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Capital structure volatility, financial vulnerability, and stock returns: Evidence from Korean firms

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ABSTRACT

Using a large dataset of listed firms in Korea, we test whether volatility of capital structure affects stock returns in a systematic way. Stock returns of high capital-structure-volatility firms belonging to different size groups move together over time, suggesting the existence of a capital-structure-volatility factor. This factor earns a sizable, negative risk-premium of −1.08% on a monthly basis over the sample period spanning 2004–2017, and the factor return is adversely affected by deteriorating financial market conditions. Moreover, the cross-sectional relation between capital structure volatility and stock returns is also negative. Overall results indicate that the capital structure volatility may represent another pricing puzzle in stock markets.

1. Introduction

Capital structure has been one of the central issues in finance research since the seminal work of Modigliani and Miller (1958). While empirical studies testing the capital structure theories have had both successes and failures in explaining the observed heterogeneity in corporate capital structure, the pervasive assumption in many studies has been that corporate leverage is stable over time.

However, the validity of such an assumption was questioned in a recent study by DeAngelo and Roll (2015), where they conducted an extensive analysis of the U.S. firms over long horizons. Surprisingly, they found that "capital structure stability is the exception, not the rule… and… industry-median leverage varies widely over time." While they do not extensively analyze the cause of leverage instability, they conjecture that it could be related with the budget constraint.[1] Specifically, they maintain that since corporate financial policies such as investment, dividend, and leverage decisions are interlinked through the budget constraint, wide variation in leverage across time could be a consequence of the instability of other components of corporate financial policies. A subsequent study by Campbell and Rogers (2018) examined the issue of capital structure instability in European countries. They found that, consistent with DeAngelo and Roll (2015), leverage of European companies show substantial volatility across time. Moreover, firms with highly volatile capital structure are characterized by being smaller and less profitable, and having more volatile operating and investing activities or stricter dividend policies, compared to firms with stable capital structure.

The questions then arise: is the instability of corporate capital structure over time a rule rather than an exception for firms in countries other than the U.S or the European countries? More importantly, what ramifications the instability of capital structure have on stock prices? In seeking the answers, we analyze a large dataset of public firms in Korea over the period 2004–2017. Korea has

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[1] A firm's budget constraint means that its source of funds must equal its use of funds: ΔDebt + Net Income = Capital Expenditure + Payout (Lambrecht and Myers, 2012).

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Table 1
Definition of variables.

Variable	Definition
Firm age	Number of years since inception of the firm
Size	It is measured by market capitalization in hundred billions of KRW.
Return volatility (VOL)	Standard deviation of monthly excess returns of stocks. It is computed using 36 monthly observations.
Beta	Slope coefficient of market model. It is computed using 36 monthly observations.
Leverage (D/A)	Total debt / (total debt + book equity)
Capital structure volatility (CSV)	Standard deviation of quarterly total debt / (total debt + book equity). It is computed using 20 quarterly observations (for computation, at least 13 consecutive quarters are needed).
Financing deficit	(dividend payment + capital expenditure + change in working capital – operating cash flow) / lagged total assets (defined by following Frank and Goyal, 2003).
Cash flow volatility	Standard deviation of quarterly (operating cash flow / sales). It is computed using 20 quarterly observations (for computation, at least 13 consecutive quarters are needed).
default likelihood indicator (DLI)	Measure of default risk. It is expected default probability within one year calculated based on Merton's (1974) option pricing model.
Book-to-market ratio (B/M)	Book value of equity / market capitalization
Momentum	It is measured by prior return for the six-months ending two months before the dependent variable return.
Liquidity	It is measured by (trade volume / total stocks outstanding) for the latest month preceding the calculation of monthly stock returns.
Standardized unexpected earnings (SUE)	Measure of earning surprises. It is computed as the earnings in most recent quarter in excess of the earnings announced four quarters ago normalized by the standard deviation of the difference in earnings over the prior eight quarters (defined by following standard practice in post-earnings announcement drift literature).
Whited-Wu index (WWI)	Measure of financial constraints. It is defined as per Whited and Wu (2006), and is equal to: −0.091 (cash flow/ total assets) −0.062 (dividend dummy) + 0.021 (long-term debt/total assets) −0:044 (log total assets) + 0.102 (firm's industry sales growth) −0.035 (firm's sales growth). Industry classifications are based on GICS (Global Industry Classification Standard) 25 industry groups adapted to Korea.

