JOURNAL OF FINANCIAL AND QUANTITATIVE ANALYSIS

doi:10.1017/S0022109024000474

Transitory and Permanent Cash Flow Shocks in Debt Contract Design

Le Ma
University of Technology Sydney Business School
Le.Ma@uts.edu.au *(corresponding author)*

Anywhere Sikochi
Harvard Business School
ssikochi@hbs.edu

Yajun Xiao
Xi'an Jiaotong-Liverpool University International Business School Suzhou
Yajun.Xiao@xjtlu.edu.cn *(corresponding author)*

Abstract

We examine how lenders design contracts to account for transitory and permanent cash flow shocks facing borrowers. We find that volatile transitory cash flow shocks are associated with fewer liquidity covenants, indicating financial flexibility that enables firms to survive liquidity crunches. The opposite is true for volatile permanent cash flow, suggesting that borrowers' economic fundamentals are important credit risk factors. Subsequent analyses show that borrowers exposed to transitory (permanent) shocks face less (more) severe credit consequences following poor performance. Overall, we show that transitory and permanent cash flow shocks have significant and opposite effects on debt contract covenant design.

I. Introduction

Recent corporate finance theory demonstrates the importance of distinguishing firms' exposure to transitory and permanent cash flow shocks when analyzing corporate policies (Gorbenko and Strebulaev (2010), DeMarzo, Fishman, He, and Wang (2012), and Décamps, Gryglewicz, Morellec, and Villeneuve (2017)). Transitory shocks affect short-term cash flow and are uninformative about future performance, whereas permanent shocks affect both short- and long-term productivity. They have different and sometimes opposing implications for corporate policies and investor choices, such that managers and investors are expected to respond

We are grateful for helpful comments and suggestions from the editor, the anonymous referee, Daniel Aobdia, Kai Du, Bingxu Fang (discussant), Kurt Gee, Dan Givoly, Paul Healy, Steve Huddart, Henock Louis, Rick Mergenthaler, Jed Neilson, George Serafeim, Kavi Thakkar (discussant), Biqin Xie, and seminar participants at Penn State University, Syracuse University, and the 2022 Haskayne and Fox Accounting Conference. All errors are our own.
Funding: We acknowledge financial support from Harvard Business School, University of Technology Sydney, Xi'an Jiaotong-Liverpool University (XJTLU Research Development Funding RDF-21-02-002), grants 72342022 and 72141304 from the National Natural Science Foundation of China, and Accounting and Finance Association of Australia and New Zealand Research Grant.

differently to transitory and permanent shocks. Studies such as Chang, Dasgupta, Wong, and Yao (2014) and Gryglewicz, Mancini, Morellec, Schroth, and Valta (2022) document empirical evidence on how the transitory and permanent shocks influence firms' financial decisions. However, there is limited understanding on whether creditors recognize the different temporal natures of cash flow shocks in evaluating borrowers' credit risk and developing lending practices. Given that cash flow risk is an important consideration in credit assessment (Lian and Ma (2021)), in this study, we explore this open question of how borrowers' exposure to transitory and permanent shocks impacts debt contracting, a major mechanism through which lenders control and monitor credit risk.

Specifically, we aim to empirically investigate the design of loan contracts in terms of how the choice, use, and consequences of loan covenants respond to variations in borrowers' transitory and permanent cash flow shocks. We focus on covenants because they are an integral part of loan contracts and a persistent phenomenon (Chava and Roberts (2008), Nini, Smith, and Suf (2009), and Roberts and Suf (2009a)). Covenants provide an opportunity to observe how lenders ex ante determine the corrective actions to take under given states to mitigate risks in lending relationships as borrowers can take actions that may transfer wealth from the lenders to shareholders. When borrower performance deteriorates, covenants can be used to transfer control rights to the lenders (Christensen and Nikolaev (2012), Dichev and Skinner (2002), Fama, Miller, and Miller (1972), and Smith Jr and Warner (1979)). These characteristics make covenants the ideal loan contract feature to study the implications of transitory and permanent shocks on how lenders balance the need to reduce lending risks while providing certain degrees of flexibility.

The theoretical framework by Gorbenko and Strebulaev (2010) suggests that it is not optimal to default in the wake of liquidity shocks if borrowers' future prospects are bright conditional on surviving the current liquidity crunch. In considering whether or not to default, lenders and borrowers benefit from decomposing the cash flow shocks into transitory and permanent components to determine whether variations in borrowers' performance are a result of temporary shocks that warrant no immediate lender interference or permanent shocks that reflect bleak future prospects and warrant corrective actions. Grounding our hypotheses in this theory and considering that covenants are a means for lenders to gain control rights, we test the proposition that lenders may design covenants ex ante in such a manner that minimizes the need to take corrective actions for borrowers with exposure to transitory shocks while maximizing the ability to take corrective actions for borrowers exposed to permanent shocks.

Explicitly, our first hypothesis is that loan contracts use fewer short-term financial performance focused (i.e., liquidity-based) covenants if borrowers are subject to transitory shocks. This ensures that the covenants do not trigger inefficient renegotiations or premature default if transitory shocks lead to covenant violations. In our second hypothesis, we expect contracts to include more liquidity-based covenants when borrowers are subject to permanent shocks. This allows lenders to closely monitor the borrower's fundamentals and intervene in a more timely manner if the borrower's future prospect is risky (e.g., Dichev and Skinner (2002), Christensen and Nikolaev (2012)). While these hypotheses are consistent

with debt contracting efficiency theory, the empirical outcomes are not obvious. Tension arises because loan contracting could be formulated with the main objective to limit agency conflicts and maximize lender protection, a perspective taken in most prior debt contracting studies (e.g., Christensen, Macciocchi, Morris, and Nikolaev (2022)). Accordingly, rather than ex ante designing covenants that differentiate between borrower exposure to transitory and permanent cash flow shocks, lenders may prefer to write more strict covenants and then renegotiate loan terms on a case-by-case basis as a borrower's performance changes. This is supported by a common belief that loan renegotiations are costless and by extant evidence that lenders routinely renegotiate loans when poor performance causes borrowers to violate loan covenants (Dichev and Skinner (2002), Infuehr and Laux (2022), Roberts and Suf (2009a), and Smith Jr and Warner (1979)). Thus, whether exposure to transitory and permanent cash flow shocks differently influences the design of loan covenants is an open empirical question.

To test our propositions, we use a sample of U.S. firms that issued private debt from the years 1981–2016 and examine the relation between liquidity-based covenants and variations in transitory and permanent cash flow. We capture variations in transitory and permanent cash flow using the volatility of the cyclical and trend components of cash flow (e.g., Décamps et al. (2017)). Consistent with our predictions, we find that lenders use fewer or are less likely to use liquidity-based covenants in debt contracts with borrowers exposed to high transitory cash flow volatility, and more liquidity-based covenants when permanent cash flow volatility is high. For instance, a Logit specification indicates that a 1-standard-deviation increase in volatility of transitory (permanent) cash flow is associated with a 30% decrease (12% increase) in the odds of including liquidity covenants in loan contracts. Such a covenant design gives borrowers the flexibility to survive transitory shocks while enhancing lender ability to intervene when borrowers' long-term fundamental is at risk from permanent shocks.

We also examine covenant slack and performance pricing in relation to borrowers' exposure to cash flow shocks. First, tighter covenants increase the probability of covenant violation and excessive lender intervention (Infuehr and Laux (2022)). Thus, to avoid unnecessary renegotiations or premature defaults, debt contracts are likely to have greater covenant slack when a borrower is exposed to high volatility of transitory cash flow. We find some evidence of greater covenant slack as borrowers' volatility of transitory shocks increases but less slack as permanent cash flow volatility increases. Second, contracts can employ performance pricing to address unanticipated risk changes by linking interest rate increases or decreases to a borrower's performance (Asquith, Beatty, and Weber (2005), Manso, Strulovici, and Tchistyi (2010)). In our context, we expect less frequent use of performance pricing when borrowers are exposed to volatile transitory cash flow because this would unnecessarily penalize borrowers for short-lived negative shocks or reward them for short-lived positive shocks, both of which may have nothing to do with fundamental credit risk changes. Conversely, performance pricing is more likely to be used when a borrower is exposed to volatile permanent cash flow as these better reflect a firm's economic prospect and credit quality. Our results are consistent with these predictions.

