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Cash flow risk and capital structure decisions

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ABSTRACT

We identify a link between cash flow risk, capital structure decisions and operating cash flows. Firms with higher cash flow volatility have higher debt levels and this positive link is only for firms with the weakest financial performance as measured by operating cash flow. When firms are ranked based on operating cash flows, those in the bottom half increase their use of leverage in the face of increasing cash flow risk. For firms with operating cash flows that are in the upper half, the link between cash flow risk faced by the firm and its use of leverage is not statistically significant.

1. Introduction

In this study we explore two recently documented trends in finance and show how these trends impact the way firms make capital structure decisions. First, there is evidence of an increase in cash flow volatility (Bates et al., 2009) which may lead to cash shortfalls for firms. Second, there is consistent evidence of an increasing number of firms in the market with negative cash flow (Ritter and Welch, 2002; Fama and French, 2004; Denis and McKeon, 2018). Unexpected negative changes to cash flows or the continued inability by firms to generate positive operating cash flows may result in firms not generating sufficient cash flows to cover their cash requirements for sustaining and growing their business. Huang and Ritter (2016) show that in cases where firms have near term cash needs they are more likely to issue debt than equity. The authors also find that firms at risk of running out of cash in a particular fiscal year are 11 times more likely to issue debt than firms that do not face the same risk.

Our paper is consistent with the extant capital structure literature in showing a link between cash flow volatility and capital structure Keefe and Yaghoubi (2016) and Memon et al. (2018). Like previous authors, we find that cash flow volatility has a positive and significant relation with the use of debt in capital structure. We add to the capital structure literature in finding that the relationship between the use of debt and cash flow volatility is driven by firms with the greatest shortfall in operating cash flow. We identify a strong link between firms in the lowest quartile of operating cash flow levels and their increased use of debt. Firms with higher levels of operating cash flows, specifically those in the highest and second highest quartiles, do not have the same positive relation between debt levels and cash flow volatility. These results suggest increases in cash flow volatility over time Bates et al. (2009) are contributing to capital structure decisions, and support the findings of Huang and Ritter (2016) that firms at greatest risk of a cash shortfall will increase their use of debt. These results also demonstrate that firms with positive operating cash flows do not rely on increases in debt when facing increases in cash flow volatility.

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2. Literature review

Capital structure theory has been largely dominated by discussion of the trade-off theory and the pecking order theory (Myers ,1984). However, Frank and Goyal (2008) provide a rationale for why, even with these two dominating theories, capital structure theory lacks a single model to help identify the determinants of capital structure choice.

Frank and Goyal (2009) conduct a study using a large number of potential factors in the capital structure choice based on prior literature. Using the many possible determinants, they identify six factors that provide the greatest explanation of capital structure. These factors are: median industry debt, market-to-book ratio, asset tangibility, firm profitability, firm size and expected inflation. Since these six determinants were identified, they have been used to some degree by much of the capital structure literature Faccio and Xu (2015), Leary and Roberts (2014), Reinartz and Schmid (2016), Faulkender and Smith (2016), DeAngelo et al., (2017) among others]. There is evidence that other factors may also have some influence over the capital structure decision. For example, Harris (2015) finds that higher levels of financial flexibility is positively related to firm debt levels. As firms increase flexibility through their payout policies, specifically, they appear more willing to accept less flexibility in their capital structure. Pindado et al. (2017) find that debt levels go down as expected performance in the broader economy weakens.

Bates et al. (2009) provide evidence that firm cash holdings have been increasing as a response to increased cash flow risk. This same risk that incentivizes firms to hold additional cash could also lead to firms having insufficient cash flows for operating needs. Denis and McKeon (2012) provide evidence that firms with large debt issuances are generally doing this as a response to operating needs. Additionally, Huang and Ritter (2016) provide evidence that firms projected to run out of cash at the end of the fiscal year are 11 times more likely to issue debt than firms not projected to run out of cash. Keefe and Yaghoubi (2016) find that cash flow volatility results in firms choosing to utilize a higher proportion of short-term debt. Similar findings demonstrate a negative relationship between cash flow volatility and firm leverage in China (Memon et al., 2018).

