade-off the benefits debt to reduce tax liabilities against the risk of bankruptcy. The Harvard Business Review mentions two major advantages of debt. The first advantage is the reduction in income tax liability. The second advantage is that issuing debt is generally cheaper compared to equity (Berman and Knight, 2009). Faulkender et al., 2012 demonstrate that a firm's free cash flow can impact its movement toward a target leverage ratio. Furthermore, they demonstrate that the impact is asymmetric depending on whether the firm is overlevered or underlevered. Combined their results indicate that a firm does have an optimal target leverage. Taking this result as a given if a firm has optimal leverage, then there should be a cost for being away from that target. This paper demonstrates that deviations from leverage do indeed have an impact on profitability. Further, the tax cut of 1987 demonstrates that

Theoretically, the firm value as a firm increases debt should look like a concave function. This immediately implies that the firm, following the trade-off theory, should have an optimal leverage. Overleverage can hurt firms' performance by increasing bankruptcy risk, increasing the cost of borrowing, and financial distress. In another recent study titled, "Firm crash risk, information environment, and speed of leverage adjustment", the authors demonstrate crash-risk exposure is positive relative with the magnitude of overleverage (Zhe, Li, and Yu 2015). Additional research has also pointed out five disadvantages of being overlevered, which include: limited growth potential, losing assets, inability to increase debt, and inability to attract equity (Garcia, 2014). Taken together a firm with too much debt should have lower profitability.

On the other hand, an underlevered firm can forego tax benefits. Cheng and Tzeng (2011) point out the total agency cost can be decreased by applying the appropriate leverage ratio. Agency costs can be very large and debt works as a mechanism to minimize this cost. This implies that a underlevered firm also should have lower profitability.

The paper is organized as follows. First, we will introduce the target leverage ratio for each firm-year following Faulkender et al. (2012). They estimate firm target leverage by first generating the targets using Blundell Bond GMM and controls known to impact optimal leverage. Second, we will describe our data. Third, we will demonstrate the negative relationship between a firm's leverage deviations and firm performance. Fourth, we will demonstrate the negative relationship between deviations and firm performance separately for both underlevered and overlevered firms. Overleveraged firms have greater negative effects on performance. Finally, we perform an event study around the 1987 Tax Reform Act to mitigate the risk of endogeneity. We find that the farther away from target leverage ratio, on average, the lower the firm performance.

Data Description and Manipulation

The data in this project are from Compustat annual data from 1970 to 2018 for all reported corporations in the United States contained in the WRDS database. We eliminate all missing data. The final data set contains 168,626 observations. The dependent variable for our basic regression model is earning before interest and tax (EBIT) divided by total assets. The reason we use EBIT is

because when we do the event study in the last part, the change on tax rate would not affect EBIT. EBIT is a performance measurement without being affected by taxes. Also, From the table 6, we can see that the variable *efftax* is not statistically significant as expected.

Table 1: Summary statistics

Table 1 characterizes the mean, standard deviation, and median for all variables. *ebit/at* is firm's Ebit divided by total asset for each firm year. diff is taking the absolute value of current debt ratio minus target leverage ratio for each firm year, and current debt ratio is calculated by the sum of firms' current debt plus long-term debt for each firm year. logmkvalt is calculated by taking log value of firms' market value for each firm year. logppent is calculated by taking log value of firms' property, plant, and equipment for each firm year. logcapx is calculated by taking log value of firms' capital expenditure for each firm year. lnage is taking log value of how many years the firm is existing in the market, which is calculated by using most current firm year minus the earliest firm year. mbr is the market to book ratio for each firm year, which is calculated by using market value divided by book value. Dvt is dividend payment for each firm year. *opmadmedian* is the EBIT for Fama French (1997) industry average EBIT ratio.

Table 1: Summary statistics

Variable	Obs	Mean	Std. Dev.	P50
ebit_at	64932	-.045	.768	.056
diff	64955	.154	.202	.111
logmkvalt	64955	5.713	2.201	5.684
logppent	64679	3.716	2.658	3.721
logcapx	64049	2.192	2.566	2.272
lnage	64955	2.382	.955	2.485
mbr	64955	2.886	143.028	2.05
dvt	64845	58.274	443.681	0
opmad_median	64955	-.061	.392	.051

For the right-hand side of our basic regression model, the independent variable is $diff$, which is calculated by the

$$|current\ debt\ ratio - target\ leverage\ ratio|.$$

This is calcuted in the year prior to EBIT realizations to further reduce the risk of endogeneity. In theory, we expect to see the firms that are farther away from their target leverage ratio, the worse firm performance will be. We include the following standard controls: $\log(market\ value)$, $\log(property, plant, and\ equipment)$, $\log(capital\ expenditure)$, $mbr(market - to - book\ ratio)$, $dvt(dividend\ payment)$, $and\ opmad\ median(industry\ median)$. It is interesting to see the summary statistics and distribution for both dependent variable and major independent variable.