Table 2
Summary statistics of capital structure change.

No. obs.	Mean	10th percentile	1st quartile	Median	3rd quartile	90th percentile
188,187	−0.005	−0.200	−0.090	0.000	0.083	0.200

This table reports the distribution of firm-level change in leverage during the 20 quarters (the period over which our measure of capital structure volatility is computed) for the 188,187 firm-months.

large and liquid equity capital markets. At the end of 2016, Korea ranks 11th in market capitalization and third in stock market turnover ratio (World Bank).

We use both time-series and cross-sectional tests to examine the relation between capital structure volatility and stock prices. We measure capital structure volatility by the standard deviation of book leverage using quarterly financial statement data and construct a capital-structure-volatility factor using a methodology proposed by Lamont et al. (2001), who constructed a financial-constraints factor. This approach was adopted later by Whited and Wu (2006), Hahn and Lee (2009), and Campello and Chen (2010), among others, to form their own versions of the financial-constraints factor.

This paper contributes to the literature in two ways. First, the empirical findings of this paper add to the emerging research on the instability of corporate capital structure. Second, and more importantly, we investigate the relation between volatility of capital structure and stock returns. To the best of our knowledge, our study is the first to examine this issue. The empirical results from our time-series and cross-sectional tests strongly indicate that stock returns are negatively associated with capital structure volatility. This suggests that there may exist a capital-structure-volatility pricing puzzle in stock markets.[2]

The remainder of this paper is organized as follows. Section 2 explains our data and research methodology. Section 3 presents empirical findings. Section 4 concludes.

2. Data and methodology

Our sample consists of public firms in Korea. We gather financial statement and stock price data from FnGuide, a leading data provider in Korea. The unit of analysis is a firm-month. All firm-month observations up to December 2017 are initial candidates for inclusion. Since the number of firms reporting quarterly financial statements is considerably smaller before 2004, and the classification of firms (into quintiles of size or capital structure volatility) is made at the end of June each year, the starting month for the sample is set to July 2004. The final sample consists of 188,187 firm-month observations.

[2] Like cash flow or earnings volatility, capital structure volatility can be viewed as a risk in terms of corporate financial status. Moreover, we find that high capital structure volatility is associated with high financial vulnerability. In this respect, the negative relation between risk and return is puzzling.

Table 3
CSV Portfolios, returns, and characteristics.

		Number of firms	Excess returns	Firm age	VOL	Beta	D/A	CSV	DLI	Financing deficit
Panel A: Value weighted										
Small-cap										
Low CSV	SL	109	1.49	30	0.52	0.96	0.16	0.02	0.03	0.00
Mid CSV	SM	129	0.99	29	0.56	1.00	0.27	0.06	0.04	0.04
High CSV	SH	149	−0.19	26	0.67	1.10	0.32	0.13	0.08	0.20
Mid-cap										
Low CSV	ML	127	1.20	33	0.47	0.98	0.13	0.02	0.01	0.00
Mid CSV	MM	135	0.94	31	0.52	1.09	0.24	0.06	0.02	0.04
High CSV	MH	134	0.01	28	0.62	1.16	0.28	0.13	0.05	0.16
Large-cap										
Low CSV	BL	158	0.97	41	0.36	1.06	0.12	0.02	0.00	−0.04
Mid CSV	BM	131	0.66	36	0.41	1.03	0.21	0.06	0.01	−0.02
High CSV	BH	105	0.59	35	0.47	1.05	0.24	0.11	0.02	0.05
HIGH CSV			0.14	30	0.58	1.10	0.28	0.13	0.05	0.14
LOW CSV			1.22	34	0.45	1.00	0.14	0.02	0.01	−0.01
CSV PORT (*t*-stat)			−1.08 (−5.57)	−5	0.13	0.11	0.14	0.10	0.02	0.15
Panel B: Equal weighted										
Small-cap										
Low CSV	SL	109	2.00	30	0.53	0.95	0.16	0.02	0.03	0.00
Mid CSV	SM	129	1.64	29	0.57	0.99	0.28	0.06	0.05	0.04
High CSV	SH	149	0.57	26	0.67	1.10	0.32	0.13	0.08	0.20
Mid-cap										
Low CSV	ML	127	1.44	33	0.47	0.97	0.13	0.02	0.01	0.00
Mid CSV	MM	135	1.13	31	0.53	1.08	0.24	0.06	0.03	0.05
High CSV	MH	134	0.11	27	0.63	1.16	0.28	0.13	0.05	0.18
Large-cap										
Low CSV	BL	158	1.16	37	0.42	0.97	0.13	0.02	0.01	0.01
Mid CSV	BM	131	0.98	35	0.48	1.05	0.24	0.06	0.02	0.03
High CSV	BH	105	0.36	32	0.55	1.09	0.27	0.12	0.03	0.13
HIGH CSV			0.35	28	0.62	1.12	0.29	0.13	0.05	0.17
LOW CSV			1.53	33	0.47	0.96	0.14	0.02	0.02	0.00
CSV PORT(*t*-stat)			−1.18(−7.25)	−5	0.14	0.15	0.15	0.11	0.04	0.17

