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Investor sentiment and firm capital structure

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ABSTRACT

We provide novel evidence of the role of investor sentiment in determining firms' capital structure decisions from three perspectives: leverage ratio, debt maturity and leverage target adjustment. We find that when investor sentiment is high, firms increase their leverage ratios, supporting our contention that high investor sentiment increases firms' debt capacity and facilitates the use of an aggressive leverage policy. Debt maturity is shorter in high sentiment periods, implying that firms are confident about future earnings and use shorter debt maturity to signal their financial solvency. Leverage target adjustment is slower in low sentiment periods, indicating higher costs of external finance. Furthermore, the sentiment-leverage relationship sensitivity is greater for financially constrained firms. Our extended analysis determines that leverage-increasing firms generate lower stock returns subsequent to a period of high sentiment, offering practical insights into the economic consequences of increasing leverage in high sentiment periods on corporate value for investors. Our research advances the understanding of the impact of investor sentiment on firms' financing decisions and stock returns.

1. Introduction

How does investor sentiment influence firms' financing decisions? Extant studies have documented that investor sentiment can influence the pricing of assets (e.g., Brown and Cliff, 2005; Lemmon and Portniaguina, 2006) and subsequent stock returns (e.g., Baker and Wurgler, 2006; Baker et al., 2012; Gao et al., 2020). Firms react to a wave of high sentiment by increasing investments (Alimov and Mikkelson, 2012; Arif and Lee, 2014) and issuing more equity (Lowry, 2003; Lamont and Stein, 2006) and debt (Mclean and Zhao, 2014). What is little known, though, is how investor sentiment and the security issues that this raises affect a firm's capital structure. The traditional interpretation, based on the market timing hypothesis of capital structure (Baker and Wurgler, 2002), posits that firms should use equity financing in high sentiment periods, when stock prices are overvalued and the costs of issuing equity are low (Lowry, 2003; Mclean and Zhao, 2014). However, the newly issued equity can enhance firms' ability to sustain more borrowing. In the *Compustat* universe between 1966 and 2017, over 60% of the companies issuing equity in high sentiment periods also have a net debt issuance in the same year, leaving the relationship between investor sentiment and firms' leverage ratios open to question. Therefore, this study takes a step forward by examining the effects of investor sentiment on a firm's capital structure decisions: specifically, its leverage ratio, debt maturity, and leverage target adjustment.

The behavioural finance literature maintains that investors are not entirely rational and that their demand for stocks is not invariably underpinned by an informed analysis of a firms' fundamental attributes (Baker, 2009; He et al., 2020). Thus, variation in

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investor sentiment creates opportunities for asset misvaluations (Brown and Cliff, 2005), enabling firms to take advantage of prevailing high sentiment to issue shares at overvalued prices (DeAngelo et al., 2010; Warusawitharana and Whited, 2016). A few studies have examined the effects of investor sentiment on corporate financial decision-making. For example, Lamont and Stein (2006) find that firms are more active in issuing equity and seeking mergers in high sentiment periods. Arif and Lee (2014) demonstrate that corporate investments peak during such phases because managers rationally exploit market misvaluations. Mclean and Zhao (2014) show that firms' investments and financing activities, comprising debt and equity issuances, are more sensitive to Tobin's *Q* but less sensitive to cash flows in these periods, indicating that high sentiment reduces the cost of external finance. Although prior studies have delineated the effects of investor sentiment on firms' investments and external financing activities, little is understood of how a firm's leverage ratio is modified following a change in investor sentiment.[1]

Capital structure theories have yet to reach a consensus on the impact of investor sentiment. A classical explanation, in the spirit of the market timing hypothesis (Baker and Wurgler, 2002), predicts that firms should engage in equity financing in high sentiment periods when stock prices are overvalued. Since raising equity capital may reduce the demand for debt finance, firms are likely to use lower leverage ratios. However, debt capacity theory (Myers, 1977) suggests a positive relationship, because the overestimated investment income during such periods expands firms' debt capacity and enables them to borrow more, leading to an increase in their leverage ratios. Within the context of this debate, our study investigates the relationship between investor sentiment and firms' capital structure decisions. Specifically, does the widespread use of equity financing in high sentiment periods reduce the reliance on debt financing and lead to a lower leverage ratio, or do firms issue more debt because the newly issued shares can enhance their ability to sustain increased borrowing? If the leverage ratio changes, does the maturity structure of debt change as well? Furthermore, since prior studies have noted that both equity and debt financing are sensitive to investor sentiment (e.g., Mclean and Zhao, 2014), would firms take advantage of favorable market conditions to adjust their leverage ratios?

To address these questions, we employ the University of Michigan Consumer Sentiment Index (*CCI_ort*) and the orthogonalized Baker and Wurgler Investor Sentiment Index (*BWI_ort*) as two measures of investor sentiment to examine its effects on firms' capital structure decisions. These two Indices have been widely used in the literature to examine the impact of investor sentiment on asset prices (e.g., Lemmon and Portniaguina, 2006; Baker and Wurgler, 2006; He et al., 2020) and corporate behaviours (e.g., Bergman and Roychowdhury, 2008; Alimov and Mikkelson, 2012; Arif and Lee, 2014; Mclean and Zhao, 2014). Our study makes an important contribution to prior research by identifying a positive and economically significant effect of investor sentiment on a firm's leverage ratio, which tends to favor our debt capacity contention. Specifically, a one-standard-deviation increase in *BWI_ort* (0.96 units) is associated with an increase in the leverage ratio of 0.6 percentage points after controlling for firm and macroeconomic characteristics, which is equivalent to \$12.9 million of debt for an average firm. Our results are robust to alternative model specifications, alternative estimation methods and alternative definitions of variables, and demonstrate that a wave of high sentiment increases firms' debt capacity and facilitates the use of a higher leverage ratio.

We also examine the effect of investor sentiment on a firm's debt maturity structure because two major theories advance contradictory predictions for this relationship. On the one hand, the contracting cost theory (Myers, 1977) suggests a positive relationship because firms, with expanded operations and lower credit risks in high sentiment periods, would have better access to the bond market. To reduce the contracting costs of rolling over short-term debt, firms would access the bond market and use long-term debt finance, resulting in longer debt maturity.[2] Conversely, the signalling and liquidity risk theory (Flannery, 1986) suggests a negative relationship because firms in an overheated market may overestimate future earnings and signal their financial solvency by taking on debt with shorter maturity. We contribute to these theoretical debates by demonstrating a negative and economically significant effect of investor sentiment on debt maturity. Specifically, a one-standard-deviation increase in *BWI_ort* is associated with a decrease in debt maturity of 0.7 percentage points, indicating a \$4.2 million movement of long-term debt to short-term debt for an average firm. This negative relationship is robust to alternative definitions of variables and alternative estimation methods, indicating that firms are optimistic about future earnings in high sentiment periods and use debt of shorter maturity. Hence, our investigation provides robust evidence that signalling and liquidity risk theory provides a more convincing explanation than does contracting cost theory.

Next, we examine the effect of investor sentiment on the speed of adjustment (SOA) to the target leverage ratio, finding that the SOA is lower in low sentiment periods. Using the partial adjustment framework (Flannery and Rangan, 2006) to estimate the SOA, we show that, in the years when *Sent_ort* is at least one-standard deviation below the sample mean value, the estimated SOA decreases by 36.3% from 17.9 percentage points to 11.4 percentage points per annum. This result suggests that a wave of low sentiment, when investors are pessimistic about future returns, results in firms adjusting their leverage ratios slowly towards the optimum values, indicating higher costs of external finance.

Further, we analyze how financial constraints impact the sentiment-leverage relationship. Since we argue that high investor sentiment can increase a firm's debt capacity, it is reasonable to posit that firms with a greater demand for external finance would benefit more from high sentiment, and that their leverage ratios are more sensitive to variations in investor sentiment. Our results

[1] Two prior studies attempt to explore the relationship by using small samples. First, Oliver (2010) documents a positive relationship between the non-orthogonalized consumer sentiment index and the leverage ratio of 500 large firms from 1995 to 2004. Second, Cagli et al. (2018) find a negative relationship using 169 Turkish firms from 2010 and 2017. Our study has a broader coverage, not only because we use all *Compustat* firms from 1966 to 2017, but also because we address more questions and explain in greater depth the effects of investor sentiment. In addition, we use the orthogonalized investor sentiment index and control for other macroeconomic characteristics, making our results more robust.

[2] Prior studies (e.g., Barclay and Smith, 1995; Hackbarth et al., 2007) note that the average maturity of corporate bond is usually longer than that of private debt and that firms with access to the bond market tend to have a longer debt maturity.

clearly show that the positive effect of investor sentiment on the leverage ratio is more pronounced for financially constrained firms. For example, using the *SA index* (Hadlock and Pierce, 2010) to identify firms that are more financially constrained in each industry, we find that a one-standard-deviation increase in *BWI_ort* is associated with an increase in the book leverage ratio of 0.4 percentage points in financially unconstrained firms, and an increase of 0.7 percentage points in financially constrained firms. These results establish that financially constrained firms are more prone to the influence of sentiment than their counterparts, indicating that a wave of high sentiment provides them with opportunities for issuing more debt. Our results imply that high sentiment helps firms raise external funds and alleviate the severity of financial problems. The cross-sectional heterogeneity provides further evidence substantiating an interpretation of the relationship between investor sentiment and a firm's capital structure.

We test how the components of the Baker and Wurgler Investor Sentiment Index individually impact firm capital structure and debt maturity. Among these components, we find that the dividend premium is negatively correlated with the leverage ratio, while the number of IPOs and equity share in new issues are positively correlated with the leverage ratio. Debt maturity is positively determined by the dividend premium and the closed-end fund discount, but negatively determined by the first-day returns on IPOs. These relationships are in alignment with the components' contributions to the Investor Sentiment Index as in Baker and Wurgler (2006), indicating that all the component variables are associated with firms' capital structure decisions and that the documented relationships between investor sentiment and firms' capital structure decisions are not driven by one particular component of the Investor Sentiment Index.

Finally, we conduct an additional analysis to extend our research and examine whether, and how, firms' leverage decisions influence the well-documented negative relationship between investor sentiment and firms' stock returns (e.g., Baker and Wurgler, 2006; Baker et al., 2012; Gao et al., 2020). We find the effect to be greater if firms increase their leverage ratios in high sentiment periods. Specifically, we incorporate investor sentiment into the Fama and French 3-factor model and examine the differential effect on stock returns between leverage-increasing firms and leverage-non-increasing firms. Our results demonstrate that, with a one-standard-deviation increase in the beginning-of-period *BWI_ort*, stock returns decrease by 5.3 percentage points for leverage-increasing firms but by 1.0 percentage points for leverage-non-increasing firms. Correspondingly, the extent of the decrease in stock returns is reduced by 81.1% if firms do not increase leverage. Our study provides the practical insight that investors can gain an advantage by avoiding leverage-increasing firms in an overheated stock market.

Our study makes four original contributions to research on capital structure decisions. First, we extend the literature on the effects of market-wide investor sentiment on firms' financing decisions. Prior studies suggest that firms respond to high (or low) investor sentiment by issuing (repurchasing) both equity (Lowry, 2003; Lamont and Stein, 2006) and debt (Mclean and Zhao, 2014). However, little is known of how such issuances (repurchases) affect the debt-to-asset ratio in the net term. We examine the effect of investor sentiment on the leverage ratio, identifying a positive relationship. This finding contributes significantly to the evaluation of the relative validity of the market timing hypothesis (Baker and Wurgler, 2002) versus debt capacity theory (Myers, 1977) in predicting corporate capital structure decisions. The traditional interpretation, based on the market-timing hypothesis, predicts a negative relationship between investor sentiment and a firm's leverage ratio, whereas the debt capacity theory postulates a positive relationship. Our results are in favor of the debt capacity theory, establishing that a wave of high sentiment presents not only an opportunity to issue new shares, but also increases a firm's debt capacity, enabling it to adopt a higher leverage ratio.

