# The Effect of Operating Risk (Cash Flow Volatility) on Capital Structure: A Survey of the Literature

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**Abstract.** Capital structure, a critical indicator of a company's operations, is often considered to be influenced to some extent by operational risk. Prior researchers have been divided on the subject of the latter's impact on the former. This survey encompasses theoretical and empirical papers in this field from recent decades, comparing their information cross-sectionally, including perspectives, key assumptions, definitions of variables, empirical models, selection of data, etc. A seminal theoretical paper is presented in detail. In the work, evidences suggest that, although the methodologies used and the conclusions reached by various scholars are not identical, overall, a firm's cash flow volatility is negatively related to its financial leverage. It is highly recommended that subsequent researchers conduct further research into the causal relationship between the two.

**Keywords:** capital structure, operational risk, cash flow volatility, financial leverage

## 1 Introduction

This paper considers logic, relevance and citation rate as the most important factors in the selection of papers, particularly relevance. Targeted literature mainly focuses on two issues: 1, The influence of cash flow volatility on capital structure; 2, The impact of cash flow on the target speed of capital structure adjustment. Among these papers, Chinese scholars' papers focus more on the second question, which is probably because Chinese researchers seem to be more inclined to use Trade-off theory to group and optimize their assets, mentioning "the target debt ratio" in almost all the relevant papers. Finding provides evidence that the high earning volatility leads to a reduction in the firm's use of debt. Thus, the lower the cash flow volatility is, the more the company prefer to borrow money, which results in higher leverage. The rest of this paper proceeds as follows. A brief overview of theoretical literature is presented in the second part. In the third part of the work, several key features of empirical literature are compared in detail, including research stages, standpoints, hypotheses, modeling approaches, definitions of variables. An important theoretical essay is discussed in the forth part. And the end is the conclusion.


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## 2 Theoretical literature summary

Cash flow is essential in the supply of the company, who utilise internal and external device in financing. Unlike internal funds, including corporate own capital and last year's residual value, external funds are usually raised through stock or debt. According to the Comparative Study of Priority Financing and trade-off theory by Liu Jianhua and Zhang Minfeng in 2021, enterprises tend to finance internally due to the low cost and low risk rather than adopt external financing, for stocks and bonds are more volatile [1]. The fluctuation of cash flow plays an important role in enterprise's debt repayment and risk resistance. It largely influences enterprise's credit decision-making and debt-paying ability. In general, most scholars assert that operational risk does have an impact on the financing structure of enterprises.

## 3 Empirical literature summary

Among the empirical papers surveyed, the most important ones for the topic this paper is examining are those in which the relationship between the volatility of corporate cash flows and the capital structure of the firm is explicitly explored. In fact, the scope of the business logic within the firm that researchers have explored in recent decades has, at least in broad terms, been naturally and continuously narrowing. What this paper is concerned with, as mentioned earlier, is a crucial turning point in this ongoing process concerning the philosophy of decision-making within the company. This process can be roughly divided into three stages with partial overlap.

In the first phase, around 1980-2010, most researchers have been testing whether overall firm volatility has a significant and non-negligible relationship with a firm's financing structure, although they have not reached a consistent conclusion on this issue. Among them, Bradley, Jarrell and Kim in 1984, Kim and Sorensen in 1986, and Halov, Heider and John in 2009 find that firm volatility is significantly negatively related to the proportion of debt in the capital structure [2-4]; Minton and Schrand in 1999 find that cash flow volatility can negatively affect discretionary investment, while Friend and Lang in 1988 find that volatility is positively related to leverage to a certain extent [5,6]. However, there are also researchers who have found no significant correlation between the two, such as Leary and Roberts in 2005, Frank and Goyal in 2009, and Antoniou, Guney, and Paudyal in 2008[7-9]. It is worth noting that there are also some far-reaching papers in academia that do not include volatility in their scholastic considerations when considering factors affecting capital structure, such as Kayhan and Titman in 2007 and Leary and Roberts in 2014[10,11]. Studying such a relatively large topic, they rarely refine this layer further and proceed to explore the characteristics of the volatility of some of the more detailed key indicators of firms in relation to their capital components.