This table reports summary for nine value-weighted and nine equal-weighted portfolios cross-sorted by market capitalization and capital structure volatility. Definition of variables is provided in Table 1. The sample period is from July 2004 to December 2017. In each June end from 2004 to 2017, firms are independently sorted into tertiles based on market capitalization and into tertiles based on capital structure volatility (CSV). Then, all firms are cross-classified into one of the nine portfolios. Small-cap firms are firms that are in the bottom 33.3% of the sample in a given year, sorted on market capitalization. Mid-cap firms are firms that are in the middle 33.3% of the sample. Large-cap firms are firms that are in the top 33.3% of the sample. Similarly, low, middle, and high capital structure volatility (CSV) are firms that are in the bottom 33.3%, the middle 33.3%, and the top 33.3% of the sample sorted by capital structure volatility in a given year. In addition to the nine base portfolios, three more portfolios are formed that are linear combinations of the nine portfolios: HIGH CSV = (BH + MH + SH)/3, LOW CSV = (BL + ML + SL)/3, CSV PORT = HIGH CSV − LOW CSV. We report the sample mean of each portfolio's monthly returns in excess of one-month risk-free rate in percentage. In each portfolio, we also calculate average number of firms, firm age, return volatility (VOL), beta, leverage (D/A), capital structure volatility (CSV), default risk (DLI) and financing deficit by averaging over the entire sample period.

We define the capital structure volatility, our key variable of interest, by the standard deviation of book leverage over the 20 quarterly observations.[3] Definition of variables is provided in Table 1.

We also define the capital-structure-volatility factor, the central variable for our time-series tests, following an approach proposed by Lamont et al. (2001). At each June end, the sample firms are sorted independently based on firm size and capital structure volatility (CSV) into the top 33.3, the middle 33.3, and the bottom 33.3%. Then, all firms are classified into one of the nine groups: small size/low CSV (SL), small size/middle CSV (SM), small size/high CSV (SH), medium size/low CSV (ML), medium size/middle CSV (MM), medium size/high CSV (MH), large size/low CSV (BL), large size/middle CSV (BM), and large size/high CSV (BH). Nine portfolios are constructed according to this classification scheme, and both value-weighted and equal-weighted average monthly portfolio returns are calculated.

In addition to these nine base portfolios, three more portfolios are formed that are linear combinations of the nine portfolios. The

[3] In defining the volatility measure, we follow Rountree et al. (2008). In that study, cash flow (earnings) volatility is measured by the standard deviation of operating cash flows (earnings) scaled by total assets, with 20 quarterly observations used in the computation.