Next, we examine the consequences of covenant violation in relation to borrowers' exposure to transitory and permanent shocks. If covenants are designed with the intent to allow borrowing firms to survive a liquidity crunch, then we expect less severe consequences when borrowers are more exposed to transitory shocks. In support of this argument, we find that transitory cash flow shocks are negatively associated with the disclosure of serious violations, but permanent cash flow shocks are positively associated with it. We also examine the changes in the borrowers' long-term credit ratings, with the view that credit rating changes fairly represent how lenders would react to borrowers' transitory and permanent cash flow shocks.[1] We find that credit ratings are more likely to change for firms exposed to permanent shocks when lenders are likely to take corrective actions, but less so for firms exposed to temporary shocks when it is less optimal for lenders to take immediate actions.

We further perform some cross sectional analyses to investigate the potential drivers of our results. First, we examine whether our results reflect lenders' experience in contract design in light of their borrowers' cash flow characteristics. We find that lenders' past lending experience with the borrowers more strongly explains our main results. Second, we examine how transitory and permanent cash flow shocks affect the design of loan covenants in two types of loans: cash flow–based and asset-based. Our results indicate that exposure to volatile transitory cash flow results in a more significant reduction in liquidity covenants for cash flow–based loans compared to asset-based loans. This is consistent with the expectation that loans backed by firms' ongoing cash flow are more exposed to borrowers' performance uncertainty; hence, their covenant design is more sensitive to cash flow volatility than loans backed by assets.

Third, we find that the documented use of liquidity covenants in response to borrowers' transitory and permanent cash flow shocks is present for both lines of credit and other commercial loans. This result indicates that financial flexibility can be provided to borrowers through the contract design of a wide range of loans other than just lines of credit which has been the main focus in liquidity insurance literature. Additionally, we explore the loan maturities at which transitory and permanent cash flow shocks matter for the use of liquidity covenants. We split our sample by loan maturity and find that as loan maturity increases, the use of liquidity covenants decreases for borrowers exposed to transitory shocks but increases for those exposed to permanent shocks. These results suggest that lenders are less concerned with transitory shocks but more concerned with permanent shocks when a loan has a longer maturity period.

Finally, we perform robustness tests to address endogeneity concerns, variable measurement, and model specifications. To mitigate the omitted variable concerns, we apply an econometrics technique called the impact threshold for a confounding variable (Larcker and Rusticus (2010)). The test suggests that if a confounding variable exists, it would need to have a much larger impact on the dependent variables than the existing control variables to overturn the significant coefficients

[1]Long-term credit ratings reflect rating agencies' current opinions of a borrower's overall creditworthiness, focusing on the borrower's capacity and willingness to meet its long-term financial obligations as agreed upon with the creditors (Moody's (2021), S&P (2021)).

of our variables of interest. We conclude that the impact from omitted confounding variables is trivial in our analysis. We also exploit severe winter weather, specifically abnormal snow, to capture exogenous and temporary changes in cash flow as argued in Brown, Gustafson, and Ivanov (2021). Our analysis shows that abnormal snow reduces transitory but not permanent cash flow in the current year, and it leads to fewer liquidity covenants used in subsequent loan contracts consistent with the paper's previous findings. We also employ alternative cash flow decomposition methods, cash flow volatility measures, and model estimation methods. Our key results remain the same.

This article contributes to three streams of literature. We contribute to the growing literature in corporate finance documenting the importance of distinguishing transitory and permanent cash flow shocks. Existing studies in this area examine the effects of transitory and permanent cash flow shocks on various corporate policies, including cash holding, liquidity management, investment decisions, share repurchase, dividend payout, and leverage (e.g., Chang et al. (2014), Décamps et al. (2017), DeMarzo et al. (2012), Gryglewicz et al. (2022), Guay and Harford (2000), and Lee and Rui (2007)). We add to this literature by documenting empirical evidence that the composition of cash flow shocks is not only important for managerial decision-making but also affects lenders' evaluation and monitoring of borrowers' credit risk. This study is the first to examine the implications of temporary and permanent cash flow shocks for debt contract design. Our findings reveal creditors' sophistication in understanding performance shocks of different temporal natures when making credit decisions.

We also contribute to the literature on creditor control rights and debt contract design, which explores lender and firm characteristics including accounting information quality, that affect the choice and use of covenants in loan contracts, covenant violations, and contract renegotiation (e.g., Ball, Bushman, and Vasvari (2008), Chava, Kumar, and Warga (2010), Christensen and Nikolaev (2012), Demerjian (2011), (2017), Denis and Wang (2014), Dyreng, Vashishtha, and Weber (2017), and Roberts and Sufi (2009b)). Incorporating theoretical development from corporate finance research, we add new evidence to the literature by showing that the level of exposure to permanent and transitory cash flow shocks conveys distinct information about borrowers' short-term liquidity and long-term profitability, affecting the type and extent of covenants used in debt contracts, and the consequences of covenant violations and credit ratings. These results are important because they show that loan contracts are designed to achieve a balance between protecting lender interest and providing flexibility to the borrower to avoid unnecessary intervention and default. Consequently, this improves the efficiency of debt contracts.

Finally, prior banking and liquidity insurance literature shows that banks have long provided flexibility and support to borrowers via lines of credit. Akin to insurance, credit lines are a vital source of immediate capital, especially during a crisis, as they give borrowers the right but not obligation to draw down cash from loans at predetermined interest rates, loan limits, and other loan terms (Shockley and Thakor (1997), Campello, Giambona, Graham, and Harvey (2011), Acharya, Almeida, Ippolito, and Perez (2014), Guney, Karpuz, and Ozkan (2017), Acharya, Almeida, Ippolito, and Perez-Orive (2021), Brown et al. (2021), and Chang, Chen, and Masulis (2023)). Recent studies document a significant dash for cash from

existing credit lines at the onset of abnormal winter weather (Brown et al. (2021)) and the COVID-19 pandemic (Acharya and Steffen (2020)). In addition, relationship lending provides liquidity insurance against firms' individual adverse liquidity shocks (see Murro, Oliviero, and Zazzaro (2023)). While this body of literature focuses on the additional finance supply to borrowers during a liquidity crunch, our article documents a different mechanism of financial flexibility built into the specific contract designs negotiated at the loan initiation. We show that banks tend to limit the use of liquidity-based covenants for performance monitoring when firms face transitory shocks. With nearly half of our sample comprised loans other than lines of credit, our article documents a general practice of lenders providing financial flexibility to borrowers. Overall, our article complements the liquidity insurance research by studying and quantifying the impact of fundamental and nonfundamental cash flow shocks simultaneously, providing a more comprehensive picture of how borrower liquidity and solvency risks are managed in lending relationships.

II. Literature and Hypotheses

A. Transitory and Permanent Cash Flow Shocks

Firms are constantly exposed to cash flow shocks of transitory and permanent nature. Transitory shocks are characterized by their largely unexpected timing, potentially substantial initial magnitude, and effect that is felt over a limited time. They affect firms' immediate cash flow and are uninformative about the future expected profitability (Gorbenko and Strebulaev (2010), Décamps et al. (2017)). In contrast, the impact of permanent shocks is persistent, thereby leading to changes in both current and future profitability.

Gorbenko and Strebulaev (2010) used a dynamic capital structure model to investigate how the exposure to transitory and permanent cash flow shocks impacts corporate financing policies. The study generates novel insights that the value of maintaining financial flexibility increases when firms face prospects of adverse transitory shocks, highlighting firms' consideration of financial flexibility in making capital structure decisions. Subsequent theoretical and empirical studies in corporate finance further demonstrate the importance of separating the effect of transitory cash flow shocks from permanent shocks in understanding corporate financial policies. For example, Décamps et al. (2017), Bolton, Wang, and Yang (2020), and Gryglewicz et al. (2022) studied how permanent and transitory cash flow shocks differently impact firms' liquidity management decisions. They illustrate that the volatility and correlation of both shocks determine not only cash holdings but also financing decisions to rebuild cash buffers. Chang et al. (2014) found that financially constrained firms allocate more temporary cash for saving rather than investment purpose. Byun, Polkovnichenko, and Rebello (2019a) showed that permanent shocks, not temporary, affect future investment opportunities, and Byun, Polkovnichenko, and Rebello (2019b) showed that firms issue more debt following cash flow increases arising from long-lived as opposed to temporary shocks. DeMarzo et al. (2012), Gryglewicz, Mayer, and Morellec (2020), and Hackbarth, Rivera, and Wong (2022) applied dynamic moral hazard models and demonstrated that the presence of permanent and transitory shocks shape the optimal compensation contract.