Second, our results contribute to the literature by demonstrating a negative effect of investor sentiment on a firm's debt maturity. Prior research has investigated the determinants of debt maturity, identifying a number of influential factors at the firm- and country-levels (e.g., Barclay and Smith, 1995; Stohs and Mauer, 1996; Fan et al., 2012), whereas the effect of investor sentiment has not been explored. Theories of debt maturity have, however, not reached a consensus, with contracting cost theory (Myers, 1977) suggesting a positive relationship, while signalling and liquidity risk theory (Flannery, 1986) suggests a negative relationship. We test the impact of investor sentiment on corporate debt maturity and document a negative effect, demonstrating that signalling and liquidity risk theory establishes a more convincing rationale than contracting cost theory does for predicting the relationship between investor sentiment and debt maturity.

Third, we provide new evidence that firms can better access external capital in high sentiment periods. Mclean and Zhao (2014) examine the effect of investor sentiment on firm investments, showing that they are more sensitive to Tobin's *Q* and less sensitive to cash flows in high sentiment periods, and conclude that the cost of external finance is lower in high sentiment periods, giving firms easier access to external funds. However, a conclusion founded on investment-cash flow sensitivity is subject to doubt because a few studies (e.g., Kaplan and Zingales, 1997) claim that a higher value of the investment-cash flow coefficient does not indicate more severe financial constraints. We take a step forward from Mclean and Zhao (2014), who examine the impact of investor sentiment on the real economy from investment and employment perspectives, by providing original evidence of how investor sentiment influences firms in their determination of capital structure and the speed of adjustment to their leverage targets. We show that firms sustain a higher leverage ratio in high sentiment periods and that this relationship is stronger for financially constrained firms. Furthermore, we find that firms adjust their leverage ratios significantly slower in low sentiment periods. These findings confirm the role of market-wide high sentiment in helping firms access external finance, which is particularly valuable for financially constrained firms.

Fourth, we extend the asset pricing literature by demonstrating that the increased leverage ratio is an important driving factor of the well-documented relationship between investor sentiment and future stock returns. Numerous studies have examined the effects of investor sentiment on stock returns and documented a negative relationship (e.g., Baker and Wurgler, 2006; Baker et al., 2012; Gao et al., 2020). By investigating firms' leverage decisions, we show that decreasing the leverage ratio in high sentiment periods can effectively reduce the negative impact of investor sentiment on future stock returns. Therefore, our finding offers practical insights for managers and investors into the economic consequences of financial leverage on corporate value in high sentiment periods.

The remainder of the paper is organized as follows. Section 2 reviews relevant theories and develops the hypotheses. Section 3 discusses the data and sample and defines the variables. Section 4 presents and discusses the main results. Section 5 discusses the results of additional robustness tests. Section 6 concludes the study.

2. Theoretical framework and hypothesis development

Investor sentiment epitomizes investors' attitudes towards financial markets. In high sentiment periods, investors' optimism exerts a positive influence on price movements, with the consequence that firms' stock prices tend to be overvalued (Brown and Cliff, 2005; Lemmon and Portniaguina, 2006). Conversely, investors' pessimism in low sentiment periods has a depressive influence on stock prices, causing them to be undervalued. Unsurprisingly, managers aware of these effects take advantage of such misvaluations, actively issuing or repurchasing mispriced stocks (DeAngelo et al., 2010; Warusawitharana and Whited, 2016).

Prior literature has studied the impact of investor sentiment on firms' financing decisions. For example, Lowry (2003) finds that more companies go public in high sentiment periods than in low sentiment periods. Likewise, Lamont and Stein (2006) find that seasoned equity offerings (SEOs) and M&As are more prevalent in high sentiment periods. Furthermore, Mclean and Zhao (2014) find that both debt and equity issuances are more sensitive to Tobin's Q and less sensitive to cash flows in high sentiment periods, concluding that the cost of external finance tends to decline, so that firms are able to place less reliance on internal cash flows. Overall, the literature has documented positive impacts of high investor sentiment on firms' debt and equity financing. However, what is arguably of greater interest, albeit more difficult to ascertain, is how the increased debt and equity issuances impact the debt-to-asset ratio in the net term. This question has not been explored in the literature, but the market timing hypothesis and debt capacity theory advance theoretical frameworks underpinning the impact of investor sentiment on firm leverage.

2.1. *Investor sentiment and firm leverage*

2.1.1. *Market timing, investor sentiment and firm leverage*

Baker and Wurgler (2002) propose a market timing hypothesis, which suggests that firms make external financing decisions based on the prevailing condition of the securities market. Specifically, firms resort to equity financing when their stock prices are overvalued and repurchase equity when their stock prices are undervalued. Thus, the leverage ratio is the cumulative outcome of firms' endeavours to align their buying and selling activities with the market movements. Subsequent studies document evidence in support of the market timing hypothesis. For example, Huang and Ritter (2009) demonstrate that firms use equity financing to fund a larger proportion of their financing deficits when the cost of equity finance is lower. DeAngelo et al. (2010) observe that a firm's market timing opportunities, measured in terms of prior and future stock returns, determine whether it will engage in a seasoned equity financing. Using an ex-ante misvaluation measure, Dong et al. (2012) show that equity issuances increase with equity overvaluation. By constructing a dynamic investment model, Warusawitharana and Whited (2016) find that managers' rational responses to equity misvaluations increase shareholders' value. However, a few other studies find that the composition of net financing does not predict future stock returns (Butler et al., 2011) and that the effect of market timing on firms' leverage ratios is not persistent (Alti, 2006). Nevertheless, the preceding pioneering studies establish that firms take into account stock price misvaluations when making financing decisions.

In general, the market timing hypothesis suggests that firms can make financing decisions by responding to sentiment-driven variations in stock prices. When high sentiment leads to irrationally overvalued stocks, firms take advantage of the overvaluation by issuing new shares. Given the total demand for external finance, raising funds through issuing new shares reduces firms' reliance on debt finance, leading to a lower leverage ratio. When low sentiment leads to undervalued stock prices, firms react by repurchasing equity, resulting in a higher leverage ratio. Therefore, based on the market timing hypothesis, we propose a negative relationship between investor sentiment and a firm's leverage ratio:

Hypothesis 1a. Investor sentiment is negatively correlated with the leverage ratio.

2.1.2. *Debt capacity, investor sentiment and firm leverage*

Myers (1977) constructs a theoretical framework that debt capacity is determined by the total amount of debt that firms can incur and repay. According to this theory, in order for firms to execute the option to invest, the value of newly acquired asset (V_s) needs to cover both investment cost (I) and the interest payment to debtholders (P). This leads to a condition of $V_s > I + P$. Hence, the maximum interest expenses that a firm is able to pay is equal to the value of the newly acquired asset minus investment cost ($P_{max} = V_s - I$). P_{max} constrains firms' ability to raise debt capital. Empirically, Lemmon and Zender (2010) demonstrate an inverted U-shape relationship between a firm's financing deficit and net debt issued, and suggest that firms are constrained by their debt capacity and therefore cannot always use debt to fund their financing deficits. Thus, firms with a greater financing deficit are more likely to reach their debt capacity, after which they issue equity to fund their financing deficiency. More recent literature observes that firms can expand their debt capacity by increasing the degree of asset tangibility (Gan, 2007), or through the coinsurance effect of merger activities (Levine and Wu, 2021).

Debt capacity theory postulates a positive relationship between investor sentiment and a firm's leverage ratio. In high sentiment periods, when firms tend to overestimate future cash flows and the value of V_s is greater, firms' debt capacity, P_{max}, increases. Conversely, in low sentiment periods, when firms underestimate future cash flows and the value of V_s is lower, firms are constrained by a reduced debt capacity, P_{max}, leading to a lower leverage ratio. Therefore, based on debt capacity theory, we propose a positive relationship between investor sentiment and firm leverage:

Hypothesis 1b. Investor sentiment is positively correlated with the leverage ratio.

2.2. Investor sentiment and firm debt maturity

When determining the leverage ratio with regard to how much debt to take on, firms must also decide whether to raise short-term or long-term debt. The existing literature has not explored the relationship between investor sentiment and a firm's debt maturity structure; however, contracting cost theory and signalling and liquidity risk theory advance theoretical frameworks underpinning the impact of investor sentiment on firm debt maturity.

2.2.1. Contracting cost, investor sentiment and debt maturity

Myers (1977) develops a contracting cost theory of debt maturity, in which short-term debt is more costly than long-term debt because of the costs associated with renegotiating and rolling over successive contracts. Short-term debtholders require frequent monitoring, refinancing and renegotiation of a debt's contract terms (Demirguc-Kunt and Maksimovic, 1999), increasing uncertainty and transaction costs to firms. Therefore, firms prefer long-term debt to avoid the transaction costs of refinancing and intrusive monitoring by lenders (Diamond, 1991; Ben-Nasr et al., 2015). Empirical studies test the contracting cost theory and document that firms with better credit quality can routinely access the bond market and issue long-term debt, whereas firms with poor credit quality are obliged to use short-term private debt (e.g., Diamond, 1991). Barclay and Smith (1995) substantiate this contention by finding that firms with a larger size are likely to use longer debt maturity, which supports the contracting cost theory.

Contracting cost theory suggests a positive relationship between investor sentiment and debt maturity. In high sentiment periods, firms enjoy favorable prospects, and thus seek to expand their operations and boost investments (Alimov and Mikkelson, 2012; Arif and Lee, 2014). Expansion increases firm size, decreases firms' credit risks and enhances their credit quality (Pogue and Soldofsky, 1969; Zhang, 2022), which facilitates their access to the bond market, enabling them to issue more long-term debt (Barclay and Smith, 1995). Firms would take advantage of these favorable periods to extend their debt maturity, aiming to reduce the transaction costs arising from continuously rolling over short-term debt. Conversely, in low sentiment periods, firms have fewer investment opportunities, diminished operations, and higher credit risks; hence, they have less access to the bond market and therefore must rely more on short-term borrowing. Based on the foregoing discussion, we propose a positive relationship between investor sentiment and debt maturity:

Hypothesis 2a. Investor sentiment is positively correlated with debt maturity.

2.2.2. Signalling and liquidity risk, investor sentiment and debt maturity

Although short-term debt incurs the costs of debt rollover and the risk that lenders may refuse to refinance the debt when confronted by bad news (Diamond, 1991), taking on short-term debt could signal that firms are financially healthy and well able to make interest payments as they fall due (Flannery, 1986). Flannery's signalling and liquidity risk theory posits that, when insiders have more information than investors, high-quality firms prefer to undertake short-term debt commitments to signal their true quality to the market, whereas low-quality firms prefer to use long-term debt to avoid the cost of debt rollover. Stohs and Mauer (1996) test this theory and find a negative impact of abnormal earnings on debt maturity, supporting the signalling and liquidity risk theory. Further, Ben-Nasr et al. (2015) find that firms undertaking short-term debt commitments are prepared to expose themselves to more frequent monitoring, and therefore short-term debt is taken as a signal to the market indicating the financial solvency of the firm. Overall, the signalling and liquidity risk literature indicates that using debt with shorter maturity is regarded as a signal of higher quality.

Signalling and liquidity risk theory predicts a negative relationship between investor sentiment and debt maturity. In an overheated market, firms are optimistic about future cash flows, and are hence inclined to use short-term debt to communicate a positive signal to the market. Conversely, in low sentiment periods, firms are pessimistic about future earnings and would opt for longer-term debt to reduce their refinancing risk, ceteris paribus. Therefore, based on signalling and liquidity risk theory, we propose a negative relationship between investor sentiment and debt maturity:

Hypothesis 2b. Investor sentiment is negatively correlated with debt maturity.

2.3. Investor sentiment and leverage target adjustment

The trade-off theory of capital structure predicts an optimal leverage ratio at which firms can balance the benefit of the tax shield and bankruptcy cost to maximize firm value (Kraus and Litzenberger, 1973), and hence, firms adjust their leverage ratios to target this optimal level. Many studies test the trade-off theory and estimate the speed of adjustment (SOA) parameter, which indicates the rapidity with which firms make this adjustment, demonstrating that they adjust their leverage ratios towards a time-varying leverage target (e.g., Hovakimian et al., 2001; Fama and French, 2002; Flannery and Rangan, 2006; Antoniou et al., 2008).