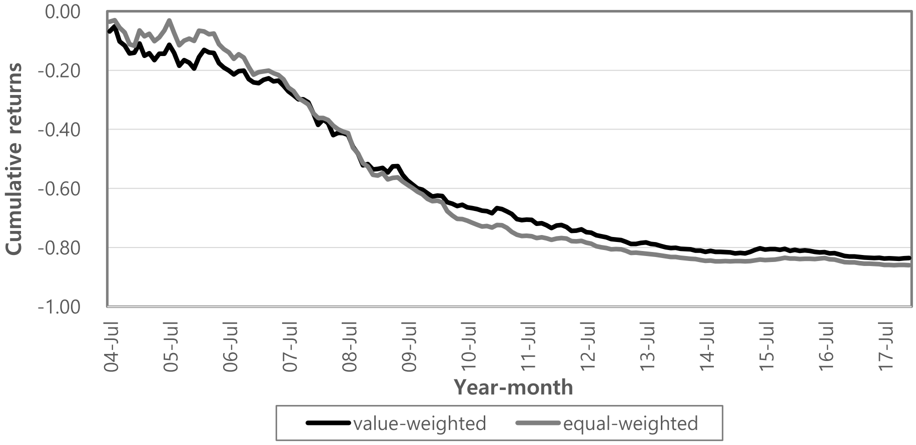

Fig. 1. Cumulative returns of CSV PORT. This figure plots cumulative returns of the value- and equal-weighted CSV PORT over the period from July 2004 to December 2017. CSV PORT is a zero-cost factor-mimicking portfolio for capital structure volatility. Details are provided in Table's 3 caption.

first, HIGH CSV, is the equal-weighted average of the three most-volatile-capital-structure portfolios in each of the three size categories: HIGH CSV = (BH + MH + SH)/3. The second portfolio, LOW CSV, is the equal-weighted average of the three least-volatile-capital-structure portfolios in each of the three size categories: LOW CSV = (BL + ML + SL)/3. The third portfolio, CSV PORT, is the difference between these two portfolios: CSV PORT = HIGH CSV – LOW CSV. The CSV PORT is a zero-cost factor-mimicking portfolio for capital structure volatility.

3. Empirical results

Table 2 presents summary statistics of the firm-level change in leverage between the end and start of the 20 quarters, over which our measure of capital structure volatility is computed. It shows that 50% of the entire 188,187 firm-months have changed their leverage ratios at least 8% in absolute value. Capital structure changes at the tail sides of the distribution are even more striking: 20% of the firm-months have changed their leverage ratios at least 20% in absolute value. These results suggest that the capital structure of the majority of Korean firms is not stable over time.

Table 3 reports average returns and characteristics of the nine base portfolios cross-sorted by size and capital structure volatility (CSV). To obtain portfolios' mean returns and characteristics, we first value and equal weight returns and characteristics each month, and then, we average the monthly portfolio returns and characteristics over the entire sample period. Several interesting features are apparent. First, the more volatile the capital structures, the lower the returns in each size group. For instance, value (equal)-weighted average monthly excess returns for small-cap, low, mid, and high CSV portfolios are 1.49 (2.00), 0.99 (1.64), and −0.19% (0.57%), respectively, as shown in Panel A (Panel B) of Table 3. Second, the CSV PORT earns a sizable, negative risk-premium of −1.08% on a monthly basis when stocks are value-weighted (−1.18% when equal-weighed), and it is statistically significant at less than 1% level. The cumulative returns of the value- and equal-weighted CSV PORT are plotted in Fig. 1. Clearly, the difference in returns between HIGH CSV and LOW CSV is persistently negative over the entire sample period. Third, higher CSV firms are characterized by being younger, more leveraged, and financially more vulnerable (having greater default risk and higher financing deficits[4]), and they are having higher return volatility and stock beta.

There exists a recent literature on the low volatility (or low risk) puzzle (Ang et al., 2006; Frazzini and Pedersen, 2014), and the negative premium of CSV PORT could have been driven by the abnormally low returns of high-volatility firms. To address this concern, we define CSV PORT alternatively by sorting sequentially firms first on return volatility and then on CSV. The results presented in Table A1 shows that the CSV PORT still earns a negative, albeit reduced, risk-premium of −0.74 or −0.66% per month, and it is statistically significant at less than 1% level.[5]

We next turn to the central issue of this paper. Following an approach proposed by Lamont et al. (2001), we conduct time-series regressions to test for the existence of a capital-structure-volatility (CSV) factor. In these tests, the nine value-weighted base portfolios are regressed on three reference portfolios: BIG, SMALL, and CSV PORT.[6] In Table 4, we report the results of these nine regressions as well as the composition of the three reference portfolios for each of these regressions. The loading on the market factor (BIG) is larger for bigger firms, and the loading on the size factor (SMALL) is larger for smaller firms. Moreover, for each size category, higher CSV firms have larger loadings on the CSV PORT. The results show that stock returns of high CSV firms co-move in the same direction with

[4] Financing deficit is one of the key variables used in the capital structure literature to explain leverage adjustments. It represents the amount of external financing.