While these studies have examined various corporate decisions, creditors' consideration of firm exposure to transitory and permanent shocks in designing debt contracts has not been investigated. In particular, Gorbenko and Strebulaev (2010) point out that for efficient debt contracting, creditors should design debt contracts with in-built flexibility to give borrowers more chances to survive if borrowers experience volatile short-term performance but have sound long-term prospects. This also implies different contract designs for borrowers with favorable short-term but weak long-term performance. Building on these theoretical insights on optimal default, our study aims to extend existing empirical evidence to loan contracting and examine whether the default implications of both cash flow shocks are well understood by lenders and borrowers, and whether they have significant impact on debt contract designs.

B. Covenants in Loan Contracts

In loan contracting, there are incentive conflicts between shareholders and debtholders because corporate actions that maximize shareholder wealth may not maximize debtholder wealth (Fama et al. (1972), Smith Jr and Warner (1979)). Specifically, debtholders face asymmetric payoffs in that they are exposed to downside risk but do not enjoy the rewards of any upside from risky actions a firm may take (Black and Scholes (1972), Smith Jr and Warner (1979)). To reduce costs associated with these conflicts, loan contracts include various covenants such as financial and negative covenants, which require a borrower to maintain the financial ratios within certain benchmarks, and restrict the firm from engaging in actions that diminish the value of debtholder claims in the firm (Jensen and Meckling (1976), Smith Jr and Warner (1979)). When corporate performance or actions deviate, covenants can serve as trip wires which provide lenders with the option to step in and take action as the circumstances warrant (Dichev and Skinner (2002), Christensen and Nikolaev (2012)). Essentially, through the use of covenants, lenders enjoy broad powers by controlling corporate policies as managers attempt to avoid violating covenants, or by having the power to decide the fate of a firm in the event of covenant violation (Chava, Wang, and Zou (2019), Roberts and Sufi (2009a), and Bradley and Roberts (2015)).

Debt contract design has been extensively studied in the finance and accounting literature (e.g., Ball et al. (2008), Chava and Roberts (2008), Chava et al. (2010), (2019), Christensen and Nikolaev (2012), Demerjian (2011), (2017), Denis and Wang (2014), Dichev and Skinner (2002), Dyreng et al. (2017), Frankel, Seethamraju, and Zach (2008), Nini et al. (2009), Roberts and Sufi (2009b), and Zhang (2019)). Relevant to our study is a stream of research inquiry into how the quality of financial information influences the use of financial covenants in debt contracts (Christensen and Nikolaev (2012), Demerjia (2011), Demerjian, Donovan, and Lewis-Western (2020), Dou (2020), and Dyreng et al. (2017)). For example, Demerjian et al. (2020) found that private debt contracts are more likely to include earnings-based covenants when borrowers have smoother income that improves creditors' ability to assess credit risk. Focusing on the contractability of accounting balance sheet information, Demerjian (2011) documented that changes in accounting standards that introduce volatility in firms' balance sheet reduce the use of balance sheet covenants in debt contracts. Moreover, Demerjian (2017)

examined the impact of borrowers' information and economic uncertainty on debt contracting and found that greater uncertainty of borrowers' creditworthiness is associated with higher financial covenant intensity. These studies provide insights on the usefulness of accounting information in helping lenders evaluate borrowers' credit risk and design debt contracts. However, none of them distinguishes the temporary and permanent nature of performance shocks experienced by borrowing firms—a critical consideration for credit risk evaluation and contracting efficiency. Our study intends to add new insights in this regard.

C. Hypotheses Development

Our main hypotheses examine the association of debt covenants and borrowing firms' exposure to variations in transitory and permanent cash flow. We focus on the notion that a firm with sound long-term prospects may experience volatile transitory cash flow, and when this happens inefficient debt contracts could force the firm into unnecessary renegotiation or liquidation even if the risk of economic default is low. Given that debt covenants are the primary instruments to determine creditors' control rights and can hold the key to firms' ability to survive (Bradley and Roberts (2015)), we expect covenants to be designed in a manner that monitors a borrower's performance but also allows financial flexibility (Gorbenko and Strebulaev (2010)).

In particular, liquidity-based covenants are those covenants determined by periodic performance measures and are typically used by lenders as trip wires to monitor borrowers' performance from time to time (Christensen and Nikolaev (2012)). Because transitory shocks affect immediate cash flow and are uninformative about firms' future expected profitability (Gorbenko and Strebulaev (2010), Décamps et al. (2017)), all else equal, efficient use of liquidity covenants should reflect the intent to prevent frequent and unnecessary covenant violations and renegotiations by borrowers who are subject to temporary cash flow shocks (Gorbenko and Strebulaev (2010)). By contrast, greater use of liquidity-based covenants is expected when a borrower is exposed to permanent shocks to cash flow, which reflect the risk of its long-term prosperity and influence firm value. Thus, we test the propositions that the use of liquidity-based covenants decreases when a borrowing firm is subject to greater variations in transitory cash flow but increases when subject to greater variations in permanent cash flow. We state this as follows:

Hypothesis 1. The use of liquidity-based covenants is negatively associated with variations in transitory cash flow.

Hypothesis 2. The use of liquidity-based covenants is positively associated with variations in permanent cash flow.

III. Research Design

A. Sample and Data

We obtain financial data from Compustat, stock market data from CRSP and loan data from Thomson/Refinitiv DealScan (DealScan) via Wharton Research

Data Services (WRDS). We start with the Compustat universe of U.S. publicly listed firms, and exclude financial, utility, not-for-profit, and government entities (SIC codes 4900–4999, 6000–6999, and 8000–9999). We exclude firms or organizations that are differently regulated or have financing decisions that are affected by different factors (e.g., capital adequacy regulations) (Chang et al. (2014)). We then merge with loan data using the Roberts DealScan-Compustat Linking Database (Chava and Roberts (2008)).[2] After restricting observations with available financial, stock market, and loan data, we reach a sample of 19,005 firm-year observations or 33,872 loan observations from fiscal year 1981 to 2016. For all our analyses, either this full sample or a subset is used depending on the data availability. For our main test on liquidity covenants, a subsample of 9,550 firm-years or 15,238 loan observations is applied.

DealScan contains data on loan packages and facilities, where a package is a collection of facilities that are structured and contracted as one transaction. In general, a set of debt covenants apply to all facilities within a given package. However, a facility has its own contractual terms, such as facility amount, maturity, interest rate, and loan type or purpose. Performance pricing provision and lender allocations of syndicated loan amounts may also apply to specific facilities. Hence, in this study, we perform our analysis at the facility level to better control facility-level characteristics (Houston, Itzkowitz, and Naranjo (2017)).[3]

B. Decomposing Transitory and Permanent Cash Flow Shocks

To test our hypotheses, we first use filtering methods to decompose firms' cash flow into transitory and permanent components.[4] There are three reduced-form decomposition methods that are commonly applied in macroeconomics to separate a time series into a trend (permanent) component and a cyclical (transitory) component, namely, Hodrick and Prescott (HP) filter (Hodrick and Prescott (1997)), Beveridge and Nelson (BN) filter (Beveridge and Nelson (1981)), and Baxter and King (BK) filter (Baxter and King (1999)). While there is ongoing discussion in the literature about the performance of these methods under different economic applications (e.g., Botshekan and Lucas (2017), Hamilton (2018), and Hodrick (2020)), with regards to the decomposition of firm-level cash flow prior studies have demonstrated the superiority of HP filter over the other standard filters via

[2]"Dealscan-Compustat Linking Database.xlsx" dated Apr. 13, 2018, as accessed June 8, 2021.

[3]Similar to prior studies (e.g., Christensen and Nikolaev (2012)), we perform a robustness test based on package level analyses which yield results with similar signs and significance, and provide the same inferences.