Given the fact that increases in cash flow risk may either create more need for cash to fund operations or increase the probability a firm will run out of cash during a given fiscal year, and given that firms running out of cash are likely to issue debt as a response, we expect cash flow volatility to be positively related to the level of debt in a firm's capital structure.

H1. *Firm debt has a positive and significant relation to cash flow risk.*

Fama and French (2004) provide evidence that after 1979 there has been a large increase in the number of new firms listed on major U.S. exchanges, and that the profile of newly listed firms has changed. Specifically, there has been a decline in the level of profitability of newly listed firms. Further evidence of this change is provided by Denis and McKeon (2018) who show that the total percentage of firms with negative cash flows is increasing, and that these negative cash flows often persist. In recent years, over 30% of publicly listed firms have reported negative cash flow (Denis and McKeon, 2018). Additionally, the authors provide evidence that much of the reported increases in cash balances (Bates et al., 2009) is a reflection of near-term operating needs with the expectation that the negative cash flows will continue.

Given the increase in the number of newly listed firms (Fama and French, 2004) and that many firms do not generate positive cash flows (Denis and McKeon, 2018), there may be a large number of firms that have significant cash needs in any given year. Added to the observation that firms at risk for running out of cash in a given year are much more likely to issue debt than firms not at risk of running out of cash (Huang and Ritter, 2016), we explore whether a firms' operating cash flows impact their capital structure response to increases in cash flow risk. Specifically, we believe that the relation between capital structure and cash flow volatility is greatest for firms with the lowest operating cash flows and that this relation should weaken as cash flows increase.

H2. *The positive relation between debt in capital structure and cash flow volatility is greatest among firms with the lowest operating cash flows.*

3. Data, variable descriptions and method

The data for this study comes from U.S. firms in the *Compustat* database from fiscal years 1960 through 2016. The sample excludes financial firms, regulated utilities, firms with missing or less than $5 million in sales, firms with missing or less than $10 million in total assets, and firms with missing or negative stockholder equity. Our final sample includes 223,399 firm-year observations.[1] Not all measures used in our regressions are available for every firm, so the sample size used may be smaller for some analyses. All ratios are winsorized at the 1% and 99% levels.

Our model construction is initially based on the model of Frank and Goyal (2009). We have selected this model because of its robustness in selecting variables summarized in prior capital structure literature. Because of this robustness, it remains widely used in capital structure literature now. The independent variable is total debt to market value of assets (TDM) which is equal to the sum of debt in current liabilities and long-term debt, divided by the market value of assets (MVA). MVA is equal to the sum of the market value of equity, total debt, and preferred equity liquidation value minus deferred taxes and investment tax credits. The final explanatory variable we use is the cash flow risk variable defined by Bates et al. (2009). This cash flow risk variable is added to identify the impact of cash flow volatility on firm debt levels. The other key variables and their definitions are as follows:

- median industry debt level (INDTDM) – equal to the median of total debt to MVA by four-digit SIC code and by year,

[1] The number of observations in the starting sample was 466,094. Eliminating financial firms, regulated utilities, firms with missing data, etc, reduced the final sample by 242,695 observations.

Table 1.
Summary statistics for final sample: 1960–2016.

Variable	Average	Median	Min	Max	Std dev
Leverage (TDM)	0.2779	0.2199	0	0.9221	0.2514
Industry Debt (INDTDM)	0.2440	0.2560	0	0.7817	0.1324
Market to Book (MB)	2.3556	1.5249	0.1954	17.9107	2.6930
Asset Tangibility (TANG)	0.3433	0.2802	0.0004	0.9335	0.2594
Profitability (PROF)	0.1132	0.1222	−0.3975	0.4098	0.1231
Firm Size (SIZE)	6.0298	5.7828	2.2979	13.7442	1.8762
Inflation Rate (RATE)	4.0190	3.3000	0.7000	12.0000	2.2764
Cash Flow Volatility (CFV)	0.1086	0.0762	0.0146	0.4774	0.0887

Table 1 presents a summary of the descriptive data for firms in our sample. The data is from annual observations from the CompuStat database and variable definitions are based on Frank and Goyal (2009) and Bates et al. (2009).