[5] We obtain qualitatively similar results if we define CSV PORT by sorting firms first on stock beta and then on CSV.

[6] To avoid spurious results if the same return series would be in both dependent and independent variable, the specific definitions of three reference portfolios differ for each of the nine base portfolios. See Table's 4 caption for how they are constructed.

Table 4
Covariance tests of nine base portfolios.

	Regression estimates Constant		Market factor (BIG)		Size factor (SMALL)		CSV factor (CSV PORT)		R^2	Factor definition Market factor (BIG)	Size factor (SMALL)	CSV factor (CSV PORT)
Small-cap												
Low CSV (SL)	0.01	(3.16)	0.38	(5.60)	0.59	(10.77)	0.01	(0.08)	0.90	(BM + BL + MM + ML)/4	SM	(BH + MH-BL-ML)/2
Mid CSV (SM)	−0.00	(−0.97)	0.36	(4.65)	0.72	(10.77)	0.28	(4.03)	0.90	(BM + BL + MM + ML)/4	SL	(BH + MH-BL-ML)/2
High CSV (SH)	−0.01	(−4.90)	−0.22	(−2.46)	1.06	(13.60)	0.27	(3.31)	0.86	(BM + BL + MM + ML)/4	(SM + SL)/2	(BH + MH-BL-ML)/2
Mid-cap												
Low CSV (ML)	0.00	(0.63)	0.43	(7.07)	0.56	(11.37)	−0.02	(−0.43)	0.90	(BM + BL + MM)/3	(SM + SL)/2	(BH + SH-BL-SL)/2
Mid CSV (MM)	−0.00	(−1.46)	0.44	(7.67)	0.69	(15.34)	0.09	(1.71)	0.93	(BM + BL + ML)/3	(SM + SL)/2	(BH + SH-BL-SL)/2
High CSV (MH)	−0.01	(−4.71)	0.32	(3.78)	0.73	(10.29)	0.21	(2.89)	0.88	(BM + BL + MM + ML)/4	(SM + SL)/2	(BH + SH-BL-SL)/2
Large-cap												
Low CSV (BL)	0.00	(0.87)	0.86	(7.04)	−0.22	(−2.04)	−0.12	(−1.15)	0.58	(BM + MM + ML)/3	(SM + SL)/2	(MH + SH-ML-SL)/2
Mid CSV (BM)	−0.00	(−0.50)	1.01	(7.68)	−0.17	(−1.50)	0.02	(0.15)	0.66	(BL + MM + ML)/3	(SM + SL)/2	(MH + SH-ML-SL)/2
High CSV (BH)	−0.00	(−0.28)	1.24	(10.40)	−0.22	(−2.28)	0.15	(1.99)	0.73	(BM + BL + MM + ML)/4	(SM + SL)/2	(MH + SH-ML-SL)/2

This table reports the estimates from the time-series regression of the nine value-weighted base portfolios described in Table 3. The sample period is from July 2004 to December 2017. We regress the excess return on each portfolio on three reference portfolios: a market factor (BIG), a size factor (SMALL), and a CSV factor (CSV PORT). The market and size factors are constructed by using the base portfolios. The market factor (BIG) is the return on a portfolio of low-to-mid capital-structure-volatility, medium-size and large firms in excess of one-month risk-free rate. The size factor (SMALL) is the return on a portfolio of low-to-mid capital-structure-volatility small firms in excess of one-month risk-free rate. The CSV factor (CSV PORT) is defined in Table 3. In each regression, we omit the portfolio that is the dependent variable from the construction of the portfolios that constitute the regression's independent variables. In the case of CSV PORT, we also omit the matching portfolio on the short side. Reported in parentheses are *t*-statistics.

Table 5
Time-series regression of CSV factor returns.