[4]In this article, we do not use decomposed stock returns to measure transitory and permanent performance shocks as stock returns are not only affected by firm fundamentals, but also non-fundamental factors such as noisy trading, market speculations, and investor sentiment (De Bondt and Thaler (1985), Baker and Wurgler (2006), (2007), and Brogaard, Nguyen, Putnins, and Wu (2022)). We follow past corporate finance studies (e.g., Byun et al. (2019b), Chang et al. (2014), and Gryglewicz et al. (2022)) and rely on decomposed cash flow to conduct our inquiry.

simulations (Byun et al. (2019b), Gryglewicz et al. (2022)).[5] Therefore, we use HP filter as our main cash flow decomposition method following Byun et al. (2019a), (2019b). A detailed description about HP filter is provided in Appendix A. As BN filter has also been applied in other studies to decompose firm cash flow, for example, Chang et al. (2014), we use it as a robustness test. We drop firms with fewer than 10 cash flow observations and firms with two or more consecutive missing cash flow observations. Since HP filter requires consecutive observations without gaps, we fill in the gap by the average over the nearest neighboring cash flow observations if there is a single missing observation in 1 year (Byun et al. (2019b)).

Following Denis and Sibilkov (2010) and Byun et al. (2019b), we define a firm's operating cash flow as operating income before depreciation. We perform the decomposition process and obtain transitory and permanent cash flow shock series by firm. We normalize the cash flow shocks by dividing them using book value of assets (Chang et al. (2014), Gryglewicz et al. (2022)). We then compute the volatility of permanent (*Permanent Vol*) and transitory cash flow (*Transitory Vol*), based on their standard deviations over the past 5 years.[6]

We do not presuppose that in practice lenders utilize the same cash flow decomposition method in evaluating borrowing firms' credit risk. Rather, we argue that creditors do consider the transitory or permanent nature of firm performance in designing debt contracts. Relying on credit rating agency analysts as proxies for lender behavior, we identify anecdotal evidence to illustrate that lenders/credit analysts indeed distinguish between transitory and permanent shocks. For example, in Aug. 2016, Noble Group Limited, a Hong Kong-based commodities trader experienced a liquidity crunch but Fitch Ratings did not change Noble's credit rating, explaining that the firm's liquidity crunch was only temporary (Fitch Ratings (2016)).

C. Baseline Regression Model

Our main panel model regresses measures of liquidity-based debt covenants on temporary and permanent cash flow shocks, as follows:

$$(1)\qquad Covenants_{it} = \beta_0 + \beta_1 Transitory\,Vol_{it-1} + \beta_2 Permanent\,Vol_{it-1} + \sum_{m=1}^{m} \gamma_m Controls_{it-1} + \delta_t + \alpha_j + \epsilon_{it}.$$

where *Covenants* is the measure of liquidity covenants at year *t*. To capture liquidity covenants, we aggregate covenants that are based on measures of short-term performance: debt-to-EBITDA, senior debt-to-EBITDA, cash interest coverage, debt service coverage, EBITDA, fixed service coverage, and interest coverage. We

[5]Hamilton (2018) criticizes HP filter for introducing spurious effects and proposes an alternative regression filter. But subsequent works show that Hamilton filter does not improve on HP filter in practice (Moura (2024), Franke, Kukacka, and Sacht (2025)), and performs worse when decomposing complex time series (Hodrick (2020)). Gryglewicz et al. (2022) use structural estimation to obtain estimates of cash flow shock parameters which are not firm specific, hence it is not suitable for the purpose of our study. This is discussed in Appendix A.

[6]We find consistent results (untabulated) when we use either 3 or 10-year time windows.

then define *LiqCov* as the number of these liquidity-based covenants per loan facility. Alternately, we measure *LiqCovInd* as a dummy variable indicating whether liquidity covenants are used at all in the loan facility. We also define *LiqCovRatio* as the ratio of liquidity covenants out of total number of financial covenants.[7] Higher values of these three variables indicate more liquidity-based covenants. We define *LiqCovSlack* as liquidity covenant slack, which measures how tight a covenant benchmark is set at the initiation of a loan contract. We measure *LiqCovSlack* through the slack of interest coverage ratio and debt/EBITDA ratio at the initiation of the loan. For interest coverage ratio, we calculate the slack by taking the difference between firms' reported EBITDA/Interest Expense and contracted minimum covenant threshold obtained from DealScan. For debt/EBITDA ratio, slack is calculated using the maximum threshold set in the debt contract and the actual initial value of this ratio, which is the sum of current and long-term debt divided by operating income before depreciation. We choose these two ratios to perform the analysis because they are the most frequently used liquidity covenants according to prior literature (Dichev and Skinner (2002), Demerjian and Owens (2016), and Graham (2022)). We eliminate observations with initial negative slack, that is, cases where initial interest coverage (debt/EBITDA) value already exceeds (falls under) the threshold set in the contract. The reason for the initial negative slack may be due to the different definitions of accounting variables used in specific loans which could result in miscalculation of covenant slack (Chava and Roberts (2008), Demerjian and Owens (2016)). Higher values of *LiqCovSlack* indicate greater covenant slack (i.e., less tight). We run separate regressions for the number (*LiqCov*), the ratio (*LiqCovRatio*), and the slack (*LiqCovSlack*) of liquidity covenants using ordinary least squares (OLS), and for the indicator for liquidity covenants (*LiqCovInd*) using Logit regression.

TransitoryVol is the volatility of transitory cash flow shocks and *PermanentVol* is the volatility of permanent cash flow shocks over the past 5 years prior to t. We expect $\beta_1 < 0$ ($\beta_1 > 0$) consistent with the use of liquidity covenants decreasing (increasing) with variations in transitory (permanent) cash flow when the dependent variables are *LiqCov*, *LiqCovInd*, and *LiqCovRatio*. For *LiqCovSlack*, we expect greater (less) covenant slack when borrower is exposed to transitory (permanent) shocks. *Controls* represent vectors of firm and loan characteristics that are found in prior literature to determine debt covenants (e.g., Chava et al. (2010), Christensen and Nikolaev (2012), and Demerjian (2011)). We measure firm characteristics at the most recent fiscal year prior to loan inception. All the variables are described in Appendix B. We also include year dummies (δ) to control for time fixed effects and industry dummies (α) to control for unobservable industry heterogeneity. Industry dummies are based on Fama and French 48-industry classification. The coefficient estimates are based on standard errors adjusted for firm and year clustering to account for firms that have multiple loan facilities in the sample period.

[7]Financial covenants include the liquidity covenants and other solvency-based covenants: Debt-to-equity, Debt-to-tangible networth, Leverage ratio, Loan-to-value, Net debt-to-assets, Senior leverage, Total debt-to-tangible networth, Equity-to-asset ratio, Networth-to-total asset, Networth, Tangible networth.

D. Summary Statistics

Table 1 reports summary statistics for the main regression analysis variables based on the full sample.[8] All continuous variables are winsorized at 1% and 99% levels. As shown in Panel A, for firm-year level observations, the mean and median of transitory cash flow are zero, confirming its basic feature of a zero-mean stationary process (Chang et al. (2014)). Permanent cash flow has a mean (median) of 0.13 (0.13) and follows a value distribution nearly identical to that of total cash flow. This conforms to the cash flow properties reported in other studies where total cash flow is dominated by the decomposed permanent component for most observations (Chang et al. (2014), Byun et al. (2019b)). For our primary focus which is the variations in the transitory and permanent cash flow, there is slightly greater volatility in transitory than permanent shocks.

Panel B, for loan-level observations, shows that the average loan has 1.61 liquidity covenants, with a liquidity covenant ratio of 74%. The average loan maturity is 49.7 months. Nearly half of the loans are secured and are funded by about 8 lenders. Cash-proceeds sweeps and performance pricing provision are present in 20% and 32% of the loans, respectively. Of the loans in our sample, 54% are lines of credit, 30% term loans, and the remainder are other types.

To better understand the nature of firms with relatively high or low exposure to transitory relative to permanent shocks, in Panel C, we compare the various firm characteristics that are included as control variables in our regression analyses across observations with lower and higher transitory cash flow volatility. We divide the 19,005 firm-year observations in the full sample into two subsamples based on the size of transitory cash flow volatility relative to permanent cash flow volatility. We show that observations with relatively less volatile transitory shocks tend to have larger asset/market value, better financial health (indicated by Loss, ROA, and *Z*-score), younger age, and less stock return volatility. They also exhibit slightly more dividends, less capital/R&D investments, but more advertising investment.