- market to book ratio (MB) – equal to MVA divided by the book value of total assets,
- asset tangibility (TANG) – equal to the ratio of net property, plant and equipment to the book value of total assets,
- firm profitability (PROF) – equal to operating income before depreciation,
- firm size (SIZE) – equal to the log of firm assets, deflated to 2015 dollars,
- expected inflation (INFL) – the expected change in CPI index over the coming year as reported in the Livingston Survey
- cash flow volatility measure (CFV) – equal to the standard deviation of industry cash flows over the previous 5 years

Summary statistics of these key variables are included in Table 1.

Table 2 presents the summary statistics for the four quartiles of operating cash flows used when testing hypothesis 2.

There are a few interesting observations from Table 2. First, firm size and asset tangibility are both growing as operating cash flow increases. Second, cash flow volatility is decreasing as operating cash flow increases.

We analyze the relationship between capital structure and cash flow volatility by using the following multivariate regression:

$$M_{i,t}\,\alpha + \beta_1 INDTDM_{i,t} + \beta_2 MB_{i,t} + \beta_3 TANG_{i,t} + \beta_4 PROF_{i,t} + \beta_5 SIZE_{i,t} + \beta_6 INFL_{i,t} + \beta_7 CFV_{i,t} + Firm\ Effects + \varepsilon_{i,t} \quad (1)$$

4. Empirical results

The results for the regression estimates of the base model are reported in Table 3.

We see that the signs of the first six coefficients are consistent with the predictions by Frank and Goyal (2009) and are each significant at the 1% level. The coefficient on cash flow volatility also has the predicted sign and shows a positive and statistically significant link between cash flow risk and the use of debt in a firm's capital structure. This is consistent with the first hypothesis presented in Section 2. These results can be interpreted to mean that an increase in cash flow volatility is linked to a firm increasing its borrowing as a response.

In Table 4 we present the findings of the regression with the sample divided into four quartiles based on the level of operating cash flow. The quartiles are formed by sorting all firms by operating cash flow levels, by year. This sorting allows the composition of each quartile to vary by year, based on the operating cash flows of each firm in the sample.

Table 2.
Summary statistics by operating cash flow quartile.

Variable	Lowest operating cash flow (1st quartile)		2nd Quartile–operating cash flow		3rd quartile–operating cash flow		Highest operating cash flow (4th quartile)	
	Average	Median	Average	Median	Average	Median	Average	Median
Leverage (TDM)	0.2902	0.2194	0.2574	0.1836	0.2702	0.2132	0.2948	0.2524
Industry Debt (INDTDM)	0.2235	0.2375	0.2381	0.2545	0.2520	0.2597	0.2625	0.2631
Market to Book (MB)	2.5597	1.4079	2.1010	1.3802	2.3120	1.5858	2.4574	1.7073
Asset Tangibility (TANG)	0.2540	0.1886	0.3114	0.2479	0.3644	0.3035	0.4437	0.4030
Profitability (PROF)	0.0144	0.0498	0.1308	0.1257	0.1519	0.1417	0.1158	0.1455
Firm Size (SIZE)	4.6700	4.4609	4.8443	4.8140	6.2114	6.1861	8.3948	8.2613
Inflation Rate (RATE)	4.0191	3.3000	4.0189	3.3000	4.0191	3.3000	4.0191	3.3000
Cash Flow Volatility (CFV)	0.1230	0.0817	0.1121	0.0799	0.1013	0.0721	0.0978	0.0709

Table 2 presents a summary of the descriptive data for firms in our sample sorted by operating cash flows. The data is from annual observations from the CompuStat database and variable definitions are based on Frank and Goyal (2009) and Bates et al., (2009).

Table 3.
Regression estimation–full Sample.

Independent variable	Expected coefficient sign	Coefficient	Std error	*P*-value
Industry Debt (INDTDM)	+	0.5108***	0.0096	0.000
Market to Book (MB)	–	−0.0092***	0.0003	0.000
Asset Tangibility (TANG)	+	0.2219***	0.0103	0.000
Profitability (PROF)	–	−0.4877***	0.0084	0.000
Firm Size (SIZE)	+	0.0431***	0.0015	0.000
Inflation Rate (RATE)	+	0.0042***	0.0005	0.000
Cash Flow Volatility (CFV)	+	0.1032***	0.0174	0.000
Fixed effects		Firm		
Observations		184,139		
R^2		0.253		

Table 3 presents the firm fixed effects regression results for the full sample estimating the effect on firm leverage by the independent variables.
***Significant at 1% level
**Significant at 5% level
*Significant at 10% level

Table 4.
Regression estimation by OCF quartiles.