Panel A: four-factor model and CSV factor returns	Value weighted		Equal weighted	
	3-factor	4-factor	3-factor	4-factor
Constant	−0.0088	−0.0088	−0.0104	−0.0102
	(−5.12)	(−5.03)	(−7.06)	(−6.82)
MKT	0.0793	0.0791	0.0530	0.0522
	(2.54)	(2.53)	(1.97)	(1.95)
SMB	0.1744	0.1742	0.1923	0.1908
	(4.50)	(4.47)	(5.75)	(5.71)
HML	−0.2522	−0.2515	−0.1877	−0.1833
	(−5.30)	(−5.24)	(−4.58)	(−4.45)
UMD		−0.0056		−0.0356
		(−0.15)		(−1.12)
R^2	0.2923	0.2924	0.3085	0.3139

Panel B: Macro variables and CSV factor returns	Value weighted		Equal weighted	
	C_0	$\sum_{i=0}^{2} C_i$	C_0	$\sum_{i=0}^{2} C_i$
ΔCP Spread	−0.0232	−0.0363	−0.0194	−0.0287
	(0.01)	(0.00)	(0.02)	(0.07)
ΔCB Spread	−0.0299	−0.0254	−0.0279	−0.0254
	(0.00)	(0.00)	(0.00)	(0.01)

This table reports the estimates from regressing the CSV factor on the Fama–French–Carhart 4 factors (in Panel A) or on a variable representing a shock to the aggregate credit market conditions (in Panel B) The sample period is from July 2004 to December 2017. The dependent variable is the monthly return on the CSV factor. In Panel A, the independent variables are a constant and the Fama–French–Carhart 4 factors (MKT, SMB, HML, and UMD). Reported in parentheses are *t*-statistics. In Panel B, the independent variables are a constant and one of the following: the change in the spread between the 3-month commercial paper rate and 3-month Monetary Stabilization Bond rate (ΔCP Spread) and the change in the spread between the 3-year AA- corporate bond rate and the 3-year Korean Treasury Bond rate (ΔCB Spread). Reported in parentheses are p-values.

Table 6
Cross-sectional regression of individual stock returns.

	Whole sample		HighFinancing deficit		MidFinancing deficit		LowFinancing deficit	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log(size)	−0.0030	−0.0037	−0.0031	−0.0038	−0.0029	−0.0034	−0.0028	−0.0036
	(−4.19)	(−5.29)	(−3.22)	(−3.99)	(−3.55)	(−4.25)	(−3.82)	(−4.52)
log(B/M)	0.0056	0.0057	0.0053	0.0057	0.0055	0.0055	0.0066	0.0065
	(4.78)	(4.95)	(4.17)	(4.42)	(3.42)	(3.52)	(4.71)	(4.45)
Momentum	0.0025	−0.0010	0.0049	0.0012	0.0007	−0.0023	−0.0025	−0.0050
	(0.89)	(−0.35)	(1.55)	(0.37)	(0.20)	(−0.66)	(−0.73)	(−1.45)
Liquidity	−0.0071	−0.0062	−0.0076	−0.0067	−0.0087	−0.0076	−0.0053	−0.0045
	(−6.35)	(−5.69)	(−6.38)	(−5.81)	(−5.44)	(−4.73)	(−3.06)	(−2.62)
SUE	0.0105	0.0108	0.0100	0.0102	0.0111	0.0113	0.0108	0.0109
	(15.73)	(16.25)	(12.70)	(13.01)	(13.35)	(13.48)	(13.59)	(13.85)
VOL	−0.0193	−0.0097	−0.0326	−0.0233	−0.0038	0.0031	−0.0081	−0.0015
	(−4.71)	(−2.26)	(−6.36)	(−4.44)	(−0.67)	(0.52)	(−1.69)	(−0.27)
WWI		−0.0068		−0.0036		−0.0031		−0.0106
		(−3.25)		(−1.45)		(−0.81)		(−2.05)
DLI		−0.0514		−0.0310		−0.0488		−0.0600
		(−2.53)		(−1.05)		(−1.54)		(−2.04)
CSV	−0.0534	−0.0349	−0.0588	−0.0446	−0.0337	−0.0207	−0.0342	−0.0228
	(−5.11)	(−3.80)	(−4.00)	(−3.17)	(−2.08)	(−1.40)	(−2.49)	(−1.70)