Fischer et al. (1989) develop a theoretical model of capital structure to establish that, due to the adjustment cost (e.g., the transaction costs of external finance), firms target an optimal leverage ratio at a slow SOA rather than adhering closely to a specific target. According to this rationale, when the adjustment cost is equal to zero, firms should immediately adjust their leverage ratios to correct a deviation from the target. When the adjustment cost is higher than the benefit of making an adjustment, firms will temporarily deviate from the target and only adjust their leverage ratios if the benefits outweigh the costs. A number of empirical studies document a slow SOA at <20% per year (e.g., Fama and French, 2002; Hovakimian and Li, 2011; Li et al., 2021), verifying the theoretical prediction. Recent studies examining the heterogeneity of the SOA suggest that management decisions relating to leverage target adjustments are influenced by such factors as firms' institutional environments (Oztekin et al., 2012), cash flows (Faulkender et al., 2012), equity misvaluations and market-timing opportunities (Faulkender et al., 2012; Warr et al., 2012). In particular, Faulkender et al. (2012) suggest that firms accessing capital markets for other reasons, such as market timing motives, adjust the leverage ratio while incurring lower marginal costs.

Extant literature indicates that high investor sentiment causes a decrease in the cost of external finance. Mclean and Zhao (2014) demonstrate that a firm's investments are less reliant on its cash flows in high sentiment periods, suggesting that the cost of external finance decreases in high sentiment periods, and vice versa. Since the high cost of external finance is the cause of a slow SOA (Fischer et al., 1989), we expect that low investor sentiment should lead to a decrease in the SOA. Specifically, in low sentiment periods, when the cost of external finance is high, firms will remain deviated from the leverage target. Conversely, in high sentiment periods, firms are able to raise external funds from both debt and equity while incurring lower transaction costs, predisposing managers to adjust leverage. Therefore, based on this reasoning, we predict that firms will have a lower propensity to adjust their leverage ratios in low sentiment periods and that the SOA will respond with decreased rapidity. Accordingly, we propose our third hypothesis:

Hypothesis 3. The SOA is lower in low sentiment periods.

Table 1
Descriptive statistics.

Panel A Firm Characteristics						
Variables	N	Mean	Median	Std. Dev	p5	p95
LEV	280,360	0.277	0.222	0.292	0	0.754
MLEV	244,532	0.193	0.144	0.188	0	0.574
MAT	244,383	0.678	0.809	0.330	0	1
MAT3	174,971	0.431	0.446	0.355	0	0.979
MAT5	171,279	0.264	0.141	0.306	0	0.860
DEBISS	262,008	0.049	0	0.246	−0.184	0.421
EQUISS	256,834	0.256	0.005	0.984	−0.042	1.246
RETAIN	258,145	−0.098	0.019	0.499	−0.744	0.208
ROA	280,933	−0.031	0.066	0.385	−0.648	0.242
ETR	266,724	0.246	0.309	0.551	−0.275	0.769
TAN	281,569	0.301	0.241	0.238	0.019	0.792
M/B	245,030	2.149	1.374	2.529	0.728	5.938
SIZE	282,090	4.594	4.447	2.456	0.742	8.902
AB	226,118	0.040	0.004	0.520	−0.345	0.513
AM	276,262	8.215	6.229	9.093	1.015	20.915
INV	256,038	0.189	0.103	0.280	0.006	0.644
KZ	228,069	−3.354	−0.957	6.788	−18.133	2.954
WW	254,326	−0.226	−0.224	0.128	−0.443	−0.014
SA	282,090	−2.794	−2.885	1.132	−4.602	−0.780
Panel B Macroeconomic Characteristics						
Variables	N	Mean	Median	Std. Dev	p5	p95
CCI_ort	52	0	0.001	0.100	−0.155	0.148
BWI_ort	52	0.020	0.015	0.960	−1.830	1.700
IPG	52	0.023	0.028	0.042	−0.052	0.088
GCD	52	0.062	0.055	0.055	−0.040	0.160
GCN	52	0.056	0.052	0.033	0.014	0.121
GCS	52	0.075	0.074	0.029	0.031	0.122
GE	52	0.017	0.019	0.018	−0.017	0.047
REC	52	0.135	0	0.345	0	1
ERP	52	0.042	0.040	0.011	0.027	0.061
RIR	52	0.010	0.011	0.023	−0.031	0.042
DSP	52	0.011	0.010	0.004	0.006	0.019
TSP	52	0.011	0.012	0.011	−0.006	0.028
RGDP	52	0.029	0.030	0.020	−0.005	0.056
ASR	52	0.077	0.074	0.159	−0.189	0.277
PDND_ort	52	0	0	0.112	−0.200	0.198
RIPO_ort	52	0	−0.037	0.139	−0.137	0.303
NIPO_ort	52	0	−0.023	0.061	−0.245	0.348
CEFD_ort	52	0	0.009	0.066	−0.125	0.080
SOEI_ort	52	0	0	0.058	−0.080	0.102

This table presents the descriptive statistics of the firm and macroeconomic characteristics. The data of firms are collected from the CRSP/Compustat Merged Database. The sample includes all of the unregulated firms from 1966 to 2017. Financial (SIC Codes 6000–6999) and utility (4900–4949) firms are not included. The data of macroeconomic characteristics are collected from the University of Michigan Survey of Consumers website, Jeffrey Wurgler's website, Aswath Damodaran's website and Datastream. We report the number of observations (N), the mean, the median, the standard deviation, and values at the 5st and 95th quantiles. Definitions of the variables are summarized in Appendix 1.

3. Data and descriptive statistics

3.1. Data and sample

We collect firm-level data from the CRSP/Compustat Merged database. The sample period is from 1966 to 2017, with the starting year at 1966, when investor sentiment data become available. Consistent with prior studies on firm capital structure (e.g., Fama and French, 2002; Faulkender et al., 2012; Graham et al., 2015), we exclude financial (SIC Codes 6000–6999) and utility (4900–4999) firms. To perform regression analysis, we exclude firms with a record of less than three years. To reduce the effects of outliers, we winsorize all variables at the 1st and 99th percentiles. Detailed definitions of the variables capturing firm characteristics are provided in Panel A of Appendix 1.

Panel A of Table 1 presents the descriptive statistics of the variables capturing firm characteristics. Following the capital structure literature (e.g., Faulkender et al., 2012; Graham et al., 2015), we use the book leverage ratio as the main measure of firm leverage and use the market leverage ratio as a robustness test measure. The book leverage ratio (*BLEV*) is a measure of total debt divided by the book value of total assets and has a mean value of 0.277. We define the market leverage ratio (*MLEV*) by replacing the book value of equity with the market value of equity. *MLEV* has a mean value of 0.193. Debt maturity (*MAT*) is measured as the ratio of long-term debt to total debt, following Fan et al. (2012). The mean value of *MAT* is 0.68, and the median value is 0.811. Our leverage ratio and debt maturity ratio are close to those observed in recent studies. For example, Faulkender et al. (2012) report a mean value of the book leverage ratio at 0.276 and Fan et al. (2012) report a median value of debt maturity at 0.80.

3.2. Investor sentiment measures

We adopt two measures of investor sentiment widely used in prior literature. The first measure is the University of Michigan Consumer Sentiment Index, following Mclean and Zhao (2014). This is a survey-based sentiment index and is constructed using telephone interviews to determine consumers' attitudes towards the future of the economy. Following Baker and Wurgler (2006) and Mclean and Zhao (2014), we use a list of macroeconomic indicators to orthogonalize the Index and use regression residuals to measure investor sentiment (*CCI_ort*). These macroeconomic indicators include industrial production growth (*IPG*), growth in consumption of durable goods (*GCD*), growth in consumption of non-durable goods (*GCN*), growth in consumption of services (*GCS*), growth in employment (*GE*), and the NBER economic recession indicator (*REC*). The orthogonalization helps remove the effect of the business cycle on investor sentiment.

The second measure is the orthogonalized Baker and Wurgler (2006) Investor Sentiment Index, referred to as *BWI_ort*. It is a financial market-based measure constructed using five economic indicators, including the value-weighted dividend premium (*PDND*), the first-day returns on IPOs (*RIPO*), the number of IPOs (*NIPO*), the closed-end fund discount (*CEFD*), and the equity share in new issues (*SOEI*). *BWI_ort* is orthogonal to the six macroeconomic characteristics (i.e., *IPG*, *GCD*, *GCN*, *GCS*, *GE* and *REC*) used to extract the sentiment components of confidence from the Consumer Sentiment Index.

Panel B of Table 1 presents the descriptive statistics of the macroeconomic characteristics. *CCI_ort* has a mean value of zero and a low value of standard deviation (0.10). *BWI_ort* has a mean value of 0.02 but a substantially wider standard deviation (0.96). Untabulated results indicate that the two orthogonalized sentiment measures have a correlation coefficient of 0.32, showing that the two variables share commonalities. As well as the aforementioned business cycle variables, we also control for a series of macroeconomic characteristics that may influence firms' capital structure, following the literature (Huang and Ritter, 2009; Lamont and Stein, 2006), which we introduce in Eq. (4) of the next section. Detailed definitions of these variables are presented in Panel B of Appendix 1.

4. Empirical results and discussions

4.1. The effect of investor sentiment on firm leverage

We employ the partial adjustment framework (Flannery and Rangan, 2006) to test the effect of investor sentiment on the leverage ratio. The model has been widely used in the literature to examine firms' capital structure decisions (e.g., Antoniou et al., 2008; Huang and Ritter, 2009; Faulkender et al., 2012; An et al., 2021). The partial adjustment model is specified below:

$$LEV_{i,t} - LEV_{i,t-1} = \theta\left(Target\ LEV_{i,t} - LEV_{i,t-1}\right) \tag{1}$$

where $LEV_{i,t}$ denotes the leverage ratio of firm i in year t. θ is the SOA coefficient, capturing the proportion of deviation from the leverage target that is reverted in year t. θ varies between 0 and 1. $Target\ LEV_{i,t}$ denotes the target leverage ratio, which is estimated using a vector of firm-level characteristics:

$$Target\ LEV_{i,t} = \sum \psi X_{i,t-1} \tag{2}$$

where X is a vector of variables representing firm-level characteristics, including firm size (*SIZE*), EBIT over assets (*ROA*), tangibility (*TAN*), market-to-book ratio (*M/B*) and the industry-fixed effects, following the capital structure literature (e.g., Rajan and Zingales, 1995; Leary and Roberts, 2010).[3] We then incorporate Eq. (2) into Eq. (1) and derive the following model:

$$\Delta LEV_{i,t} = -\theta LEV_{i,t-1} + \sum \theta\psi X_{i,t-1} \tag{3}$$

We test the effect of investor sentiment on the leverage ratio by adding the sentiment measures into Eq. (3) and controlling for other macroeconomic characteristics. We use year-end values of investor sentiment and the sentiment measures are lagged for one period to reduce reverse causality. This is also consistent with Baker and Wurgler (2006), who test the effect of "beginning-of-period" sentiment on future stock returns. Thus, our regression model is as specified below:

$$\Delta LEV_{i,t} = \alpha + \beta_0 Sentiment_{t-1} - \theta LEV_{i,t-1} + \sum \beta X_{i,t-1} + \gamma Macro + \varepsilon_{i,t} \tag{4}$$

where *Macro* represents a vector of macroeconomic characteristics. These include the six variables that the sentiment variables are orthogonal to and also the variables identified as determinants of firm capital structure following Huang and Ritter (2009), including equity risk premium (*ERP*), real interest rate (*RIR*), default spread (*DSP*), term spread (*TSP*),[4] growth in real GDP (*RGPD*), and effective tax rate (*ETR*).[5] We also control for aggregate stock returns (*ASR*) following Lamont and Stein (2006), and industry-fixed effects based on the three-digit SIC codes. We use the firm-year two-way clustered standard errors to deal with potential cross-firm and cross-year correlations in error terms, following Cameron and Miller (2015).