Subsequently, in the second period, around 2010-2021, scholars began to expand on previous work and concentrate on the connection between a company's operating risk and its capital structure. These studies under this theme have generally concluded that the risk of cash flow and the leverage of a firm are negatively correlated. For example,

Keefe and Yaghoubi in 2014 use data to argue that companies with high cash flow volatility are more likely to use bonds with shorter repayment periods and using fewer debt financing instruments [12]. They reached a similar conclusion in 2016 and quantified this effect: Keefe and Yaghoubi in 2016 show that a one standard deviation increase in the mean of cash flow volatility implies an approximate 24% decrease in the long-term debt ratio, a 26% decrease in the probability of holding debt with more than 10 years to maturity, and a 39% increase in the probability of holding neither short-term nor long-term debt [13]. In addition, Dudley and James in 2015 argue that operational volatility affects more significantly on the firms' leverage in financial distress than healthy firms, and that the impact is still negatively correlated [14]. They found that those in financial distress, while actively increasing the proportion of debt financing at times of reduced cash flow volatility, tend not to reduce their leverage due to increased cash flow volatility. This is mainly because companies that are already in a difficult position are already finding it difficult to make a profit or even raise capital again. Another perspective on financially distressed firms is provided by Ghasemzadeh, Heydari and Mansourfar in 2021, who argue that the implications of increased volatility in earning on the decline in corporate debt ratios are significant.In this relationship, financial distress plays a moderating role, i.e., it reduces the negative correlation between the two[15]. Researchers have likewise considered the situation in several different developing countries and found some discrepancies with most developed countries. In the Chinese context, Memon, Chen, Tauni and Ali in 2018 find that, overall, higher cash flow volatility in firms gives rise to lower debt ratios, although evidence of such an inverse association is lacking in SOEs state-owned enterprises [16]. Tripathi and Ahamed in 2021 conclude in their study of Indian companies that while operating cash flow and leverage are inversely correlated, the volatility of operating cash flow and overall debt are positively correlated [17]. In Tehran, according to Mosavi, Karimipoua, Zarei and Heidari in 2015, there is not enough evidence to prove that the corporate capital structure is impacted due to the operational volatility [18]. Unlike most scholars, who focus on the "impact of cash flow volatility on firm capital structure", Park and Jang in 2013 explore the "impact of changes in debt on firm cash flows" in the opposite direction [19]. The results show that a firm's debt issuance reduces overall free cash flow, due to the issue, known as the agency problem, that managers may choose to over-invest in this case, given the firm's cash flow surplus.

Finally, in the third phase 2015-2022, researchers have conducted more detailed studies than in the previous phase. For example, Dufour, Luu and Teller in 2017, Xiao, Chang and Cui in 2015, Jiang, Xiao and Wang in 2015, Peng and Hu in 2019 and others, focus more on the companies' adjusting speed of capital structure on account of the cash flow, a more in-depth detailed issue that involves the firm's target leverage ratio [20-23]. The second stage of the process is thought to be relatively more critical, as the empirical results from this stage provide clearer and more general guidance to companies in their internal analysis and external decisions.

In the work, two main hypotheses are most widely tested. The first hypothesis, that "cash flow volatility exhibits a negative relationship with debt use", is tested, though the specific statement of the hypothesis and the methodology used to test it are not identical, by Keefe and Yaghoubi in 2014 and 2016, and Memon, Chen, Tauni and Ali

in 2018 and others [12,13,16]. Together with Mosavi, Karimipoua, Zarei and Heidari in 2015, they also test the second hypothesis that firms with low cash flow volatility are more likely to use bonds with long maturities, and vice versa [18]. Besides, Mosavi, Karimipoua, Zarei and Heidari in 2015 and Ghasemzadeh, Heydari and Mansourfar in 2021 also test whether there is a significant relationship between operational risk and capital structure, which is in fact closely related to the first hypothesis mentioned before [15,18]. Of course, there are a number of other hypotheses that have been included in some of the papers due to the varying situations of the researchers themselves. For example, Dudley and James in 2013 also set up a hypothesis mainly on firm behaviour: the propensity to save debt proceeds as cash is greater when cash-flow volatility is low [24]; while Halov, Heider and John in 2009 consider the issue of optimal capital structure in their hypothesis: optimal leverage choices would be decreasing in the volatility of the firm cash flow variance [4].