Table 2: Distribuation table

Table 2presents the result of summary statistic and distribuation for dependent variable $ebit_at$ and $diff$.

	(1)							
	mean	sd	Var	Skewn	sum	p1	p99	p50
ebit_at	.0026766	.5820134	.3387396		450.8515	-1.243542	.3485868	.0733158
diff	.1881486	.2167182	.0469668		31726.74	0	.7225035	.1427389
N	168626							

Table2 shows the summary statistics and distribution for dependent variable *ebit_at* . We could see firms' performance has negative skewness with a long-left tail, which means there are portions of firms that do not perform well during the time range of 1970-2018, but we are getting the 0.0026766 mean. Table 2 also shows the summary statistics and distribution for independent variable diff. With the mean of *0.1881486,* we could tell firms do care about their leverage ratio and grow their company close to the target leverage ratio. After brief description

to our independent and dependent variable, the next we will walk in to our first basic regression model.

Table 6: Regression table

	(1) ebit_at_1
efftax	0.0000260 (0.20)
logmkvalt	0.0197*** (15.24)
logppent	-0.00655*** (-3.74)
logcapx	-0.00390* (-2.10)
lnage	0.0104*** (6.46)
mbr	0.000422*** (3.84)
dvt	-0.00000218 (-1.35)
_cons	-0.0392*** (-5.92)
N	39436

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Empirical analysis

To exam the relationship between firms' performance and their leverage difference with target, we will need to perform regression on $ebit/at$ to $diff$ with several control variables, which is

$$ebit/at_{i,t} = \alpha + \beta_1 diff_{i,t} + \beta_2 logmkvalt_{i,t} + \beta_3 logppent_{i,t} + \beta_4 logcapx_{i,t} + \beta_5 lnage_{i,t} + \beta_6 mbr_{i,t} + \beta_7 dvt_{i,t} + \beta_8 opmad\_median_{i,t} + \varepsilon$$

Logmkvalt is log of market value. *Logppent* is log of property, plant, and equipment. *Logcapx* is log of capital expenditure. *Inage* is log of corporations' age. *Mbr* is corporations' market-to-book ratio. *Dvt* is corporations' dividend payment. *Opmand_median* is industry EBIT from Fama French 48 industry model (French, 1997). To solve the problem of heterogeneity, we use industry fixed effect model in above regression with the cluster of firms, which is the *gvkey* in the data set. The weight on each different industry should be static, because each industry has its own characteristics. For example, for aircraft industry, on average, firms have higher than normal debt ratios, which could cause more distance from their target leverage ratio. By using industry fixed effects, we can focus on deviations relative to the industry mean. After running the industry fixed effect regression, we have the following results.

Table 3: Regression table

	(1) ebit_at
diff	-0.456***
	(-5.83)
logmkvalt	0.0201***
	(8.93)
logppent	0.0331***
	(7.30)
logcapx	0.00321
	(0.82)
lnage	0.0371***
	(12.68)
mbr	0.0000497***
	(4.57)
dvt	-0.0000447***
	(-6.90)
opmad_median	0.0983***
	(7.54)
_cons	-0.292***
	(-18.06)
N	63943

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

From table 3, for our independent variable *diff,* it has -.4565 coefficient with 99% statistically significant. The interpretation is on average, for every percentage the leverage ratio is away from the target leverage ratio, firms would have lower $ebit/at$ ratio (worse performance). Almost all the control variables are 99% statistically significant. Besides, those variables with

statistically significant make sense theoretically. From this basic regression model, we know that when leverage ratios are farther away from their target leverage ratio, there is a significant effect on their performance. We then analyze if the effect is asymmetrical. The next step we would introduce our second regression model, which separately illustrate the effect for both overlevered and underlevered firms.

To evaluate the effect of both overleveraged firms and underleveraged firms separately, we would like to introduce the following two independent variables. The first one is *ovlege_nd* , which is calculated by $current\ leveverage\ ratio - target\ leverage\ ratio$. In this variables, we only take the value larger than 0, and set others equal to 0. $ovlege\_nd$ is used to measure the degree of overleverage. The second one is $uderlege\_nd\_abs$, which is calculate by using the if statement $if\,(current\ leverage\ ratio - target\ leverage\ ratio) < 0, then\ |current\ leverage\ ratio - target\ leverage\ ratio|$, otherwise set to 0. $uderlege\_nd\_abs$ is used to measure the degree of underleverage. We would use those two independent variables to replace $diff$, which is

$$ebit/at_{i,t} = \alpha + \beta_1 ovlege\_nd_{i,t} + \beta_2 uderlege\_nd\_abs_{i,t} + \beta_3 logmkvalt_{i,t} + \beta_4 logppent_{i,t} + \beta_5 logcapx_{i,t} + \beta_6 lnage_{i,t} + \beta_7 mbr_{i,t} + \beta_8 dvt_{i,t} + \beta_9 opmad\_median_{i,t} + \varepsilon$$

The regression result are showing as below.