The results of Table 2 show a positive relationship between investor sentiment and the leverage ratio. *CCI_ort* and *BWI_ort* are significant determinants of the leverage ratio, both statistically and economically, after controlling for firm-level and other macroeconomic characteristics. Specifically, a one-standard-deviation increase in BWI_ort_{t-1} (0.96 units) is associated with an increase in the book leverage ratio of 0.6 percentage points (column 2) and an increase in the market leverage ratio of 0.7 percentage points (column 4). This is equivalent to $12.9 million of debt for an average firm. The positive effect is robust to using *CCI_ort* as an alternative measure of investor sentiment, and is consistent with our *Hypothesis 1b*, indicating that firms have a higher debt capacity in high sentiment periods. These results do not support the market timing hypothesis, which predicts a negative relationship; rather, debt capacity theory offers a better explanation of the relationship between investor sentiment and the leverage ratio. Albeit it has been well-documented that high investor sentiment can cause stock prices to rise, creating an opportunity to issue shares at a higher price, our study establishes that, in their decision-making, firms take advantage of the high sentiment and increased debt capacity to issue more debt, leading to a higher leverage ratio.

Next, we follow the literature (e.g., Flannery and Rangan, 2006; An et al., 2021) and use the reduced form specification as an alternative model to test the effect of investor sentiment on the leverage ratio:

$$LEV_{i,t} = \alpha + \beta_0 Sentiment_{t-1} + (1-\theta) LEV_{i,t-1} + \sum \beta X_{i,t-1} + \gamma Macro + \varepsilon_{i,t} \tag{5}$$

where the dependent variable is $LEV_{i,t}$, and $LEV_{i,t-1}$ is placed on the right hand side of the regression model to capture the dynamics of the leverage decision. The results of columns (5)–(8) show similar effects of investor sentiment on the leverage ratio to those of columns (1)–(4), confirming that the relationship between investor sentiment and firm leverage is robust to the two alternative model specifications.

Furthermore, we control for fixed-effects at the firm level in estimating Eq. (5) and test the effect of investor sentiment on firm leverage, because *LEV* is a level variable exhibiting cross-sectional heterogeneity. The results are reported in Table 3. We find that the coefficients of CCI_ort_{t-1} and BWI_ort_{t-1} remain positive and statistically significant. In terms of economic significance, in column (2), a one-standard-deviation increase in BWI_ort_{t-1} is associated with an increase in the book leverage ratio of 0.5 percentage points, which is equivalent to $10.8 million of debt for an average firm. In summary, the findings of Tables 2-3 demonstrate that the positive relationship between investor sentiment and the leverage ratio is robust to the two regression specifications, alternative definitions of variables, and alternative estimation methods.

How do we reconcile our findings with previous studies that equity issuance is more sensitive to investor sentiment than is debt issuance (e.g., Dong et al., 2012; Mclean and Zhao, 2014)? Mclean and Zhao (2014) show that investor sentiment and equity issuance have a correlation coefficient of 0.073, while investor sentiment and debt issuance have a correlation coefficient of 0.043. If the sensitivity of equity issuance is greater than that of debt issuance, an increase in investor sentiment should lead to a larger variation in the denominator than in the numerator of the leverage ratio, resulting in a decrease in the ratio. Why, then, do we observe a positive relationship? A plausible explanation is that investor sentiment may also influence another element of capital structure, which is

[3] A few prior studies control for R&D expenses and depreciation and amortization in their regression specifications of capital structure (e.g., Hovakimian and Li, 2011; Oztekin and Flannery, 2012). Our findings are robust to controlling these variables.

[4] In a recent study, Lopez-Salido et al. (2017) develop a credit market sentiment indicator using the yields of Moody's Baa-rated bonds and 10-year Treasury bonds, which have been captured in the calculation of *DSP* and *TSP*. We use the credit market sentiment variable to replace *DSP* and *TSP* in our control variables and this change does not impact the observed relationship between investor sentiment and leverage ratio (or debt maturity). This result is reported in our online appendix (Table OA4).

[5] We use the effective tax rate, following Givoly et al. (1992), to replace the statutory corporate tax rate in Huang and Ritter (2009) to capture the cross-sectional variation in tax rate.

Table 2
The effect of investor sentiment on firm leverage.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variables	$\Delta LEV_{i,t}$		$\Delta MLEV_{i,t}$		$LEV_{i,t}$		$MLEV_{i,t}$	
Estimation methods	OLS, clustered by firm and year							
CCI_ort_{t-1}	0.044***		0.024*		0.044***		0.024*	
	(2.69)		(1.80)		(2.69)		(1.80)	
BWI_ort_{t-1}		0.006***		0.007***		0.006***		0.007***
		(3.13)		(3.37)		(3.13)		(3.37)
$LEV_{i,t-1}$	−0.176***	−0.176***			0.824***	0.824***		
	(−28.18)	(−27.40)			(131.74)	(128.24)		
$MLEV_{i,t-1}$			−0.160***	−0.159***			0.840***	0.841***
			(−21.09)	(−21.15)			(110.83)	(112.20)
$SIZE_{i,t-1}$	0.000	0.000	0.001**	0.001**	0.000	0.000	0.001**	0.001**
	(0.14)	(0.29)	(2.58)	(2.54)	(0.14)	(0.29)	(2.58)	(2.54)
$ROA_{i,t-1}$	−0.047***	−0.048***	−0.003	−0.003	−0.047***	−0.048***	−0.003	−0.003
	(−8.86)	(−9.02)	(−1.04)	(−1.04)	(−8.86)	(−9.02)	(−1.04)	(−1.04)
$TAN_{i,t-1}$	0.022***	0.022***	0.020***	0.019***	0.022***	0.022***	0.020***	0.019***
	(6.08)	(5.99)	(6.55)	(6.27)	(6.08)	(5.99)	(6.55)	(6.27)
$M/B_{i,t-1}$	−0.002***	−0.002***	−0.001**	−0.001**	−0.002***	−0.002***	−0.001**	−0.001**
	(−3.35)	(−3.28)	(−2.27)	(−2.40)	(−3.35)	(−3.28)	(−2.27)	(−2.40)
IPG_t	0.028	−0.050	0.140	0.101	0.028	−0.050	0.140	0.101
	(0.31)	(−0.75)	(1.22)	(1.24)	(0.31)	(−0.75)	(1.22)	(1.24)
GCD_t	−0.060	−0.097**	0.002	−0.017	−0.060	−0.097**	0.002	−0.017
	(−1.35)	(−2.01)	(0.03)	(−0.24)	(−1.35)	(−2.01)	(0.03)	(−0.24)
GCN_t	−0.233***	−0.182*	−0.039	0.025	−0.233***	−0.182*	−0.039	0.025
	(−2.75)	(−1.94)	(−0.32)	(0.20)	(−2.75)	(−1.94)	(−0.32)	(0.20)
GCS_t	0.031	0.067	−0.199	−0.164	0.031	0.067	−0.199	−0.164
	(0.33)	(0.63)	(−1.37)	(−1.13)	(0.33)	(0.63)	(−1.37)	(−1.13)
GE_t	0.900***	0.724***	1.158***	0.988***	0.900***	0.724***	1.158***	0.988***
	(6.36)	(5.26)	(5.75)	(4.99)	(6.36)	(5.26)	(5.75)	(4.99)
REC_t	0.008**	0.008*	0.025***	0.027***	0.008**	0.008*	0.025***	0.027***
	(1.95)	(1.82)	(3.25)	(3.86)	(1.95)	(1.82)	(3.25)	(3.86)
ERP_t	−0.103	−0.058	−0.446*	−0.239	−0.103	−0.058	−0.446*	−0.239
	(−0.73)	(−0.37)	(−1.84)	(−0.97)	(−0.73)	(−0.37)	(−1.84)	(−0.97)
RIR_t	−0.046	−0.097	0.011	−0.062	−0.046	−0.097	0.011	−0.062
	(−0.50)	(−1.12)	(0.09)	(−0.50)	(−0.50)	(−1.12)	(0.09)	(−0.50)
DSP_t	−0.465***	−0.339**	−0.264***	−0.145**	−0.465***	−0.339**	−0.264***	−0.145**
	(−2.89)	(−2.48)	(−2.78)	(−2.39)	(−2.89)	(−2.48)	(−2.78)	(−2.39)
TSP_t	−0.292*	−0.437**	−0.439	−0.576**	−0.292*	−0.437**	−0.439	−0.576**
	(−1.65)	(−2.03)	(−1.58)	(−2.06)	(−1.65)	(−2.03)	(−1.58)	(−2.06)
$RGDP_t$	−0.175	0.208	−0.431	−0.121	−0.175	0.208	−0.431	−0.121
	(−0.78)	(0.95)	(−1.44)	(−0.46)	(−0.78)	(0.95)	(−1.44)	(−0.46)
$ETR_{i,t}$	−0.008***	−0.008***	−0.006***	−0.006***	−0.008***	−0.008***	−0.006***	−0.006***
	(−9.72)	(−9.69)	(−7.78)	(−7.76)	(−9.72)	(−9.69)	(−7.78)	(−7.76)
ASR_t	−0.014*	−0.008	−0.081***	−0.070***	−0.014*	−0.008	−0.081***	−0.070***
	(−1.69)	(−1.05)	(−6.63)	(−5.93)	(−1.69)	(−1.05)	(−6.63)	(−5.93)
Industry fixed effects	Included	Included	Included	Included	Included	Included	Included	Included
Observations	212,851	212,851	211,249	211,249	212,851	212,851	211,249	211,249
R squared	7.15%	7.16%	10.46%	10.60%	65.85%	65.86%	73.56%	73.61%

This table presents the results for the effect of investor sentiment on firm leverage. *CCI_ort* is the orthogonalized consumer sentiment index. *BWI_ort* is the orthogonalized Baker and Wurgler Investor Sentiment Index. *IPG* is the industrial production growth. *GCD* is growth in consumption of durable goods. *GCN* is growth in consumption of non-durable goods. *GCS* is growth in consumption of service. *GE* is growth in employment. *REC* is a dummy variable for NBER recessions. *ERP* is the equity risk premium. *RIR* is the real interest rate. *DSP* is the default spread. *TSP* is the term spread. *RGDP* is the real GDP growth rate. *ETR* is the effective tax rate. *ASR* is the aggregate stock return. Definitions of the variables are summarized in Appendix 1. Standard errors are clustered by firm and year. Coefficients and t-values in parentheses are reported. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

retained earnings. The capital structure literature tends to use total debt divided by total assets to define leverage, where assets include retained earnings. It is widely acknowledged that firms generate lower returns in high sentiment periods (e.g., Baker and Wurgler, 2006) and should therefore retain lower earnings. For example, in our sample, the mean value of profitability (ROA) for firms in high sentiment periods is −0.09, when CCI_ort_{t-1} is >0.1 (one standard deviation above the mean); while the mean value is 0.014 in low sentiment periods, when CCI_ort_{t-1} is less than −0.1. The mean value of annual change in retained earnings is −0.173 in high sentiment periods, while it is −0.063 in low sentiment periods.[6] The large decrease in retained earnings in high sentiment periods results in a

[6] These results, together with other univariate analysis results, are reported in Table OA1 of the Online Appendix.

Table 3
The effect of investor sentiment on firm leverage: controlling for firm-fixed effects.

	(1)	(2)	(3)	(4)
Dependent variables	$LEV_{i,t}$		$MLEV_{i,t}$	
Estimation methods	FE, clustered by firm and year			
CCI_ort_{t-1}	0.036**		0.017*	
	(2.26)		(1.71)	
BWI_ort_{t-1}		0.005***		0.006***
		(3.38)		(4.14)
$LEV_{i,t-1}$	0.646***	0.646***		
	(72.97)	(72.96)		
$MLEV_{i,t-1}$			0.646***	0.648***
			(71.32)	(71.42)
Firm control	Included	Included	Included	Included
Macro control	Included	Included	Included	Included
Industry fixed effects	Included	Included	Included	Included
Observations	211,390	211,390	209,724	209,724
R squared	71.36%	71.36%	77.84%	77.85%

This table presents the results for the effect of investor sentiment on firm leverage after controlling for fixed-effects at the firm level. *CCI_ort* is the orthogonalized consumer sentiment index. *BWI_ort* is the orthogonalized Baker and Wurgler Investor Sentiment Index. Definitions of the variables are summarized in Appendix 1. Standard errors are clustered by firm and year. Coefficients and t-values in parentheses are reported. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

decrease in shareholders' equity. Firms issue both equity and debt while experiencing a reduction in the level of retained earnings in high sentiment periods, with the aggregate effect of these three factors producing a higher leverage ratio.