Overall, these assumptions are largely supported by the data collected by the researchers, although with a few exceptions. Keefe and Yaghoubi in 2014 and 2016, and Memon, Chen, Tauni and Ali in 2018 all conclude that "Firms with high cash flow volatility issue less debt" and "The probability of a firm using longer (shorter) maturity debts decreases (increases) with cash flow volatility"[12,13,16]. Others, including Halov, Heider and John in 2009, Park and Jang in 2013 and Ghasemzadeh, Heydari and Mansourfar in 2021, have reached similar conclusions regarding that the firm's risk of volatility and debt ratio are negatively correlated [4,15,19]. Exceptions seem, at least in the sample studied, to occur more in developing countries. For example, Mosavi, Karimipoua, Zarei and Heidari in 2015 suggest that in Tehran there is no significant association between the risk of the cash flow from the regular operation of a firm and its decisions about capital structure[18]; one of the conclusions drawn by Tripathi and Ahamed in 2021 shows that in India, there is there is a positive relationship between total debt (adjusted for total market value of the firm) and volatility of the operating cash flow both in their full sample and the two highest quartiles[17].

The test methods used by researchers are multitudinous. The relatively much used method is GLM (Generalized Linear Model), demonstrated by Keefe and Yaghoubi in 2014 and Memon, Chen, Tauni and Ali in 2018, where the latter also used the Ordered Probit regression method to develop tests on maturity-related issues [12,16]. The use of other methods is somewhat more sporadic. For example, in order to test the association between the operational risk and debt ratio of firms, Mosavi, Karimipoua, Zarei and Heidari in 2015, Halov, Heider and John in 2009, and Ghasemzadeh, Heydari and Mansourfar in 2021 use, respectively the Merton method, Multivariate linear regression and a MIMIC model of Structural Equations Modeling (SEM), respectively [4,15,18]. In addition, Minton and Schrand in 1999 use annual cross-sectional regressions to test how costly corporate volatility is[5]; Dudley and James in 2015 use the OLS (Ordinary Least Square) and PROBIT models to test whether the propensity to save debt proceeds as cash is greater when cash-flow volatility is low[14]; Park and Jang in 2013 use 2SLS (Two-Stage Least Square) and 3SLS (Three-Stage Least Square) regression methods to explore the intrinsic relationship between the firm's capital structure, free operating cash flow, diversification and the performance of the company[19]; etc.

There are two key corporate indicators: cash flow volatility and capital structure, the definitions of which are not standardised and need to be clearly established by researchers. In terms of cash flow volatility, most scholars have used relatively traditional measures. For example, Minton and Schrand in 1999 use the CVCP (firm's industry-adjusted coefficient of variation in operating cash flows) as a measure[5]; Dudley and James in 2015 adopt standard deviation of industry operating cash flows using quarterly accounting information[14]; Mosavi, Karimipoua, Zarei and Heidari in 2015 and Memon, Chen, Tauni and Ali in 2018 both choose standard deviation of corporate operating cash flow from operation as the volatility of cash flow, in three-year rolling window and in five-year rolling window respectively[18,16]. Keefe and Yaghoubi in 2014 take into account the conditional operating cash flow measure of De Veirman and Levin in 2011, and two years after that, they consider eight different measurements of cash flow volatility, introducing operating income before depreciation/cash-based operating profit and other indicator in the window sizes of one or five years [12,13,25]. Unlike others, Park and Jang in 2013 focus on the company's future growth expectations, using the same measurement as Richardson in 2006 to definite the source of cash flow, that is, the difference between free cash flow from existing assets already in place and free cash flow from corporate future growth opportunities [19,26].

In terms of capital structure, the measures chosen by researchers do not exceed six ratios overall, which are a random combination of three indicators in the numerator and two indicators in the denominator. The numerator is often: all liabilities, short and long-term debt, or just long-term debt, while the denominator is generally the company's value observed from the stock market, and the book value, measured as the value of the firm's total assets. Keefe and Yaghoubi in 2014 and Memon, Chen, Tauni and Ali in 2018 both include these six leverage ratios in their empirical tests [12,16]. Other scholars have tended to choose one or two of these six indicators. For example, Park and Jang in 2013 and Tripathi and Ahamed in 2021 both use total debt as the numerator of the ratio but choose the firm's book value of total assets and corporate stock value respectively for the denominator [17,19]. Mosavi, Karimipoua, Zarei and Heidari in 2015 use total assets as the normalised divisor in determining this key ratio, choosing the firm's debt and long-term debt as the dividend [18]. To sum up, although various methodologies are adopted and different conclusions are drawn, corporate cash flow volatility is, generally speaking, negatively related to the financial leverage.