Figure 1 further reveals that industries with high average transitory cash flow volatility are concentrated in mining, metal, and energy industries, as well as some high-tech industries such as electronic/laboratory equipment and computers. For mining, metal, and energy firms, their exposure to transitory shocks may be caused by the oil and commodity price volatility often observed in the markets. As for technology firms, many of the firms are in the early stages with limited ability to generate profit or revenue. This could make them susceptible to volatility in their operating environment. Compared to the cross-industry differences in transitory cash flow volatility, less variations is observed for permanent cash flow volatility.

Next, we report pairwise correlations of key cash flow and loan covenants variables in Table 2. The correlation between the levels of transitory and permanent cash flow is −0.11, which is consistent with the statistics documented in Chang et al. (2014) and Gryglewicz et al. (2022). In terms of volatility, the transitory and permanent cash flow volatilities are positively correlated, suggesting that transitory cash flow is likely to be more volatile when permanent cash flow changes more

[8]The descriptive statistics of the restricted liquidity covenant sample is very similar to that of the full sample, hence are not separately reported.

TABLE 1

Summary Statistics

Table 1 reports the summary statistics of firm-level (Panel A) and loan-level (Panel B) variables. Panel C reports and compares the mean of various firm characteristics between the subsamples of firm-year observations with low and high transitory cash flow volatility relative to permanent cash flow volatility. The subsamples are divided based on whether the ratio of transitory cash flow volatility to permanent cash flow volatility is below or above the sample median. ***, **, and * denote 2-tailed statistical significance for 1%, 5%, and 10%, respectively. All variables are as defined in Appendix B.

Variable	Obs.	Mean	Std. Dev.	Min	P5	P25	Median	P75	P95	Max
Panel A. Firm Characteristics										
CF	19,005	0.13	0.09	−0.21	−0.01	0.09	0.13	0.18	0.28	0.38
Transitory CF	19,005	0.00	0.04	−0.19	−0.08	−0.02	0.00	0.01	0.06	0.13
Permanent CF	19,005	0.13	0.08	−0.14	0.01	0.09	0.13	0.18	0.27	0.40
CF Vol	19,005	0.05	0.05	0.00	0.01	0.02	0.03	0.05	0.14	0.29
Transitory Vol	19,005	0.04	0.05	0.00	0.01	0.01	0.03	0.05	0.13	0.30
Permanent Vol	19,005	0.03	0.04	0.00	0.01	0.01	0.02	0.04	0.10	0.30
Market Leverage	19,005	0.27	0.22	0.00	0.00	0.10	0.22	0.40	0.73	0.91
Dividend	19,005	0.01	0.02	0.00	0.00	0.00	0.00	0.02	0.05	0.11
Size	19,005	7.01	2.03	2.60	3.59	5.60	6.99	8.36	10.44	12.06
Market-to-Book	19,005	1.43	0.96	0.37	0.54	0.84	1.14	1.69	3.36	5.77
CapEX	19,005	0.06	0.06	0.00	0.01	0.02	0.04	0.08	0.20	0.34
R&D	19,005	0.02	0.04	0.00	0.00	0.00	0.00	0.02	0.12	0.21
Depreciation	19,005	0.05	0.03	0.01	0.01	0.03	0.04	0.06	0.11	0.19
Tangible	19,005	0.33	0.24	0.01	0.04	0.14	0.26	0.47	0.81	0.90
Advertisement	19,005	0.01	0.03	0.00	0.00	0.00	0.00	0.01	0.07	0.18
Loss	19,005	0.22	0.41	0.00	0.00	0.00	0.00	0.00	1.00	1.00
ROA	19,005	0.03	0.10	−0.47	−0.15	0.01	0.04	0.08	0.15	0.22
Z-score	19,005	3.45	2.86	−2.12	0.27	1.78	2.88	4.39	8.79	16.20
Age	19,005	20.85	18.53	1.00	3.00	7.00	15.00	28.00	66.00	83.00
RetStD	19,005	0.03	0.02	0.01	0.01	0.02	0.02	0.04	0.06	0.10
Panel B. Loan Characteristics										
LiqCov	15,239	1.61	0.94	0.00	0.00	1.00	2.00	2.00	3.00	5.00
LiqCovInd	15,239	0.88	0.32	0.00	0.00	1.00	1.00	1.00	1.00	1.00
LiqCovRatio	15,058	0.74	0.34	0.00	0.00	0.50	1.00	1.00	1.00	1.00
SolCov	15,239	0.56	0.70	0.00	0.00	0.00	0.00	1.00	2.00	3.00
DealSize	33,872	18.59	1.82	0.00	15.42	17.40	18.79	19.83	21.39	24.62
Maturity	33,872	49.71	28.88	0.00	12.00	31.00	59.00	60.00	94.00	420.00
Secured	33,872	0.46	0.50	0.00	0.00	0.00	0.00	1.00	1.00	1.00
NumOfLenders	33,872	7.55	8.36	1.00	1.00	2.00	5.00	10.00	23.00	290.00
DivRestrict	33,872	0.34	0.47	0.00	0.00	0.00	0.00	1.00	1.00	1.00
Sweep	33,872	0.20	0.40	0.00	0.00	0.00	0.00	0.00	1.00	1.00
CapexRestrict	33,872	0.10	0.30	0.00	0.00	0.00	0.00	0.00	1.00	1.00
PP_Rating	33,872	0.10	0.30	0.00	0.00	0.00	0.00	0.00	1.00	1.00
PP_Indictor	33,872	0.32	0.47	0.00	0.00	0.00	0.00	1.00	1.00	1.00
Creditline	33,872	0.54	0.50	0.00	0.00	0.00	1.00	1.00	1.00	1.00

Variable	Mean (Low Trans/Perm)	Mean (High Trans/Perm)	Diff. (Low – High)	Significance
Panel C. Firm Characteristic Differences Between Observations With Relatively Low and High Transitory Cash Flow Volatility To Permanent Cash Flow Volatility				
Market leverage	0.270	0.273	−0.003	-
Dividend	0.013	0.012	0.001	***
Size	7.202	6.815	0.387	***
Market-to-book	1.567	1.300	0.266	***
CapEX	0.063	0.065	−0.002	*
R&D	0.019	0.023	−0.004	***
Depreciation	0.047	0.050	−0.003	***
Tangible	0.319	0.332	−0.014	***
Advertisement	0.014	0.012	0.003	***
Loss	0.181	0.252	−0.071	***
ROA	0.039	0.020	0.019	***
Z-score	3.586	3.318	0.268	***
Age	20.529	21.167	−0.638	**
RetStD	0.027	0.031	−0.004	***

frequently and uncertainly. Consistent with our hypotheses, the number of liquidity covenants is negatively correlated with the volatility of transitory cash flow and positively correlated, albeit insignificantly, with the volatility of permanent cash flow. The ratio of liquidity to total financial covenants is negatively correlated with

FIGURE 1

Transitory and Permanent Cash Flow Volatility By Industry

Figure 1 shows the box plots of transitory and permanent cash flow volatility for each Fama–French SIC48 industry. The lower hinge, middle line, and upper hinge of the box indicate the 25th, 50th, and 75th percentiles of the distribution, respectively. The whiskers on either side of the box extend to the lower and upper adjacent values as defined in Tukey (1977) which are calculated as 1.5 times the interquartile range from the nearest quartile. Industries are sorted in a descending order based on the median value of transitory cash flow volatility from the left to the right of the figure.