4.2. The effect of investor sentiment on firm debt maturity

Next, we examine how investor sentiment determines firms' debt maturity structure by incorporating the investor sentiment measures into the model developed by Barclay and Smith (1995) and Stohs and Mauer (1996). We further control for fixed-effects at the industry level and the set of macroeconomic variables used in the regression of leverage in Eq. (4). The results are reported in Table 4.

The results of Table 4 indicate that firms use shorter debt maturity in high sentiment periods, which supports our *Hypothesis 2b*. In columns (1) and (2), both CCI_ort_{t-1} and BWI_ort_{t-1} have negative signs, and the negative effects are statistically and economically significant. For example, a one-standard-deviation increase in BWI_ort_{t-1} is associated with a decrease in $MAT_{i,t}$ of 0.7 percentage points. This is equivalent to an average firm switching $4.2 million from long-term debt to short-term debt. These results are consistent with the signalling and liquidity risk theory but run counter to the prediction of contracting cost theory. These findings clearly indicate that, in high sentiment periods, firms are confident about their future cash flows, and hence use shorter debt maturity to signal their strong solvency to the market. The negative relationship continues to hold after controlling for fixed-effects at the firm level in columns (3)–(4).

We use alternative definitions of debt maturity to test the effect of investor sentiment on debt maturity structure to ensure that our results are not sensitive to the definition of long-term debt. Our main variable for debt maturity, *MAT*, defines debt due over 1 year as long-term debt, following Fan et al. (2012). This definition, however, does not distinguish, for example, between debt due in 2 years and debt due over 5 years. To ensure that the observed negative relationship is robust to other definitions of long-term debt, we use the proportions of debt maturing over 3 years (*MAT3*) and 5 years (*MAT5*) to define long-term debt, following prior literature (e.g., Barclay and Smith, 1995; Custodio et al., 2013), and test the relationship.

The results of Table 5 display a negative and significant relationship between investor sentiment and debt maturity. In columns (1)–(4), CCI_ort_{t-1} and BWI_ort_{t-1} negatively determine $MAT3_{i,t}$ and $MAT5_{i,t}$, demonstrating that the proportions of debt due over 3 years and 5 years decline in high sentiment periods. For example, a one-standard-deviation increase in *BWI_ort* leads to a decrease in debt due over 3 years of 0.9 percentage points, which is equivalent to $5.4 million of debt for an average firm. Debt due over 5 years decreases by 1.2 percentage points, which is equivalent to $7.2 million of debt for an average firm. Columns (5)–(8) show similar results when we control for fixed-effects at the firm level. Overall, our results confirm that the negative relationship between investor sentiment and debt maturity is robust to these alternative definitions of long-term debt.

4.3. The effect of investor sentiment on leverage target adjustment

We employ the partial adjustment framework to examine the relationship between investor sentiment and the speed of adjustment to the leverage target (SOA). Specifically, we set the SOA measure in Eq. (1), θ, as a function of investor sentiment:

$$\theta = \alpha + \delta Sentiment_{t-1} \tag{6}$$

We incorporate Eq. (6) into Eq. (4) so that $Sentiment_{t-1}$ interacts with $LEV_{i,t-1}$ and $X_{i,t-1}$. We rearrange the equation to derive the

Table 4
The effect of investor sentiment on firm debt maturity.

	(1)	(2)	(3)	(4)
Dependent variable	$MAT_{i,t}$			
Estimation methods	OLS, clustered by firm and year		FE, clustered by firm and year	
CCI_ort_{t-1}	−0.092***		−0.047**	
	(−3.69)		(−2.37)	
BWI_ort_{t-1}		−0.007*		−0.005**
		(−1.83)		(−2.41)
$SIZE_{i,t}$	0.043***	0.043***	0.043***	0.042***
	(29.90)	(29.96)	(20.91)	(20.51)
$M/B_{i,t}$	−0.007***	−0.007***	−0.002**	−0.002**
	(−8.39)	(−7.84)	(−2.16)	(−2.19)
$AB_{i,t}$	−0.026***	−0.027***	−0.026***	−0.026***
	(−11.53)	(−10.24)	(−16.44)	(−16.47)
$AM_{i,t}$	0.002***	0.002***	0.002***	0.002***
	(7.72)	(7.83)	(7.72)	(7.82)
IPG_t	−0.066	0.090	0.021	0.092
	(−0.79)	(1.17)	(0.29)	(1.45)
GCD_t	0.093	0.173**	0.090	0.124*
	(1.26)	(2.29)	(1.30)	(1.91)
GCN_t	−0.294***	−0.355***	−0.240***	−0.282***
	(−2.97)	(−3.10)	(−2.77)	(−3.31)
GCS_t	0.919***	0.868***	0.592***	0.527***
	(6.22)	(5.75)	(4.41)	(3.97)
GE_t	0.147	0.426	−0.020	0.133
	(0.62)	(1.66)	(−0.09)	(0.60)
REC_t	−0.002	0.002	−0.002	−0.001
	(−0.21)	(0.28)	(−0.27)	(−0.24)
ERP_t	0.343	0.456	0.609**	0.598**
	(1.27)	(1.55)	(2.61)	(2.55)
RIR_t	−0.169	−0.124	−0.111	−0.044
	(−1.47)	(−0.96)	(−1.29)	(−0.55)
DSP_t	0.930	1.127	1.247*	1.432**
	(0.83)	(0.95)	(1.93)	(2.25)
TSP_t	−0.426	−0.216	−0.454*	−0.302
	(−1.45)	(−0.75)	(−1.80)	(−1.35)
$RGDP_t$	0.182	−0.494**	0.142	−0.222
	(0.85)	(−2.28)	(0.68)	(−1.23)
$ETR_{i,t}$	0.011***	0.011***	0.005***	0.005***
	(5.75)	(5.51)	(3.38)	(3.47)
ASR_t	0.044***	0.042***	0.047***	0.042***
	(3.81)	(2.93)	(5.10)	(3.99)
Industry fixed effects	Included	Included	Included	Included
Observations	183,720	183,720	182,042	182,042
R squared	16.71%	16.69%	49.93%	49.93%

This table presents the results for the effect of investor sentiment on debt maturity structure. *CCI_ort* is the orthogonalized consumer sentiment index. *BWI_ort* is the orthogonalized Baker and Wurgler Investor Sentiment Index. *MAT* is debt maturity defined as long-term debt over total debt. *AB* is abnormal earnings. *AM* is asset maturity. *IPG* is the industrial production growth. *GCD* is growth in consumption of durable goods. *GCN* is growth in consumption of non-durable goods. *GCS* is growth in consumption of service. *GE* is growth in employment. *REC* is a dummy variable for NBER recessions. *ERP* is the equity risk premium. *RIR* is the real interest rate. *DSP* is the default spread. *TSP* is the term spread. *RGDP* is the real GDP growth rate. *ETR* is the effective tax rate. *ASR* is the aggregate stock return. Definitions of the variables are summarized in Appendix 1. Standard errors are clustered by firm and year. Columns (3) and (4) control for fixed effects at the firm level. Coefficients and t-values in parentheses are reported. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

following regression model:

$$\Delta LEV_{i,t} = \alpha + \beta_0 Sentiment_{t-1} - \beta_1 LEV_{i,t-1} - \beta_2 LEV_{i,t-1}{*}Sentiment_{t-1} + \sum \left(\beta_3 X_{i,t-1} + \beta_4 X_{i,t-1}{*}Sentiment_{t-1}\right) + \gamma Macro + \varepsilon_{i,t} \tag{7}$$

where β_1 is the SOA coefficient; β_2 tests the effect of investor sentiment on the SOA. Incorporating $Sentiment_{t-1}$ and $LEV_{i,t-1}$ * $Sentiment_{t-1}$ in one model enables us to consider the separate effects of investor sentiment on leverage and leverage target adjustment. We use a dummy variable, *Low_Sentiment*, to capture low sentiment periods and test the effect of investor sentiment on the SOA. *Low_Sentiment* equals 1 if the value of CCI_ort_{t-1} or BWI_ort_{t-1} is at least one standard deviation below its sample mean value, and 0 otherwise. By the *CCI_ort* measure, 16.2% of the observations fall into low sentiment periods. By the *BWI_ort* measure, 9.2% of the observations fall into low sentiment periods. We expect the interaction term to have a positive sign, which indicates that the SOA is lower in low sentiment periods.

The results of Table 6 are in line with our Hypothesis 3 that firms adjust their leverage ratios more slowly in low sentiment periods.

Table 5
The effect of investor sentiment on firm debt maturity: alternative measures of debt maturity.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	$MAT3_{i,t}$		$MAT5_{i,t}$		$MAT3_{i,t}$		$MAT5_{i,t}$	
Estimation Methods	OLS, clustered by firm and year				FE, clustered by firm and year			
CCI_ort_{t-1}	−0.089*		−0.096*		−0.085*		−0.083	
	(−1.74)		(−1.83)		(−1.88)		(−1.64)	
BWI_ort_{t-1}		−0.009*		−0.012*		−0.008*		−0.010*
		(−1.70)		(−1.81)		(−1.80)		(−1.94)
Control variables	Included	Included	Included	Included	Included	Included	Included	Included
Industry fixed effects	Included	Included	Included	Included	Included	Included	Included	Included
Observations	137,968	137,968	135,045	135,045	135,986	135,986	133,014	133,014
R squared	27.97%	27.97%	25.14%	25.15%	56.46%	56.46%	53.60%	53.60%

This table presents the results for the effect of investor sentiment on debt maturity using alternative definitions of debt maturity. *MAT3* and *MAT5* use debt due over 3 and 5 years to calculate long-term debt, respectively. Definitions of the variables are summarized in Appendix 1. Standard errors are clustered by firm and year. Columns (5)–(8) control for fixed effects at the firm level. Coefficients and t-values in parentheses are reported. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

According to column (2), firms in medium and high sentiment periods ($Low\_Sentiment = 0$) adjust their leverage ratios at an SOA of 17.9 percentage points per annum. In low sentiment periods, the SOA decreases by 36.3% from 17.9 percentage points to 11.4 percentage points.[7] The interaction term, $LEV_{i,t-1}*Low\_Sentiment_{t-1}$, has a t-value of 5.90, indicating that the difference in the SOA between the two groups is statistically significant. The difference remains significant when we use *MLEV* to measure the leverage ratio in column (4). Specifically, when investor sentiment is low, the SOA of the market leverage ratio decreases by 22.1% from 16.3 percentage points to 12.7 percentage points. When we use *CCI_ort* to measure investor sentiment, the coefficient of $LEV_{i,t-1}*Low\_Sentiment_{t-1}$ remains positive although not statistically significant (0.013, $t = 1.06$), while $MLEV_{i,t-1}*Low\_Sentiment_{t-1}$ is positive and significant at the 5% level (0.062, $t = 2.10$). These findings support our Hypothesis 3 that low sentiment has an adverse influence on the cost of external finance, which makes managers tardy to adjust leverage ratios to meet their firms' targets.

4.4. The effect of financial constraints on the sentiment-leverage relationship

Since high sentiment increases a firm's debt capacity, a further question arises as to whether the effect is homogeneous. Baker and Wurgler (2006) find that investor sentiment impacts the cross-section of stock returns and that it has a greater impact on small, young, highly volatile, unprofitable, dividend non-paying, and high growth firms. Given these cross-sectional variations, one might expect that *investor sentiment would have a greater impact on the leverage ratio of firms demanding greater external finance than that of firms demanding lesser external finance*. We introduce the variables capturing a firm's financial constraints and interact them with the investor sentiment measures in Eq. (4) to test whether the effect of investor sentiment on leverage depends on the degree of financial constraints. We adopt the three most frequently used measures of financial constraints: the *KZ index* (Kaplan and Zingales, 1997), the *WW index* (Whited and Wu, 2006) and the *Size and Age* (*SA*) *index* (Hadlock and Pierce, 2010). $Constrained_{i,t-1}$ is a dummy variable equal to 1 if the value of the financial constraint index is above the industry annual median value, and 0 otherwise.