This table reports the estimates for the cross-sectional regressions of firm excess returns on firm characteristics including the capital structure volatility. Definition of variables is provided in Table 1. The sample period is from July 2004 to December 2017. The dependent variable is the monthly firm excess return. The independent variables are a constant, log(size), log(B/M), momentum, liquidity, earning surprises (SUE), return volatility (VOL), Whited-Wu index (WWI), default likelihood indicator (DLI), and capital structure volatility (CSV). We use the Fama–Macbeth technique to compute the means of the time-series of regression coefficients. Reported in parentheses are the time-series *t*-statistics.

the returns of other high CSV firms. We obtain qualitatively similar results when we use equal-weighted base portfolios (not reported to save space). It seems that this common variation of stock returns indicates the presence of a capital-structure-volatility factor (CSV factor, hereafter).

We conduct two more sets of time-series test to characterize the properties of the CSV factor. The first is to regress monthly CSV factor returns on the Fama–French–Carhart 4 factors (MKT, SMB, HML, and UMD). Panel A of Table 5 reports estimation results. In all specifications, the intercept is negative, ranging from −0.0088 to −0.0104, and is statistically significant at less than 1% level. It appears that capital structure volatility is a distinct factor that cannot be fully explained by the four factors. The second is to regress monthly CSV factor returns on a variable representing a shock to the aggregate credit market conditions. Two variables are employed one at a time: the change in spread between the 3-month commercial paper and Monetary Stabilization Bond (ΔCP Spread) and the change in spread between the 3-year AA- corporate bond and Korea Treasury Bond (ΔCB Spread).[7] Panel B of Table 5 shows results from regressing monthly CSV factor returns on current and two lagged monthly macroeconomic variables. It displays both the contemporaneous coefficient, and the sum of all three coefficients. The estimation results indicate that a shock to the aggregate credit market conditions has a negative effect on the CSV factor in all specifications. This result is consistent with the characteristics of the CSV factor: higher CSV firms are financially more vulnerable (i.e., higher external financing needs and/or higher default risk) than lower CSV firms.

We now turn to examine the cross-sectional relation between capital structure volatility and stock returns using the Fama–MacBeth approach. Table 6 reports estimation results. The dependent variable is monthly excess return.[8] The control variables include log(size), log(B/M), momentum, liquidity, and earning surprises (SUE) and return volatility (VOL).[9] The regressions are estimated for the whole sample as well as the subsamples partitioned into tertiles of financing deficits. In odd-numbered specifications, capital structure volatility (CSV) negatively affects stock returns in the presence of control variables. To test whether capital structure volatility still accounts for return variations even in the presence of financial vulnerability factors, we include financial constraints and financial distress measures (WWI and DLI, respectively) as additional independent variables in even-numbered specifications. The results are robust to the inclusion of financial vulnerability measures, although the coefficient on CSV diminishes somewhat in magnitude.

4. Conclusion

This study shows that the capital structure of Korean firms is not stable over time, and that firms with higher capital structure

[7] In Korea's bond markets, 3-month Monetary Stabilization Bond (issued by the Bank of Korea) and 3-year Korea Treasury Bond (issued by the Ministry of Strategy and Finance) are the most liquid instruments representing risk-free bonds.

[8] We obtain qualitatively similar results when monthly abnormal return computed using the Fama–French–Carhart four-factor model is used as a dependent variable.

[9] The dependent and control variables are defined following the standard practices in the asset pricing literature.

volatility are characterized by higher level of financial vulnerability. Using a methodology proposed by Lamont et al. (2001), we provide strong evidence for the existence of a capital-structure-volatility (CSV) factor, which earns a sizable, negative risk premium of approximately −1% per month. The cross-sectional regressions confirm the negative relation between capital structure volatility and stock returns even in the presence of financial vulnerability measures. To the extent that higher capital structure volatility is associated with higher financial vulnerability and lower stock returns, our results are consistent with several studies on distress risk that find stocks with high default risk deliver abnormally low returns (e.g., Dichev, 1998; Campbell et al., 2008). Investigating the relation between capital structure volatility and distress risk in more detail would be an interesting research issue and we leave it for future work.

Appendix

Table A1.

Table A1
Alternative definition of CSV Portfolios, returns, and characteristics.