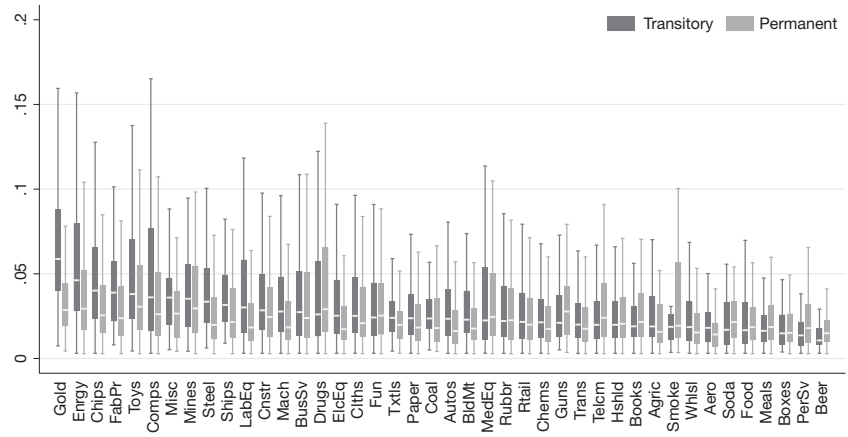

TABLE 2

Correlation Matrix for Key Variables

Table 2 reports the pairwise correlation among the key cash flow and loan covenant variables. ***, **, and * denoted 2-tailed statistical significance for 1%, 5%, and 10%, respectively. All variables are as defined in Appendix B.

Variables	CF	Transitory CF	Permanent CF	CF Vol	Transitory Vol	Permanent Vol	LiqCov	SolCov	LiqCovRatio
CF	1								
Transitory CF	0.36***	1							
Permanent CF	0.87***	−0.11***	1						
CF Vol	−0.20***	−0.11***	−0.17***	1					
Transitory Vol	−0.18***	−0.14***	−0.12***	0.81***	1				
Permanent Vol	−0.08***	−0.12***	−0.02***	0.68***	0.74***	1			
LiqCov	0.09***	−0.01*	0.11***	−0.06***	−0.06***	0.01	1		
SolCov	−0.05***	0.02**	−0.06***	0.06***	0.08***	0.03***	−0.36***	1	
LiqCovRatio	0.09***	−0.01	0.10***	−0.09***	−0.11***	−0.03***	0.65***	−0.83***	1

both cash flow volatility. Untabulated correlations also show that the use of liquidity and solvency covenants is correlated with other firm and loan characteristics. Accordingly, we next perform multivariate tests to control for these factors to isolate the incremental effects of cash flow shocks on covenants.

IV. Main Results

A. Liquidity Covenants

Our objective relates to whether and how cash flow shocks affect liquidity-based covenants used in debt contracts. Table 3 presents the results of equation (1) when the dependent variable is the number of liquidity covenants (*LiqCov*) in

TABLE 3

Use of Liquidity Covenants with Transitory and Permanent Cash Flow Volatility

Table 3 reports the association between the use of liquidity covenants and firms' transitory and permanent cash flow volatility. In columns 1 and 2, the dependent variable is the number of liquidity covenants used in the loan contract and the model is ordinary least squares (OLS). In columns 3 and 4, the dependent variable is an indicator variable equal to 1 if the number of liquidity covenants used in the loan contract is nonzero, and 0 otherwise. The model is a Logit regression. In columns 5 and 6, the dependent variable is the ratio between the number of liquidity covenants and the total number of liquidity and solvency covenants. The model is estimated using OLS. Industry fixed effects are based on Fama and French 48-industry classification. All variables are as defined in Appendix B. *t*-stats are reported in parentheses. Standard errors are clustered by firm and year. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively.

	Liquidity Covenants								Liquidity Ratio			
	OLS (# Covenants)				Logit (Indicator Covenants)				OLS (Liquidity/Total Covenants)			
	1		2		3		4		5		6	
CF Vol	−0.969***	(−3.44)			−4.832***	(−5.30)			−0.355**	(−2.53)		
Transitory Vol			−1.653***	(−4.77)			−7.012***	(−5.60)			−0.660***	(−4.44)
Permanent Vol			1.218***	(3.43)			3.644***	(2.90)			0.448***	(3.62)
Market leverage	0.262***	(3.04)	0.261***	(3.00)	1.248***	(4.46)	1.228***	(4.39)	0.120***	(5.10)	0.117***	(4.77)
Dividend	−0.342	(−0.44)	−0.405	(−0.53)	−0.505	(−0.22)	−0.869	(−0.39)	0.034	(0.13)	0.012	(0.04)
Size	−0.078***	(−4.30)	−0.076***	(−4.28)	−0.306***	(−7.62)	−0.300***	(−7.51)	−0.011*	(−1.79)	−0.010*	(−1.75)
Market-to-book	0.068***	(4.06)	0.056***	(3.45)	0.199***	(3.73)	0.174***	(3.25)	0.042***	(6.32)	0.038***	(5.80)
CapEX	−0.119	(−0.46)	−0.100	(−0.38)	0.758	(0.87)	0.865	(0.99)	−0.024	(−0.25)	−0.013	(−0.13)
R&D	−2.341***	(−6.56)	−2.354***	(−6.60)	−5.609***	(−5.49)	−5.789***	(−5.70)	−0.420***	(−3.53)	−0.418***	(−3.65)
Depreciation	1.215**	(2.48)	1.170**	(2.38)	3.116**	(1.99)	3.249**	(2.07)	0.597***	(4.03)	0.588***	(3.98)
Tangible	−0.337***	(−4.01)	−0.329***	(−3.89)	−0.485*	(−1.70)	−0.490*	(−1.71)	−0.138***	(−3.45)	−0.137***	(−3.37)
Advertisement	−0.358	(−0.65)	−0.389	(−0.71)	3.316**	(2.15)	3.180**	(2.05)	0.255	(1.50)	0.248	(1.46)
Loss	−0.075*	(−1.71)	−0.078*	(−1.77)	−0.234*	(−1.91)	−0.253**	(−2.07)	0.008	(0.63)	0.007	(0.54)
ROA	0.526***	(2.77)	0.525***	(2.79)	1.710***	(3.16)	1.872***	(3.47)	0.093*	(1.86)	0.089*	(1.80)
Z-score	−0.018***	(−3.08)	−0.017***	(−2.98)	−0.063***	(−3.29)	−0.065***	(−3.44)	−0.007***	(−2.81)	−0.007**	(−2.71)
Age	−0.003***	(−3.21)	−0.003***	(−2.99)	−0.012***	(−5.60)	−0.012***	(−5.39)	−0.002***	(−3.03)	−0.001***	(−2.90)
RetStD	−4.182***	(−3.43)	−4.138***	(−3.47)	−11.266***	(−3.23)	−10.642***	(−3.08)	−0.769**	(−2.42)	−0.711**	(−2.14)
DealSize	0.024	(1.69)	0.024	(1.62)	0.069*	(1.77)	0.072*	(1.86)	0.016***	(3.80)	0.015***	(3.71)
Maturity	0.005***	(8.13)	0.005***	(8.18)	0.012***	(6.26)	0.012***	(6.31)	0.001***	(7.02)	0.001***	(7.07)
Secured	0.021	(0.63)	0.017	(0.50)	0.178*	(1.87)	0.168*	(1.76)	0.038***	(3.45)	0.037***	(3.38)
NumOfLenders	0.006***	(4.12)	0.006***	(4.13)	0.021***	(3.70)	0.020***	(3.57)	0.001*	(1.78)	0.001*	(1.79)
DivRestrict	0.177***	(6.67)	0.176***	(6.72)	0.494***	(6.01)	0.488***	(5.97)	0.041***	(3.50)	0.040***	(3.51)

(continued on next page)

https://doi.org/10.1017/S0022109024000474 Published online by Cambridge University Press

TABLE 3 (continued)