The results of Table 7 show that the leverage ratio of financially constrained firms is more sensitive to the variation in investor sentiment than that of unconstrained firms. Panel A reports the results of book leverage ratio. Column (1) shows that the interaction term, $Sentiment_{t-1} * Constrained_{i,t-1}$, has a positive sign in determining the book leverage ratio, indicating that firms suffering severe financial constraints are more sensitive to variations in investor sentiment. Specifically, when we use the *KZ index* to measure financial constraints, $Sentiment_{t-1}$ has a coefficient of 0.039 for unconstrained firms, whereas the coefficient is 0.048 for financially constrained firms. The difference between the two groups is significant at the 10% level. The difference continues to hold when we use the *WW index* and the *SA index* to measure financial constraints in columns (2) and (3), respectively. Columns (4)–(6) report the results of using *BWI_ort* to measure investor sentiment. The coefficients of $Sentiment_{t-1} * Constrained_{i,t-1}$ remain statistically significant. These results consistently show that the stronger sensitivity of financially constrained firms to market sentiment in their leverage ratios is robust to the two measures of investor sentiment. The results of applying the market leverage ratio are reported in Panel B. The *KZ index* generates similar results to those in Panel A. In respect of the *WW index* and the *SA index*, the coefficients of $Sentiment_{t-1}*Constrained_{i,t-1}$ remain positive, although not statistically significant.

Overall, the results reported in Table 7 establish that the leverage ratio of financially constrained firms is more sentiment-prone. Financially constrained firms, with greater demand for external finance, are more inclined to take advantage of high investor sentiment to increase leverage. Our investigation illustrates the heterogeneous sentiment effects for financially constrained versus unconstrained firms and demonstrates that high investor sentiment, through increasing firms' debt capacity, helps financially constrained firms raise funds externally.

[7] The calculation is 0.065/0.179 = 36.3%.

Table 6
The effect of investor sentiment on leverage target adjustment.

	(1)	(2)	(3)	(4)
Dependent variables	$\Delta LEV_{i,t}$		$\Delta MLEV_{i,t}$	
Sentiment measures	CCI_ort	Sent_ort	CCI_ort	Sent_ort
$Low\_Sentiment_{t-1}$	−0.016**	−0.023***	−0.009	−0.014
	(−2.11)	(−2.79)	(−0.91)	(−1.32)
$LEV_{i,t-1}$	−0.177***	−0.179***		
	(−27.12)	(−28.33)		
$LEV_{i,t-1}$* $Low\_Sentiment_{t-1}$	**0.013**	**0.065*** **		
	(1.06)	**(5.90)**		
$MLEV_{i,t-1}$			−0.163***	−0.163***
			(−21.32)	(−20.07)
$MLEV_{i,t-1}$* $Low\_Sentiment_{t-1}$			**0.062*** *	**0.036*** *
			(2.10)	**(2.38)**
$SIZE_{i,t-1}$	0.000	0.001	0.001***	0.001***
	(0.16)	(0.63)	(2.89)	(2.77)
$SIZE_{i,t-1}$ * $Low\_Sentiment_{t-1}$	0.003**	−0.001	0.001	−0.001
	(2.52)	(−1.43)	(0.53)	(−0.79)
$ROA_{i,t-1}$	−0.047***	−0.049***	−0.003	−0.003
	(−8.68)	(−8.91)	(−1.09)	(−1.29)
$ROA_{i,t-1}$ * $Low\_Sentiment_{t-1}$	−0.028***	0.016**	−0.015	0.015
	(−3.54)	(2.28)	(−1.62)	(1.25)
$TAN_{i,t-1}$	0.023***	0.022***	0.020***	0.020***
	(6.14)	(5.83)	(6.24)	(6.12)
$TAN_{i,t-1}$ * $Low\_Sentiment_{t-1}$	−0.025*	−0.015	−0.022	−0.009
	(−1.77)	(−1.46)	(−1.21)	(−0.79)
$M/B_{i,t-1}$	−0.002***	−0.002***	−0.001**	−0.001**
	(−3.55)	(−3.37)	(−2.16)	(−2.58)
$M/B_{i,t-1}$ * $Low\_Sentiment_{t-1}$	0.004***	0.003	−0.001	−0.000
	(2.78)	(1.17)	(−0.69)	(−0.33)
IPG_t	−0.060	−0.042	0.096	0.116
	(−0.79)	(−0.55)	(1.08)	(1.29)
GCD_t	−0.125**	−0.083	−0.076	−0.006
	(−2.56)	(−1.62)	(1.09)	(−0.08)
GCN_t	−0.288***	−0.241**	−0.108	−0.047
	(−3.45)	(−2.55)	(−0.89)	(−0.38)
GCS_t	0.103	0.105	−0.092	−0.135
	(1.04)	(0.86)	(−0.67)	(−0.91)
GE_t	0.786***	0.851***	1.118***	1.145***
	(5.13)	(5.27)	(5.54)	(5.48)
REC_t	0.004	0.007	0.022***	0.026***
	(0.81)	(1.64)	(2.85)	(3.13)
ERP_t	−0.331**	−0.291*	−0.497*	−0.553**
	(−2.07)	(−1.97)	(−1.80)	(−2.52)
RIR_t	−0.050	−0.098	−0.002	−0.037
	(−0.54)	(−0.88)	(−0.01)	(−0.25)
DSP_t	1.499***	1.422***	2.166***	2.075***
	(2.91)	(3.03)	(3.03)	(2.83)
TSP_t	−0.436**	−0.354	−0.497*	−0.464
	(−2.15)	(−1.58)	(−1.80)	(−1.60)
$RGDP_t$	0.181	0.062	−0.186	−0.320
	(0.87)	(0.27)	(−0.73)	(−1.17)
$ETR_{i,t}$	−0.009***	−0.008***	−0.006***	−0.006***
	(−9.90)	(−9.83)	(−7.85)	(−7.52)
ASR_t	−0.019**	−0.018**	−0.079***	−0.082***
	(−2.15)	(−2.21)	(−7.91)	(−7.85)
Industry fixed effects	Included	Included	Included	Included
Observations	212,851	212,851	211,249	211,249
R squared	7.17%	7.17%	10.59%	10.49%

This table presents the results for the effect of investor sentiment on the leverage speed of adjustment (SOA). *Low_sentiment* is a dummy variable equaling one if investor sentiment is at least one standard deviation below the sample mean value. Our primary variable is $LEV_{i,t-1}$ * $Low\_Sentiment_{t-1}$, highlighted in bold font. Definitions of the variables are summarized in Appendix 1. Standard errors are clustered by firm and year. Coefficients and t-values in parentheses are reported. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

4.5. The effects of sentiment components on firm capital structure

Next, we study the effects of the sentiment components on firms' financing decisions. Previous sections have documented the impact of investor sentiment on the leverage ratio and debt maturity, but little is known of how the components of Investor Sentiment

Table 7
The effect of financial constraints on the sentiment-leverage relationship.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A Dependent variable: $\Delta LEV_{i,t}$						
Sentiment measures	CCI_ort			BWI_ort		
Constraint measures	KZ	WW	SA	KZ	WW	SA
$Sentiment_{t-1}$	0.039***	0.034*	0.035**	0.005**	0.005**	0.004**
	(2.80)	(1.88)	(2.03)	(9.14)	(2.66)	(2.56)
$Sentiment_{t-1}$ * $Constrained_{i,t-1}$	0.009*	0.019*	0.017*	0.001*	0.002**	0.003**
	(1.71)	(1.88)	(1.75)	(1.69)	(1.96)	(2.34)
$Constrained_{i,t-1}$	0.010***	0.002**	0.006***	0.009***	0.003**	0.006***
	(9.74)	(1.96)	(3.87)	(9.66)	(2.23)	(3.98)
Control variables	Included	Included	Included	Included	Included	Included
Industry fixed effects	Included	Included	Included	Included	Included	Included
Observations	212,851	212,851	212,851	212,851	212,851	212,851
R squared	7.22%	7.16%	7.17%	7.23%	7.17%	7.19%
Panel B Dependent variable: ΔMLEVi,t						
Sentiment measures	CCI_ort			BWI_ort		
Constraint measures	KZ	WW	SA	KZ	WW	SA
$Sentiment_{t-1}$	0.020	0.026	0.024	0.004***	0.007***	0.006***
	(1.53)	(0.99)	(0.92)	(3.22)	(3.52)	(3.36)
$Sentiment_{t-1}$ * $Constrained_{i,t-1}$	0.040**	0.005	0.02	0.004**	0.000	0.001
	(2.31)	(0.51)	(0.63)	(2.43)	(0.53)	(1.03)
$Constrained_{i,t-1}$	0.035***	0.006**	0.006***	0.006***	0.003**	0.006***
	(6.79)	(2.55)	(4.60)	(6.47)	(2.38)	(4.44)
Control variables	Included	Included	Included	Included	Included	Included
Industry fixed effects	Included	Included	Included	Included	Included	Included
Observations	211,249	211,249	211,249	211,249	211,249	211,249
R squared	10.54%	10.47%	10.51%	10.67%	10.61%	10.66%

This table presents the results for the effect of financial constraints on the sentiment-leverage relationship. *Constrained* is a dummy variable equaling one for firms with a value of the financial constraint measures above the industry annual average using the 3-digit SIC codes. We use *KZ index*, *WW index* and *SA index* as the three measures of financial constraints. Firm- and macro-level characteristics and industry-fixed effects are controlled. Definitions of the variables are summarized in Appendix 1. Standard errors are clustered by firm and year. Coefficients and t-values in parentheses are reported. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Index might impact firms' financing decisions. Since the Investor Sentiment Index is constructed using a vector of macro characteristics in Baker and Wurgler (2006), any influence that it has on firms' financing decisions must be due to the impact of one or more of its constituent components. Thus, identifying and measuring the influence of individual components can help refine our understanding of the relationship between investor sentiment and firms' financing decisions. Therefore, we assess the impact of the orthogonalized sentiment components on the leverage ratio and debt maturity. We predict the signs of the coefficients of the sentiment components based on the relationships between these components and the Investor Sentiment Index in Baker and Wurgler (2006), and the relationships between investor sentiment and firms' capital structure decisions that we document in Tables 2-5. For example, Baker and Wurgler (2006) find that investor sentiment is negatively correlated with the dividend premium and our results indicate that investor sentiment is positively correlated with the leverage ratio; hence, by inference, we predict a negative relationship between the dividend premium and the leverage ratio.

The results of Table 8 indicate that all the sentiment components have an impact on firms' capital structure decisions. Their influence, however, differs. For example, in column (1) of Panel A, we find a negative relationship between dividend premium ($PDND\_ort_{t-1}$) and the book leverage ratio (−0.023, $t = -1.79$), which is in line with the negative relationship between dividend premium and investor sentiment in Baker and Wurgler (2006). Column (5) shows a positive relationship between $SOEI\_ort_{t-1}$ and the book leverage ratio (0.052, $t = 2.64$), in line with the predicted sign. In column (3) of Panel B, the number of IPOs ($NIPO\_ort_{t-1}$) is positively correlated with the market leverage ratio (0.021, $t = 1.99$). In Panel C, we find that $PDND\_ort_{t-1}$ (0.059, $t = 4.19$) *and* $CEFD\_ort_{t-1}$ (0.046, $t = 1.79$) are positively correlated with debt maturity, while $RIPO\_ort_{t-1}$ (−0.035, $t = -2.75$) and $NIPO\_ort_{t-1}$ (−0.022, $t = -1.66$) are negatively correlated with debt maturity. These results confirm that the relationship between investor sentiment and firms' financing decisions is not driven by one particular component of the Sentiment Index. Rather, all five components individually exert an influence on firms' financing decisions, because each of these variables incorporates information that is a derivative of investor sentiment. Among them, the dividend premium (*PDND*), the number of IPOs (*NIPO*), and the equity share in new issues (*SOEI*) are significant in predicting the leverage ratio, while the dividend premium (*PDND*), the first-day returns on IPOs (*RIPO*), the numbers of IPOs (*NIPO*) and the closed-end fund discount (*CEFD*) are significant in predicting debt maturity. Overall, our findings rationalize the influence of the components of the Sentiment Index and their individual impact on firms' capital structure decisions.