## 4 Individual Paper

To better study this topic, an important essay was selected to explain the relevant content in detail -- Corporate debt value, bond covenant, and optimal capital structure by Hayne E. Leland in The Journal Of Finance [27]. Actually, the value of corporate debt and cash flow volatility, and capital structure are interrelated variables. A lack of understanding about one of these aspects can impact the firm's optimization. The article examines the indicators in a unified analytical framework, raising two main conjectures. Firstly, the author refers to the work by Brennan and Schwartz in 1978, who carried out the initial scientific study on optimal leverage [28]. When a firm's

unleveraged value follows a diffusion process with continual variations, the author employed numerical approaches to calculate the optimal leverage, which is a significant beginning yet with certain restrictions. This article expands the work by exploring two potential causes of bankruptcy and draws closed-form conclusions by deeply investigating the securities of companies whose value is reliant on the underlying company but otherwise independent of time. Secondly, this paper builds on the findings of Merton 1974 and Black and Cox 1976, who used an explicit dynamic model to study indefinite duration debt [29,30]. The authors construct a closed-form solution for the best capital structure based on their results. According to the authors' second premise, additional debt issuance will harm present debt holders, which is typically forbidden by bond covenants. Different debt issues, according to the author, will hurt current owners. Large discontinuous debt buybacks via tender offers, on the other hand, may benefit both stock and bondholders in some situations if refinancing costs are low.

The author creates a straightforward dynamic model of a leveraged business in section I and obtains values for time-independent securities. The author considers a company whose activity is valued as an unknown, which follows a diffusion process with constant fluctuations of returns. Furthermore, the authors make the supposition that the financial structure of the company has no bearing on the stochastic process of the firm's "asset value." Any net cash outflow related to the leverage option must thus be covered by the sale of further stock. A number of variables, such as the constant interest rate and some boundary conditions, are added to create an equation. The firm's total value is equal to the value of the firm's assets plus the value of the tax deduction claimed on the coupon, minus the value of the costs of bankruptcy. The author reaches precise results by taking into account the functional relationship between the firm's total value and the other particular characteristics. Taxes affect a company's value when endogenous conditions determine bankruptcy. In this case, taxes and bankruptcy costs are essential factors in determining the value of debt. There are two main ways that the issuing of debt impacts the firm's overall value. First of all, the likelihood of insolvency reduces the firm's value. Secondly, the interest payments are tax-deductible, raising the enterprise's price. The value of these two effects is independent of time and is determined by the firm's value. The second case concerns debt with no protective covenant, which is the endogenous bankruptcy case. The author broadly explores three areas. The first is the data analysis of debt value, the second is the risk structure of interest rates, and the total firm value and equity value. To explore the relationship between taxes and bankruptcy on debt value. The author concludes that higher bankruptcy costs reduce the value of debt. At the same time, it is interesting to note that an increase in a company's tax rate increases the value of debt by reducing the level of bankruptcy. The debt capacity of an organisation is inversely correlated to the value of its assets and declines as business risk and bankruptcy expenses rise. As business taxes and risk-free rates rise, debt capacity also rises. Additionally, companies with junk debt behave considerably differently from companies with investment-grade debt in terms of their overall firm value. The overall worth of a firm may grow when the company's risk increases in the context of bankruptcy expenses and corporation taxes. At the same time, an increase in the risk-free rate may also increase the company's overall value. The previous section has shown an equation that describes the bankruptcy level of total corporate market