		Number of firms	Excess returns	Firm age	VOL	Beta	D/A	CSV	DLI	Financing deficit
Panel A: Value weighted										
Low-vol										
Low CSV	LL	131	1.34	40	0.33	1.05	0.09	0.02	0.00	−0.05
Mid CSV	LM	132	0.49	38	0.34	1.02	0.17	0.04	0.00	−0.03
High CSV	LH	132	1.06	36	0.35	0.94	0.22	0.09	0.00	−0.02
Mid-vol										
Low CSV	ML	131	1.15	38	0.49	1.07	0.19	0.03	0.01	−0.01
Mid CSV	MM	132	0.79	35	0.49	1.08	0.23	0.06	0.01	0.01
High CSV	MH	132	0.84	34	0.50	1.13	0.26	0.11	0.02	0.04
High-vol										
Low CSV	HL	129	0.01	33	0.71	1.10	0.20	0.03	0.04	0.10
Mid CSV	HM	129	0.12	31	0.73	1.19	0.28	0.08	0.06	0.15
High CSV	HH	130	−1.63	29	0.78	1.16	0.32	0.16	0.09	0.30
HIGH CSV			0.09	33	0.54	1.08	0.27	0.12	0.04	0.11
LOW CSV			0.83	37	0.51	1.07	0.16	0.03	0.02	0.01
CSV PORT			−0.74	−4	0.03	0.00	0.10	0.09	0.02	0.09
(*t*-stat)			(−3.35)							
Panel B: Equal weighted										
Low-vol										
Low CSV	LL	131	1.58	35	0.34	0.88	0.08	0.01	0.00	−0.02
Mid CSV	LM	132	1.67	38	0.35	0.96	0.21	0.04	0.00	0.00
High CSV	LH	132	1.64	34	0.36	0.96	0.24	0.09	0.00	0.02
Mid-vol										
Low CSV	ML	131	1.63	33	0.51	1.02	0.16	0.02	0.01	0.00
Mid CSV	MM	132	1.39	30	0.51	1.06	0.26	0.06	0.02	0.02
High CSV	MH	132	1.13	29	0.52	1.08	0.28	0.12	0.02	0.06
High-vol										
Low CSV	HL	129	0.84	29	0.73	1.04	0.20	0.04	0.06	0.06
Mid CSV	HM	129	0.10	27	0.75	1.21	0.29	0.08	0.08	0.16
High CSV	HH	130	−0.72	25	0.80	1.17	0.31	0.16	0.10	0.34
HIGH CSV			0.68	30	0.56	1.07	0.28	0.12	0.04	0.14
LOW CSV			1.35	32	0.52	0.98	0.15	0.02	0.03	0.02
CSV PORT (*t*-stat)			−0.66 (−5.56)	−3	0.03	0.09	0.13	0.10	0.02	0.13

This table reports summary for nine value-weighted and nine equal-weighted portfolios cross-sorted by return volatility and capital structure volatility. Definition of variables is provided in Table 1. The sample period is from July 2004 to December 2017. In each June end from 2004 to 2017, firms are sorted into tertiles based on return volatility, and, in each tertile, they are further sorted into tertiles based on capital structure volatility (CSV). Then, all firms are cross-classified into one of the nine portfolios. Low-vol firms are firms that are in the bottom 33.3% of the sample in a given year, sorted on return volatility. Mid-vol firms are firms that are in the middle 33.3% of the sample. High-vol firms are firms that are in the top 33.3% of the sample. Similarly, low, middle, and high capital structure volatility (CSV) are firms that are in the bottom 33.3%, the middle 33.3%, and the top 33.3% of the sample sorted by capital structure volatility in a given year. In addition to the nine base portfolios, three more portfolios are formed that are linear combinations of the nine portfolios: HIGH CSV = (HH + MH + LH)/3, LOW CSV = (HL + ML + LL)/3, CSV PORT = HIGH CSV − LOW CSV. We report the sample mean of each portfolio's monthly returns in excess of one-month risk-free rate in percentage. In each portfolio, we also calculate average number of firms, firm age, return volatility (VOL), beta, leverage (D/A), capital structure volatility (CSV), default risk (DLI) and financing deficit by averaging over the entire sample period.

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