Use of Liquidity Covenants with Transitory and Permanent Cash Flow Volatility

	Liquidity Covenants								Liquidity Ratio			
	OLS (# Covenants)				Logit (Indicator Covenants)				OLS (Liquidity/Total Covenants)			
	1		2		3		4		5		6	
Sweep	0.356***	(6.60)	0.354***	(6.56)	0.770***	(7.08)	0.770***	(7.06)	0.081***	(6.29)	0.080***	(6.25)
CapexRestrict	0.172***	(4.34)	0.172***	(4.39)	−0.193	(−1.60)	−0.177	(−1.46)	0.036***	(4.03)	0.036***	(4.06)
PP rating	−0.463***	(−12.64)	−0.468***	(−12.66)	−1.526***	(−13.61)	−1.545***	(−13.80)	−0.119***	(−7.67)	−0.120***	(−7.86)
PP indicator	0.323***	(7.85)	0.325***	(7.86)	1.292***	(13.22)	1.300***	(13.30)	0.079***	(7.27)	0.079***	(7.34)
Creditline	−0.074***	(−3.45)	−0.073***	(−3.38)	−0.294***	(−4.34)	−0.287***	(−4.25)	−0.016**	(−2.33)	−0.016**	(−2.27)
Const.	1.233***	(4.61)	1.224***	(4.50)	0.646	(0.46)	0.679	(0.52)	0.349***	(4.46)	0.347***	(4.41)
Industry FE	Yes		Yes		Yes		Yes		Yes		Yes	
Year FE	Yes		Yes		Yes		Yes		Yes		Yes	
N	15,238		15,238		15,128		15,128		15,058		15,058	
Adj./Pseudo R^2	0.319		0.320		0.227		0.228		0.328		0.329	
			Coefficient Test: Transitory Vol vs. Permanent Vol									
F-stat (*p*-value)			21.77	(0.000)			21.05	(0.000)			22.84	(0.000)

columns 1 and 2, an indicator variable equal to 1 for nonzero number of liquidity covenants (*LiqCovInd*) in columns 3 and 4, and the ratio of liquidity covenants to total financial covenants (*LiqCovRatio*) in columns 5 and 6. In columns 1, 3, and 5, we start with the total cash flow volatility as explanatory variable and show that the coefficient estimates for cash flow volatility (*CF Vol*) are negative and significant. This indicates that the number, the odds and ratio of liquidity covenants decrease as overall cash flow volatility increases. When we decompose cash flow volatility into the transitory and permanent shocks, we find that the negative effect between liquidity covenants and overall cash flow volatility is driven by the impact of transitory cash flow. This is reflected in the negative and significant coefficient estimate on transitory shocks in column 2 for *LiqCov*, in column 4 for *LiqCovInd*, and in column 6 for *LiqCovRatio*. By contrast, the coefficient estimate on permanent shocks is positive and significant in columns 2, 4, and 6.

In terms of economic magnitude, the OLS estimation results in column 2 suggests that on average, a 1-standard-deviation increase in transitory cash flow volatility causes the number of liquidity covenants to decline by 5% ($= -1.653 \times 0.05/1.61$), while a 1-standard-deviation increase in permanent cash flow volatility causes the number of liquidity covenants to rise by 4% ($=1.218 \times 0.05/1.61$). The estimated average impact from the OLS regression may not seem economically large, but if we look at the Logit estimation in column 4 where the transitory (permanent) cash flow volatility coefficient of −7.012 (3.644) indicates that a 1-standard-deviation increase in cash flow volatility is associated with a 30% decrease (12% increase) in the odds of including liquidity covenants in loan contracts.[9] This estimated impact of transitory and permanent shocks on liquidity covenants is not trivial. As shown in both OLS and Logit estimations, it is comparable to or higher than the impact magnitude of other control variables which are identified in prior studies as significant determinants of loan covenants, such as leverage, firm size, capital/R&D investment, profitability, and *Z*-score (Christensen and Nikolaev (2012), Demerjian (2017), and Roberts (2015).

The results are consistent with our hypotheses that transitory cash flow shocks are associated with lower liquidity-based covenant intensity, but permanent cash flow shocks are associated with higher liquidity covenant intensity. That is, transitory and permanent cash flow have opposite effects on the use of liquidity covenants. This indicates that borrowers and creditors act in a manner exhibiting awareness about the composition of cash flow shocks, and view temporary shocks as a noisy signal of economic profitability. Thus, all else equal, lenders choose to finance a borrower with fewer liquidity covenants if the borrower experiences noisy temporary cash flow. However, if a borrower's economic fundamentals are at higher risk, creditors tend to use more liquidity covenants to closely monitor the borrower's performance. These findings provide new evidence to the existing debt contracting literature on how covenant designs balance financial flexibility to avoid

[9]The effect of transitory cash flow volatility on the log odds ratio is calculated as 0.3506 ($= -7.012 \times 0.05$). Then we take its exponential to get the odds ratio of 30% ($=1 - e^{-0.3506}$). Similarly, we calculate the economic interpretation of the permanent cash flow volatility coefficient.

unnecessary intervention with lender protection, which together improves the debt contract efficiency.

Table 4 presents the results on *LiqCovSlack* based on a subset of the sample where we have sufficient information to compute slack for interest coverage ratio (columns 1 and 2) or debt/EBITDA ratio (columns 3 and 4). As shown in column 1, high overall cash flow volatility of a borrowing firm is associated with greater covenant slack. When we decompose the overall cash flow volatility into transitory and permanent components as reported in column 2, the coefficient estimate of volatility of temporary cash flow is positive and significant in a 1-tailed test. This indicates that the covenant tightness is low at the loan inception, supporting the prediction that contracts are designed in such a manner that avoids unnecessarily forcing borrowers to violate covenants in the event of a transitory shock. On the

TABLE 4

Slack of Liquidity Covenants with Transitory and Permanent Cash Flow Volatility

Table 4 reports the association between the liquidity covenant slack and firms' transitory and permanent cash flow volatility. In columns 1 and 2, the dependent variable is the slack of the interest coverage ratio calculated as the difference between the firm's actual ratio value when the loan was initiated and the covenant threshold recorded in DealScan. The actual interest coverage ratio is calculated as EBITDA/Interest Expense. In columns 3 and 4, the dependent variable is the slack of debt/EBITDA ratio calculated as the difference between the maximum threshold set in the debt contract and the actual initial value, which is the sum of current and long-term debt divided by operating income before depreciation. For all analyses, we drop observations with initial negative slack, that is, cases where initial interest coverage (debt/EBITDA) value already exceeds (falls under) the threshold set in the contract. Industry fixed effects are based on Fama and French 48-industry classification. All variables are as defined in Appendix B. *t*-stats are reported in parentheses. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively.

	Interest Coverage				Debt to EBITDA			
	1		2		3		4	
CF Vol	116.456*	(2.04)			4.006***	(4.89)		
Transitory Vol			79.728	(1.63)			5.231***	(3.59)
Permanent Vol			−23.894	(−0.47)			−2.035*	(−1.92)
Market leverage	−12.642	(−1.16)	−12.683	(−1.15)	−2.917***	(−10.38)	−2.919***	(−10.71)
Dividend	6.193	(0.13)	8.401	(0.18)	2.851**	(2.44)	3.076**	(2.68)
Size	2.166*	(1.95)	1.893*	(1.77)	0.005	(0.12)	−0.003	(−0.09)
Market-to-book	−12.191***	(−5.11)	−11.401***	(−5.02)	−0.148***	(−3.49)	−0.121***	(−3.12)
CapEx	20.141	(1.11)	18.470	(0.96)	0.631	(0.91)	0.464	(0.68)
R&D	98.301	(1.29)	102.903	(1.37)	0.276	(0.32)	0.416	(0.48)
Depreciation	−36.121	(−0.93)	−26.181	(−0.72)	−0.694	(−0.53)	−0.363	(−0.28)
Tangible	9.995	(1.38)	9.176	(1.26)	0.150	(0.78)	0.131	(0.66)
Advertisement	−0.638	(−0.01)	−0.493	(−0.01)	−0.508	(−0.59)	−0.425	(−0.51)
Loss	8.187*	(2.03)	8.885**	(2.10)	0.286***	(3.30)	0.305***	(3.45)
ROA	20.902	(0.51)	29.249	(0.68)	−3.899***	(−5.51)	−3.748***	(−5.31)
Z-score	15.190***	(8.33)	15.022***	(8.16)	0.117***	(10.36)	0.111***	(11.25)
Age	−2.212**	(−2.22)	−2.189**	(−2.27)	0.069**	(2.08)	0.070**	(2.13)
RetStD	0.048	(1.40)	0.046	(1.27)	0.004**	(2.39)	0.004**	(2.27)
DealSize	−2.702	(−1.03)	−2.376	(−0.90)	0.178***	(3.73)	0.186***	(3.83)
Maturity	−0.202**	(−2.53)	−0.204**	(−2.48)	0.003	(1.12)	0.003	(1.11)
Secured	−1.846	(−0.75)	−1.665	(−0.67)	0.011	(0.21)	0.009	(0.17)
NumOfLenders	1.908	(0.97)	1.971	(1.02)	0.141**	(2.49)	0.147**	(2.64)
DivRestrict	2.368	(0.70)	2.511	(0.74)	0.084	(1.20)	0.079	(1.12)
Sweep	−6.358**	(−2.06)	−6.000*	(−1.97)	0.125**	(2.30)	0.139**	(2.56)
CapexRestrict	2.351	(0.77)	2.194	(0.72)	−0.210***	(−3.37)	−0.219***	(−3.41)
PP rating	0.687	(0.37)	0.600	(0.33)	−0.075**	(−2.21)	−0.076**	(−2.24)
PP indicator	−0.093	(−1.61)	−0.097	(−1.71)	0.002*	(1.89)	0.002	(1.59)
Creditline	42.725	(0.36)	65.651	(0.54)	5.810*	(2.05)	5.290*	(2.00)
Const.	8.961	(0.39)	10.966	(0.48)	0.601	(1.37)	0.676	(1.52)
Industry fixed effect	Yes		Yes		Yes		Yes	
Year fixed effect	Yes		Yes		Yes		Yes	
N	5,268		7,687					
Adj. R^2	0.340		0.242					
	Coefficient Test: Transitory Vol vs. Permanent Vol							
F-stat (*p*-value)	1.45 (0.240)				9.07 (0.006)			