Independent Variable	Lowest operating cash flow (1st quartile)		2nd quartile–operating cash flow		3rd quartile–operating cash flow		Highest operating cash flow (4th quartile)	
	Coefficient/ Std error	*P*-value	Coefficient/ Std error	*P*-value	Coefficient/ Std error	*P*-value	Coefficient/ Std error	*P*-value
Industry Debt (INDTDM)	0.5774***	0.000	0.5176***	0.000	0.5329***	0.000	0.4252***	0.000
Market to Book (MB)	−0.0066***	0.000	−0.0114***	0.000	−0.0082***	0.000	−0.0058***	0.000
Asset Tangibility (TANG)	0.3016***	0.000	0.2877***	0.000	0.2238***	0.000	0.1237***	0.000
Profitability (PROF)	−0.2780***	0.000	−0.5139***	0.000	−0.6334***	0.000	−0.8015***	0.000
Firm Size (SIZE)	0.0522***	0.000	0.0452***	0.000	0.0568***	0.000	0.0456***	0.000
Inflation Rate (RATE)	0.0026***	0.006	0.0043***	0.000	0.0045***	0.000	0.0065***	0.000
Cash Flow Volatility (CFV)	**0.3128*** **	**0.000**	**0.1028*** **	**0.001**	**−0.0357**	**0.312**	**0.0384**	**0.160**
Fixed effects	Firm		Firm		Firm		Firm	
Observations	46,167		46,987		46,570		44,381	
R^2	0.2495		0.3039		0.3637		0.3594	

Table 4 presents the firm fixed effects regression results for the full sample estimating the effect on firm leverage by the independent variables.
***Significant at 1% level
**Significant at 5% level
*Significant at 10% level

Again the results are consistent with Frank and Goyal (2009), where the six factors have coefficients with the expected signs and remain significant at the 1% level. However, the coefficient on the cash flow volatility variable (CFV) is positive and significant only for firms in the lowest two quartiles of operating cash flow. Both quartiles have coefficients that are significant at the 1% level and we see that for firms in the lowest quartile, the coefficient is three times larger than for firms in the 2nd lowest quartile. Of note is the observation that firms with above median operating cash flows (3rd and 4th quartiles) do not exhibit a statistically significant relationship between debt and cash flow volatility. These results indicate that firms may respond to the increase in cash flow risk by increasing the level of debt in their capital structure, but only if they are a firm with comparatively low operating cash flows. Firms with comparatively high operating cash flows do not experience the same increased debt levels in response to increased cash flow risk. Overall, the results based on quartiles indicate that firms may utilize additional debt as a response to cash flow volatility, but only if the firm has low levels of operating cash flows. It appears the increases in debt may be needed to fund necessary expenses where low operating cash flows were not sufficient. Firms with higher levels of operating cash flows do not need to issue debt in response to volatile cash flows, indicating current operating cash flow levels may be sufficient to satisfy funding needs. These results provide a further insight to the findings of Bates et al., (2009). While increases in cash flow volatility may result in greater cash holdings as a precaution, the source of that cash may be determined by how much operating cash flow a firm generates. Firms with the lowest operating cash flow may issue debt, while firms with higher operating cash flow may have sufficient internal resources to meet their needs.

5. Conclusion

In this study, we examine the relationship between cash flow volatility and capital structure decisions. We see that one way firms respond to increasing cash flow risk is to increase their use of leverage. While this relationship is evident in the aggregate (there is a positive and significant relationship between cash flow volatility and the use of debt), the significance is driven by firms with the lowest operating cash flows. We sort firms into quartiles based on their operating cash flows and find that the firms in the lowest two quartiles have a positive and significant relationship between debt and cash flow volatility. We see that firms in the highest two quartiles of operating cash flows show no such statistically meaningful relationship.

The results suggest that increases in cash flow risk (Bates et al., 2009) affect capital structure decisions and are consistent with the Huang and Ritter (2016) study that demonstrates a reliance on debt for firms experiencing operating cash flow shortfalls.

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