Table 8
The effects of sentiment components on firm leverage and debt maturity.

		(1)	(2)	(3)	(4)	(5)	(6)
Panel A The Effects of Sentiment Components on Book Leverage Ratio							
Sentiment components	Predicted signs	Dependent variable $\Delta LEV_{i,t}$					
$PDND\_ort_{t-1}$	−	−0.023*					−0.048***
		(−1.79)					(−3.01)
$RIPO\_ort_{t-1}$	+		−0.001				−0.030***
			(−0.04)				(−2.90)
$NIPO\_ort_{t-1}$	+			0.011			−0.003
				(1.52)			(−0.38)
$CEFD\_ort_{t-1}$	−				0.019		0.058***
					(0.87)		(2.78)
$SOEI\_ort_{t-1}$	+					0.052**	0.047**
						(2.64)	(2.21)
Control variables		Included	Included	Included	Included	Included	Included
Industry fixed effects		Included	Included	Included	Included	Included	Included
Observations		212,851	212,851	212,851	212,851	212,851	212,851
R squared		7.13%	7.12%	7.13%	7.12%	7.14%	7.18%
Panel B The Effects of Sentiment Components on Market Leverage Ratio							
Sentiment components	predicted signs	Dependent variable $\Delta MLEV_{i,t}$					
$PDND\_ort_{t-1}$	−	−0.006					−0.002
		(−0.39)					(−0.07)
$RIPO\_ort_{t-1}$	+		−0.002				−0.017
			(−0.16)				(−1.00)
$NIPO\_ort_{t-1}$	+			0.021*			0.017
				(1.99)			(1.26)
$CEFD\_ort_{t-1}$	−				0.019		0.033
					(0.53)		(0.87)
$SOEI\_ort_{t-1}$	+					0.079***	0.065*
						(2.97)	(1.97)
Control variables		Included	Included	Included	Included	Included	Included
Industry fixed effects		Included	Included	Included	Included	Included	Included
Observations		211,249	211,249	211,249	211,249	211,249	211,249
R squared		10.44%	10.43%	10.51%	10.44%	10.55%	10.61%
Panel C The Effects of Sentiment Components on Firm Debt Maturity							
Sentiment components	predicted signs	Dependent variable $MAT_{i,t}$					
$PDND\_ort_{t-1}$	+	0.059***					0.039*
		(4.19)					(1.79)
$RIPO\_ort_{t-1}$	−		−0.035***				−0.020
			(−2.75)				(−0.99)
$NIPO\_ort_{t-1}$	−			−0.022*			−0.005
				(−1.66)			(−0.33)
$CEFD\_ort_{t-1}$	+				0.046*		0.033
					(1.79)		(1.09)
$SOEI\_ort_{t-1}$	−					−0.008	0.024
						(−0.23)	(0.57)
Control variables		Included	Included	Included	Included	Included	Included
Industry fixed effects		Included	Included	Included	Included	Included	Included
Observations		183,720	183,720	183,720	183,720	183,720	183,720
R squared		16.70%	16.68%	16.68%	16.67%	16.67%	16.70%

This table presents the results for the effects of sentiment components on firm leverage and debt maturity. *PDND_ort* is orthogonalized dividend premium. *RIPO_ort* is orthogonalized IPO first day returns. *NIPO_ort* is orthogonalized number of IPOs. *CEFD_ort* is orthogonalized closed-end fund discount. *SOEI_ort* is orthogonalized share of equity issuance. Panels A-C test the effects of sentiment components on book leverage ratio, market leverage ratio and debt maturity, respectively. Predicted signs are derived from the relationships between the sentiment components and the investor sentiment index in Baker and Wurgler (2006). Definitions of the variables are summarized in Appendix 1. Standard errors are clustered by firm and year. Coefficients and t-values in parentheses are reported. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

4.6. *Additional analysis: investor sentiment, leverage and stock returns*

Our analysis has demonstrated a positive relationship between investor sentiment and the leverage ratio. Since the literature suggests that a high leverage ratio causes a debt overhang problem (Myers, 1977) and leads to lower stock returns (Cai and Zhang, 2011), a question that naturally arises is whether the increased leverage ratio in high sentiment periods explains the negative impact of investor sentiment on future stock returns, as observed in the literature (e.g., Brown and Cliff, 2005; Baker and Wurgler, 2006; Baker et al., 2012). We conduct a further analysis to examine the possible effect of leverage on the sentiment-return relationship. We add the

Table 9
The effect of increasing leverage on the sentiment-return relationship.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Excess return									
Portfolios	Full sample	ΔLEV>0	ΔLEV≤ 0	ΔMLEV>0	ΔMLEV≤ 0	Full sample	ΔLEV>0	ΔLEV≤ 0	ΔMLEV>0	ΔMLEV≤ 0
CCI_ort_{t-1}	−0.367***	−0.551***	−0.203*	−0.605***	−0.328**					
	(−2.69)	(−2.94)	(−1.76)	(−3.54)	(−2.29)					
BWI_ort_{t-1}						−0.033**	−0.055***	−0.010	−0.061***	−0.038**
						(−2.17)	(−2.84)	(−0.78)	(−3.15)	(−2.44)
Rm-Rf	1.049***	1.081***	0.972***	0.915***	1.023***	1.038***	1.065***	0.965***	0.896***	1.013***
	(12.87)	(10.38)	(14.10)	(8.96)	(11.97)	(12.44)	(10.19)	(13.67)	(8.59)	(11.95)
SMB	0.711***	0.690***	0.691***	0.581***	0.716***	0.662***	0.585***	0.681***	0.469***	0.641***
	(6.94)	(5.27)	(7.98)	(4.53)	(6.67)	(5.80)	(4.15)	(7.16)	(3.33)	(5.61)
HML	0.095	0.175	−0.006	0.115	0.095	0.072	0.147	−0.023	0.080	0.078
	(0.96)	(1.38)	(−0.07)	(0.93)	(0.91)	(0.79)	(1.17)	(−0.27)	(0.63)	(0.77)
Constant	−0.218***	−0.332***	−0.105***	−0.414***	−0.214***	−0.213***	−0.325***	−0.103***	−0.406***	−0.209***
	(−13.99)	(−16.70)	(−7.98)	(−21.23)	(−13.12)	(−13.34)	(−16.22)	(−7.61)	(−20.29)	(−12.87)
Difference in sentiment coefficients		−0.348***		−0.277***			−0.045***		−0.023***	
		(−11.29)		(−8.87)			(−13.84)		(−6.61)	
Observations	51	51	51	51	51	51	51	51	51	51
Adjusted R-squared	85.85%	79.33%	88.26%	74.96%	84.13%	85.14%	86.92%	87.63%	73.78%	84.34%

This table presents the results for the effect of increasing leverage on the sentiment-return relationship. We use the Fama and French 3-factor model. We have three portfolios: 1) equal-weighted full Compustat firms where financial and utility firms are not included, 2) firms increasing leverage in year t and 3) firms not increasing leverage. The sample period is from 1966 to 2017. *Excess Return* is measured by the aggregate stock return of the portfolio minus the risk-free rate of return Rf. Rm-Rf, SMB and HML are the market risk factor, size risk factor and value risk factor. We use annual factors because leverage data are on an annual basis. The factor data are collected from Kenneth French's website. Columns (2)–(3) and (7)–(8) use book leverage ratio to partition firms, while columns (4)–(5) and (9)–(10) use market leverage ratio. Coefficients and t-values in parentheses are reported. We test the difference in sentiment coefficients between firms increasing leverage and firms not increasing leverage using *t*-test. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

sentiment measures to the Fama and French 3-factor model (Fama and French, 1993) and consider the differing effects in the coefficient estimates for firms increasing or not increasing their leverage ratios. We divide the sample firms into two equally weighted portfolios, according to whether the firm increases or does not increase its leverage ratio in year *t*. One portfolio comprises 52% of firms that increase their leverage ratios, while the other portfolio includes the remaining 48% of firms that do not increase their leverage ratios. We then separately calculate the excess returns for these two portfolios.

The results of Table 9 establish that leverage amplifies the sentiment-return relationship. The coefficients of the sentiment measures in columns (1) and (6) are negative, showing that stock returns are negatively correlated with beginning-of-period investor sentiment. These results are consistent with the findings in the literature (e.g., Baker and Wurgler, 2006; Baker et al., 2012; Gao et al., 2020). Furthermore, we find that the negative sentiment-return relationship is more pronounced for firms increasing their leverage ratios. The sentiment-return coefficients of leverage-increasing firms is −0.551 in column (2) but is −0.203 for firms not increasing leverage in column (3). These results indicate that the negative effect of investor sentiment on stock returns decrease by 63% if firms choose not to increase leverage.[8] The difference between the two portfolios is statistically significant ($t = -11.29$). Likewise, the negative effect decreases by 82% when we use *BWI_ort* to measure investor sentiment, as shown in columns (7)–(8). The result is robust when we use the market leverage ratio to partition the sample firms in columns (4)–(5) and (9)–(10). These findings consistently demonstrate that the negative relationship between investor sentiment and future stock returns is influenced by firms' leverage decisions. We further divide our sample firms into high-leverage and low-leverage subgroups, according to whether the beginning-of-period leverage is above or below the industry annual median. We find that the effect of increasing leverage in magnifying negative stock returns is robust for these two subgroups, with the effect being greater for the high-leverage group. These results are reported in Table OA3a and Table OA3b of the online appendix. Our finding provides practical insights into the effects of leverage decisions on firm value, suggesting that investors should avoid leverage-increasing firms if beginning-of-period investor sentiment is high.

5. Robustness check

We conduct two additional robustness checks to validate our empirical findings: i) adopting alternative definitions of leverage, and ii) examining whether the effect of investor sentiment is symmetrical in high- and low-sentiment periods.

We employ two additional definitions of leverage to ensure that our results are not sensitive to the specific measure of leverage. First, we follow Welch (2011) and use the liabilities-to-assets ratio as an alternative definition to account for non-debt liabilities. Second, we follow Graham et al. (2015) and use the net debt ratio, which classifies a firm's cash holdings as negative debt. These results are reported in Table OA4 of the online appendix. Our results consistently demonstrate that investor sentiment has a positive impact on the leverage ratio, confirming that the positive relationship between investor sentiment and firm leverage is not sensitive to alternative definitions of leverage.

Next, we examine whether high sentiment and low sentiment have symmetrical effects on firm capital structure decisions to ensure that our results are not driven by a unidirectional change in investor sentiment. A few studies indicate that equity overvaluations and undervaluations do not exert symmetrical effects on firm financing and investment decisions (e.g., Jensen, 2005; Dong et al., 2012). To check whether high- and low-sentiment periods have symmetrical effects on firm leverage and debt maturity, we first identify high- or low-sentiment periods according to whether investor sentiment is at least one-standard-deviation above or below the sample mean, and then test the effects of these high- and low-sentiment periods on firm leverage and debt maturity. By the *CCI_ort* measure, 17.9% of observations fall into high sentiment periods (*High_sentiment* = 1) and 16.2% of observations fall into low sentiment periods (*Low_sentiment* = 1). By the *BWI_ort* measure, 9.2% of observations fall into each group. The results are reported in Table 10. Panels A and B show that high investor sentiment is associated with a high leverage ratio, while low investor sentiment is associated with a low leverage ratio. Panel C shows that high investor sentiment is associated with a short debt maturity, while low investor sentiment is associated with a long debt maturity. These results demonstrate that high investor sentiment and low investor sentiment engender symmetrical impacts on the leverage ratio and debt maturity, confirming that the observed relationships are not driven by a unidirectional change in investor sentiment.