Table 4: Regression table

	(1) ebit_at
ovlege_nd	-0.491***
	(-6.41)
uderlege_nd_abs	-0.141**
	(-3.09)
logmkvalt	0.0165***
	(7.25)
logppent	0.0317***
	(7.45)
logcapx	0.00447
	(1.18)
lnage	0.0327***
	(11.07)
mbr	0.0000503***
	(4.44)
dvt	-0.0000410***
	(-6.71)
roa_median	0.890***
	(15.49)
_cons	-0.341***
	(-20.79)
N	63943

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

From table 4, we could see the variables both *ovlege_nd* and *uderlege_nd_abs* are statistically significant at 99% level. Also, they both have negative coefficient. Compared with

overleveraged firms, underleveraged firms have less negative effect on firm performance. It does make sense in the real world, because for overleveraged firm, they not only bear more financial distress, but also higher cost of debt. It could also lower their ability to access financial assistance (Opler & Titman, 1993). Both these variables are statistically significant at the 99% level. In the next stage of this paper, we would focus on the endogenous issue of this regression model with event study, which could better illustrate the change in $diff$ cause the change in corporations' performance $ebit/at$.

To mitigate endogeneity, we perform an event study. We use the 1987 Tax Reform Act signed by President Reagan as our tax cut event. Firm income tax changed from 46% to 40%. The reason why we use 1987 tax cut as event is because first, it was a 6% tax change, which is quite a large reduction in history. Second, the tax change would affect firm leverage ratios, but not normalized EBIT, because it is before interest and tax. We will narrow the data set from 1982 to 1992, which is 5 years before tax cut and 5 years after the tax cut. Also, two new variables would be added into the regression ($posttax, and\ intac$). $posttax$ is a dummy variable equal to 1 if the year is beyond 1987 and 0 otherwise. $intac$ is an interaction of $(posttax * diff)$. The regression model shows below.

$$ebit/at_{i,t} = \alpha + \beta_1 diff_{i,t} + \beta_2 posttax_{i,t} + \beta_3 intac_{i,t} + \beta_4 logassets_{i,t} + \beta_5 opmad\_median_{i,t} + \beta_6 logdiv_{i,t} + \beta_7 inage_{i,t} + \varepsilon$$

Table 5 shows the regression result of event study.

Table 5: Regression table

	(1) ebit_at
diff	-1.859***
	(-6.75)
posttax	3.746***
	(3.50)
intac	-15.76***
	(-3.47)
logassets	0.0460
	(0.58)
opmad_median	0.507
	(0.38)
logdiv	-0.238***
	(-3.50)
lnage	-0.0262
	(-0.80)
_cons	0.438
	(1.76)
N	57353

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

From the table 5, we see the coefficient for both *diff* and *intac* are negative with 99% statistically significant. By taking the partial derivative on *diff,* we are getting $\frac{d(ebit\_at)}{d(diff)} = -1.8589 + -15.76403 * posttax$. We can set *posttax* to be both 1 and 0. When *posttax* is equal to 1, which means post tax, the intercept is -17.619. It means that after tax policy change, firms with leverage ratio farer away from target leverage ratio would have lower firms' *ebit/at.*

The result of event study illustrates the change in the distances between corporations' current leverage ratio and target leverage ratio cause the change in firms' performance (firms that are farther away from their target leverage ratio would have worse performance). The above the event study explain the causality between our dependent variable and independent variables from the perspective of econometric. Furthermore, there are a lot of related paper that obtain a similar result. One study illustrates how and when overleverage hurt firm performance in UK by conducting endogenous threshold analysis in ther paper (Coricelli & Driffield &pal, 2012). In another paper "why capital structure matters", researchers discuss how overleverage hurt company's performance especially in airlines, aerospace and technology (Milken, 2009).

Conclusion

From the above empirical analysis, we see the negative effect on firms' performance when firms are farther away from their target leverage ratio. Given these findings, why would firms remain away from target leverage. The answer may be due to the cost of adjustment as demonstrated by Faulkender et. al (2012) and many others. Adjustment cost could be the biggest challenge to stop corporations adjust their leverage ratio toward to target leverage ratio. Finally, although earnings could move mechanically with changes in leverage, the tax cut of 1987 should have no effect on earnings before taxes and our results were robust to this event.

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