value derived from coupons. And now, the author wants to differentiate the equation and then set the derivative equal to zero to solve the optimal coupon as a function of asset value. The next thing to do is substitute this equation into another different equation. The result shows that the overall worth of a firm may grow when the company's risk increases in the context of bankruptcy expenses and corporation taxes. An increase in the risk-free rate may also increase the company's overall value. A graph plots total firm value at different leverage levels for three asset volatility levels. As can be seen from these statistics, when compared to an unleveraged corporation, improving the financial structure may raise the value of a company by as much as 25% to 40% for normal parameters. The data leads the author to conclude that moving from no leverage to ideal leverage has a lot of potential benefits. The riskier businesses' optimum leverage is always lower than, the less risky firms. Thus, evidences show that the riskier and more volatile the firm's assets, the lower the firm's optimal debt rate. The author's conclusions are in line with Brennan and Schwartz's 1978 result that, even when bankruptcy costs are negligible, the optimal level of leverage is below 100%. Too much debt can lead to bankruptcy, and while no fines relate to bankruptcy, coupon payments lose their tax benefits. Increased bankruptcy costs are expected to raise the interest rate, assuming the coupon remains unchanged. The ideal coupon falls as the expense of bankruptcy increases. As a result, the risk of bankruptcy falls, and the yield spread falls as well. When interest rates are high, the enhanced tax shield offsets the higher borrowing costs, which might be unstable because supply is projected to decline as rates rise. Despite the increased borrowing, the yield differential for optimal leverage narrows when the risk-free rate rises. Additionally, the authors looked at bankruptcy cases when the value of the company's assets was less than the principal. Based on the study's findings, the authors propose their hypothesis that, unlike the unprotected situation, the value of debt rises with an increase in coupons. Still, the value of debt continuously decreases with an increase in corporate risk or higher risk-free interest rates. In the sixth section of this paper, the author discusses the debt value and capital structure and mentions several situations. And one of them worth noticing is the bet cash payout by the firm. Dividends given to shareholders or after-tax coupon payments that do not completely cover equity financing may result in a net cash outflow. According to the authors, cash payments have a higher likelihood of becoming insolvent, which would result in the loss of tax benefits when they are proportional to the value of the company's assets. Therefore, covenants that prohibit businesses from selling assets to pay coupons will frequently be advantageous to safeguard the interests of shareholders. The selling of assets by the company to pay the coupons on the debt after it has been issued will benefit shareholders even though such a covenant cannot be enforced. Once this incentive is in place, debt holders would stop paying their debts, which would decrease the amount of ideal leverage.

To summarise, the values of both protected and unprotected "investment grade" debt performed exactly as was predicted. The "junk" bond table that is unprotected is distinct. For instance, a rise in business risk and a fall in coupons raise the value of debt. With the latter, this behavior does not occur. A rise in the risk-free rate leads in a greater ideal debt level, hence companies with higher bankruptcy costs may have lower optimal debt rates than companies with lower bankruptcy costs.

## 5 Conclusion

In the investigation, the result shows that there is a relatively solid theoretical support for the impact of cash flow volatility on a firm's capital structure.

According to the survey of the relevant empirical literature, albeit with some exceptions, evidences show that most researchers conclude that operational risk and a firm's use of debt are significantly and negatively related. There are also a number of scholars who conclude in their studies regarding the maturity of bond repayments: those companies with high cash flow volatility are also prone to use bonds with shorter maturity. There is no single standard method for empirical testing in this area. The one that has been used relatively often is the GLM (Generalised Linear Model); Other methods, however, such as OLS, 2SLS, 3SLS, and annual cross-sectional regressions are also used. In terms of the measurement of variables, cash flow volatility is often interpreted as the standard deviation of a company's operating cash flow, although there is no consensus among researchers on the exact criteria for defining operating cash flow and the choice of time window. Scholars use debt ratio to define a firm's capital structure, mostly specifying this metric by dividing overall debt by the firm's market or book value.

Moreover, among all the papers surveyed, an important paper, by Leland in 1994, is detailedly discussed to illustrate the relevant content in detail from a theoretical perspective. This influential article provided a robust theoretical basis for explaining the factors (including cash flow risk) that affect a firm's capital structure and pointed the way for subsequent scholarly research.

The majority of papers examining the relationship between cash flow volatility and leverage focus on the correlation relationship. It seems that no scholars have made a more in-depth study on the causal relationship between the two. While this may be more difficult in all respects, it is undoubtedly a promising future research direction. Hence, it is highly recommended that in order to better comprehend the causal relationship between operating risk and capital structure, future researchers pay more attention to the temporal relationship between the two relationships in their choice of data, as well as take full account of the diversity of cause and effect.

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