6. Conclusion

In this study, we examine the effects of investor sentiment on firms' capital structure decisions. Using the University of Michigan Consumer Sentiment Index and the orthogonalized Baker and Wurgler Investor Sentiment Index as two measures of investor sentiment, our study establishes that firms adopt a high leverage ratio when investor sentiment is high; and firms also take on debt with shorter maturity and adjust their leverage ratios towards the target more rapidly. We also find that the investor sentiment-financial leverage relationship sensitivity is greater for financially constrained firms. Furthermore, we determine that high investor sentiment has a negative impact on firms' subsequent stock returns, and this effect decreases by 60%–80% if they choose not to increase leverage.

This study makes an original contribution to a fuller understanding of how investor sentiment impacts firms' financing decisions. While the literature has documented the influence of investor sentiment on firms' issuing debt and equity, little is known of the effect on firms' leverage ratios in the net term. The market timing hypothesis (Baker and Wurgler, 2002) and debt capacity theory (Myers, 1977) offer differing predictions for this relationship. Our results demonstrate that firms not only issue more equity in high sentiment

[8] The calculation is (0.551–0.203)/0.551 = 63%.

Table 10
Testing the effects of high sentiment and low sentiment separately.

	(1)	(2)	(3)	(4)
Panel A The Effects of Investor Sentiment on the Book Leverage Ratio				
Dependent variables	$\Delta LEV_{i,t}$			
Sentiment measures	CCI_ort		BWI_ort	
High_sentiment$_{t-1}$	0.008*		0.010***	
	(1.88)		(2.69)	
Low_sentiment$_{t-1}$		−0.007**		−0.009*
		(−2.04)		(−1.91)
Control variables	Included	Included	Included	Included
Industry fixed effects	Included	Included	Included	Included
Observations	212,851	212,851	212,851	212,851
R squared	7.14%	7.14%	7.14%	7.13%
Panel B The Effects of Investor Sentiment on the Market Leverage Ratio				
Dependent variables	$\Delta MLEV_{i,t}$			
Sentiment measures	CCI_ort		BWI_ort	
High_sentiment$_{t-1}$	0.006**		0.008*	
	(1.96)		(1.79)	
Low_sentiment$_{t-1}$		−0.006**		−0.010**
		(−2.25)		(−2.09)
Control variables	Included	Included	Included	Included
Industry fixed effects	Included	Included	Included	Included
Observations	211,249	211,249	211,249	211,249
R squared	10.47%	10.47%	10.47%	10.48%
Panel C The Effects of Investor Sentiment on Firm Debt Maturity				
Dependent variables	$MAT_{i,t}$			
Sentiment measures	CCI_ort		BWI_ort	
High_sentiment$_{t-1}$	−0.013**		−0.004	
	(−2.22)		(−1.50)	
Low_sentiment$_{t-1}$		0.004*		0.019**
		(1.73)		(2.25)
Control variables	Included	Included	Included	Included
Industry fixed effects	Included	Included	Included	Included
Observations	183,720	183,720	183,720	183,720
R squared	16.68%	16.67%	16.67%	16.69%

This table presents the results for the effects of high sentiment and low sentiment on book leverage ratio (Panel A), market leverage ratio (Panel B) and debt maturity (Panel C), respectively. *High_sentiment* denotes the periods when investor sentiment is at least one-standard-deviation above the sample mean value while *Low_sentiment* denotes the periods when investor sentiment is at least one-standard-deviation below the sample mean value. Standard errors are clustered by firm and year. Coefficients and t-values in parentheses are reported. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

periods but also issue more debt, which ultimately leads to higher leverage ratios. Our findings demonstrate that the debt capacity theory offers a better explanation than the market timing hypothesis in providing a rationale for the sentiment-leverage relationship.

Furthermore, our study contributes consistent evidence that helps determine whether contracting cost theory (Myers, 1977) or signalling and liquidity risk theory (Flannery, 1986) provides a stronger theoretical framework to explain how investor sentiment impacts firms' debt maturity. In demonstrating a negative relationship, our results indicate that firms are confident about future cash flows in high sentiment periods and use shorter debt maturity to signal their financial strength, thereby establishing that the signalling and liquidity risk theory offers a more convincing theoretical framework to underpin this relationship than does the contracting cost theory.

Our findings have two important implications. First, we establish that a wave of market-wide high sentiment helps open a financing window when the costs of external finance decrease, which is particularly valuable for financially constrained firms, enabling them to acquire external capital and alleviate the severity of their financial problems. We provide original evidence of how investor sentiment influences firms in their determination of capital structure and the speed of adjustment to their leverage targets. Second, our analysis establishes that a high leverage ratio amplifies the negative impact of investor sentiment on future stock returns. Our findings provide practical insights that investors should avoid leverage-increasing firms in high sentiment periods, as doing so they can avoid 60%–80% of the decreases in stock returns subsequent to a wave of high sentiment.

Arguably, our timely and original analysis will enable companies to refine their strategies in relation to vacillating market sentiment, giving managers a clearer insight into how they might further optimize their capital structures to their companies' advantage, and also indicates a new direction for further research in this critical area of inquiry.

Data availability

Data will be made available on request.

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Appendix 1. Definitions and explanations of variables.

Panel A Firm Characteristics			
Briefs	Variables	Definitions	Reasons for inclusion
LEV	Book leverage ratio	Total debt / Total assets (book value)	To measure the leverage ratio, where total debt is calculated as the sum of long-term debt and short-term debt, we follow Graham et al. (2015).
MLEV	Market leverage ratio	Total debt / (Total assets – Book value of equity + Market value of equity)	An alternative definition of leverage to check the robustness, following Flannery and Rangan (2006).
DEBISS	Debt issuance (repurchase) ratio	(Total debt$_t$ – Total debt$_{t-1}$)/ Total assets$_{t-1}$	To measure annual net debt issuance (or repurchase if <0), we follow Graham et al. (2015).
EQUISS	Equity issuance (repurchase) ratio	(Shareholders' equity$_t$ – Shareholders' equity$_{t-1}$ – Retained earnings$_t$ + Retained earnings$_{t-1}$)/ Total assets$_{t-1}$	To be consistent with the measure of debt issuance, we use the increase (or decrease) in equity capital scaled by total assets in the previous year to measure net equity issuance (repurchase).
RETAIN	ΔRetained earnings	(Retained earnings$_t$ – Retained earnings$_{t-1}$)/ Total assets$_{t-1}$	To measure annual changes in retained earnings, scaled by total assets in the previous year.
MAT	Debt maturity	Long-term debt / Total debt	To measure debt maturity, we follow Fan et al. (2012).
MAT3	Debt due over 3 years	Debt due over 3 years/ Total debt	An alternative measure of debt maturity, following Barclay and Smith (1995) and Custodio et al. (2013).
MAT5	Debt due over 5 years	Debt due over 5 years/ Total debt	An alternative measure of debt maturity, following Custodio et al. (2013).
ROA	Return on assets	EBIT / Total assets	To measure firm profitability, we follow Rajan and Zingales (1995).
ETR	Effective tax rate	Income tax/ Profits before tax	To capture the impact of tax on the leverage ratio, we follow Givoly et al. (1992).
TAN	Tangibility	Property, plant, and equipment (Net) / Total assets	To measure firm tangibility, we follow Rajan and Zingales (1995).
M/B	Market-to-book ratio	(Total assets – Book value of equity + Market value of equity) / Total assets	To measure firms' growth opportunities, we follow Rajan and Zingales (1995).
SIZE	Total assets	Natural logarithms of book value of total assets	To measure firm size, we follow Rajan and Zingales (1995).
AB	Abnormal earnings	(EPS$_{t+1}$ – EPS$_t$)/ Stock price$_t$	To capture the effect of abnormal earnings on debt maturity structure, we follow Stohs and Mauer (1996).
AM	Asset maturity	Property, plant, and equipment (Net) / Depreciation	To capture the effect of asset maturity on debt maturity structure, we follow Stohs and Mauer (1996).
INV	Investment	(Capital expenditures + M&A expenses + R&D expenses – Sale of PPE)/Total assets	To measure firm investment, we follow Richardson (2006).
KZ	Kaplan and Zingales index	-1.002CF + 3.139TLTD-39.368TDIV-1.314CASH + 0.283Q	To measure the degree of financial constraints, we follow Kaplan and Zingales (1997), cited from Whited and Wu (2006).
WW	Whited and Wu index	−0.091CF-0.062DIVPOS + 0.021TLTD-0.044LNTA + 0.102ISG-0.035SG	To measure the degree of financial constraints, we follow Whited and Wu (2006).
SA	Size and Age index	−0.737*Size+0.043*(Size^2)-0.04*Age	To measure the degree of financial constraints, we follow Hadlock and Pierce (2010).

Panel B Macroeconomic Characteristics			
Briefs	Variables	Definitions	Reasons for inclusion
CCI_ort	Sentiment component of confidence	The regression residual component of the University of Michigan's Consumer Sentiment index	To measure investor sentiment, we follow Mclean and Zhao (2014).
BWI_ort	Orthogonalized investor sentiment	Baker and Wurgler Investor Sentiment Index (Orthogonalized)	To measure investor sentiment, we follow Baker and Wurgler (2006).
IPG	Industrial production growth	Growth rate of industrial production	To isolate the orthogonal component of investor sentiment, we follow Mclean and Zhao (2014) to control for the effect of industrial production growth.
GCD	Growth in consumption of durable goods	Growth rate of consumption of durable goods	To isolate the orthogonal component of investor sentiment, we follow Mclean and Zhao (2014) to control for the effect of consumption of durable goods.
GCN	Growth in consumption of non-durable goods	Growth rate of consumption of non-durable goods	To isolate the orthogonal component of investor sentiment, we follow Mclean and Zhao (2014) to control for the effect of consumption of non-durable goods.

(*continued on next page*)

(*continued*)

Panel A Firm Characteristics			
Briefs	Variables	Definitions	Reasons for inclusion
GCS	Growth in consumption of service	Growth rate of consumption of service	To isolate the orthogonal component of investor sentiment, we follow Mclean and Zhao (2014) to control for the effect of consumption of service.
GE	Growth in employment	Growth rate of employment	To isolate the orthogonal component of investor sentiment, we follow Mclean and Zhao (2014) to control for the effect of employment.
REC	Recessions	NBER recessions dummy	To isolate the orthogonal component of investor sentiment, we follow Mclean and Zhao (2014) to control for the effect of economic recessions.
ERP	Equity risk premium	Aggregate equity risk premium. The data are available on Aswath Damodaran's website.	To capture the effect of the equity risk premium on firm leverage, we follow Huang and Ritter (2009).
RIR	Real interest rate	Nominal interest rate - inflation rate	To capture the effect of interest rate on firm leverage, we follow Huang and Ritter (2009).
DSP	Default spread	The difference between yields of Moody's Baa-rated bonds and Aaa-rated bond	To capture the effect of default spread on firm leverage, we follow Huang and Ritter (2009).
TSP	Term spread	The difference between yields of 10- and one-year constant maturity treasures	To capture the effect of the term spread on firm leverage, we follow Huang and Ritter (2009).
RGDP	Real GDP growth	The increase in GDP at year t scaled by the value of GDP at year *t-1*	To capture the effect of GDP growth on firm leverage, we follow Huang and Ritter (2009).
ASR	Aggregate stock return	The increase in the Dow Jones Industrial Index at year *t* scaled by the value of the index at *t-1*	To capture the effect of aggregate stock market return on firm leverage, as suggested in Lamont and Stein (2006).
PDND_ort	Dividend premium	The orthogonalized component of the dividend premium	To test the effect of Baker and Wurgler Investor Sentiment Index components.
RIPO_ort	IPO first day return	The orthogonalized component of the IPO first day returns	To test the effect of Baker and Wurgler Investor Sentiment Index components.
NIPO_ort	Number of IPOs	The orthogonalized component of the number of IPOs	To test the effect of Baker and Wurgler Investor Sentiment Index components.
CEFD_ort	Closed-end fund discount	The orthogonalized component of the closed-end fund discount	To test the effect of Baker and Wurgler Investor Sentiment Index components.
SOEI_ort	Share of equity issuance	The orthogonalized component of the equity share in new issues	To test the effect of Baker and Wurgler Investor Sentiment Index components.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jcorpfin.2023.102426.

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