other hand, the coefficient estimate of permanent cash flow volatility is negative but statistically insignificant. This suggests that firms with greater exposure to volatile permanent performance shocks are not given more slack for liquidity covenants, if not tighter ones, signifying creditors' need to closely monitor borrowers' performance if long-term profitability and firm value are at risk.

We repeat the analysis using the debt/EBITDA ratio, another commonly used liquidity covenant in loan contracts (Demerjian and Owens (2016), Graham (2022)). We report the results in Table 4 as columns 3 and 4. The results in column 3 indicate that high overall cash flow volatility of a borrowing firm is associated with greater covenant slack. When we decompose the overall cash flow volatility into transitory and permanent components as reported in column 4, the coefficient estimate of volatility of transitory cash flow is significantly positive and that of permanent cash flow volatility is significantly negative. These findings are consistent with our expectations that firms with higher transitory cash flow volatility tend to be given more slack for debt/EBITDA ratio, while firms with higher permanent cash flow volatility are given less slack.

Prior research suggests that debt covenants are set tight at the start of loan agreements to give greater decision rights to creditors under asymmetric information and are used as trip wires for subsequent renegotiations when technical violations occur (Denis and Wang (2014), Garleanu and Zwiebel (2009)). Our findings provide more nuanced evidence in regard to how covenant benchmarks are chosen upon inception of debt contracts. We show that creditors can use loose liquidity covenants to avoid unnecessary renegotiation and improve contracting efficiency. Our results also complement studies that examine the impact of financial measure variability on covenant slack and the probability of covenant violation (e.g., Demerjian and Owens (2016), Dichev and Skinner (2002)). We demonstrate that the degree to which covenant slack reflects the likely variation in the financial measures depends on the temporal nature of the variability.

We note that other debt covenants may be utilized in conjunction with liquidity covenants to deal with the conflicts of interest between lenders and borrowers. Different from liquidity covenants which monitor a firm's periodic performance, solvency covenants check on a firm's capital structure and aggregate the following ratios: debt-to-equity, debt-to-tangible networth, leverage ratio, loan-to-value, net debt-to-assets, senior leverage, total debt-to-tangible networth, equity-to-asset ratio, networth-to-total asset, networth, and tangible networth. Christensen and Nikolaev (2012) showed that when liquidity covenants are less useful in monitoring credit risk, more solvency covenants are used instead to impose restrictions on the capital structure with an aim to align the interests between debtholders and equity holders. This trade-off is confirmed in our analysis of regressing solvency covenants on transitory and permanent cash flow volatility. Untabulated results show that, in contrast to our previous findings on liquidity covenants, the use of solvency covenants increases with volatility of transitory cash flow and decreases with volatility of permanent cash flow. When firms are subject to high transitory cash flow volatility, liquidity covenants are used less because the cash flow information to a lesser degree portrays credit risk. Solvency covenants are therefore used as an alternative way of controlling credit risk. Similarly, when a borrower experiences higher permanent cash flow volatility, liquidity covenants serve as the main

mechanism to monitor the borrower's fundamental performance prospect and solvency covenants are less utilized.

To complement the control mechanism of financial covenants, lenders can also use cash-proceeds sweeps as an ex ante covenant design to limit borrowers' access to excess cash and to reduce agency risk (Christensen and Nikolaev (2012), Dey, Nikolaev, and Wang (2016), and Lou and Otto (2020)). Untabulated results show that cash sweeps have a significantly positive association with permanent cash flow volatility and a negative but insignificant relation with transitory cash flow volatility. Further analysis shows that this significant positive relation is driven by debt issuance, asset sales, and insurance proceeds sweeps, not excess cash flow or equity issuance sweeps. This suggests that when permanent cash flow is volatile, indicating uncertainty in long-term prospects, the contracts are more likely to include cash-proceeds sweeps to limit the borrower's access to excess cash flow, which can be used to delay default.

B. Performance Pricing Provision

If the concern with the impact of transitory shocks is only about avoiding potential costly renegotiation, debt contracts can include performance pricing which links interest rate to a borrower's performance, either by reducing the rate if credit quality improves or by increasing the rate if credit quality deteriorates (Asquith et al. (2005), Manso et al. (2010)). Yet, in the context of transitory shocks, we propose that borrowers and lenders are less likely to use performance pricing when a borrower is exposed to volatile transitory cash flow because it would unnecessarily penalize a borrower for short-lived negative shocks or reward the borrower for short-lived positive shocks which do not reflect the fundamental performance. On the other hand, we expect that performance pricing is more likely to be included in the contract when a borrower is exposed to volatile permanent cash flow. Cash flow shocks of permanent nature affect a firm's economic prospect and credit risk, which can be addressed by performance pricing.

Table 5 presents the results from re-estimating equation (1) with the dependent variable being an indicator for whether performance pricing is used in a loan contract. The coefficient estimate of transitory cash flow volatility is negative and significant in both OLS and Logit regressions in columns 1 and 2, although the coefficient for permanent cash flow volatility is insignificant. These results are generally consistent with our expectation that transitory shocks are associated with lower likelihood of performance pricing provision being included in debt contracts to prevent temporary shocks from being automatically priced.

C. Consequences of Covenant Violations and Credit Rating Changes

1. Disclosures of Serious Covenant Violations

Next, we investigate consequences of covenant violations for firms experiencing greater variations in transitory and permanent cash flow. If covenants are designed to allow firms to survive a temporary liquidity crunch, we expect firms exposed to transitory shocks to experience less serious consequences in the event of covenant violations and those subject to permanent shocks to face more severe

TABLE 5

Use of Performance Pricing with Transitory and Permanent Cash Flow Volatility

Table 5 reports the association between the use of performance pricing and firms' transitory and permanent cash flow volatility. In both columns 1 and 2, the dependent variable is a dummy variable that takes the value of 1 if performance pricing is used in the loan contract, and 0 otherwise. Column 1 reports the OLS estimation results, and column 2 reports the Logit estimation results. Industry fixed effects are based on Fama and French 48-industry classification. All variables are as defined in Appendix B. *t*-stats are reported in parentheses. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively.

	Performance Pricing			
	OLS		LOGIT	
	1		2	
Transitory Vol	−0.329***	(−2.89)	−2.610***	(−3.70)
Permanent Vol	−0.025	(−0.23)	−0.216	(−0.31)
Market Leverage	−0.120***	(−5.97)	−0.913***	(−7.21)
Dividend	−0.499***	(−2.76)	−3.327***	(−2.89)
Size	−0.033***	(−9.49)	−0.276***	(−14.34)
Market-to-book	−0.006	(−1.00)	−0.057*	(−1.83)
CapEX	−0.195***	(−3.30)	−1.219***	(−2.79)
R&D	−0.361***	(−3.00)	−1.933***	(−2.94)
Depreciation	−0.025	(−0.21)	0.175	(0.22)
Tangible	0.022	(0.77)	0.172	(1.18)
Advertisement	0.074	(0.65)	0.605	(0.90)
Loss	−0.035***	(−4.00)	−0.202***	(−3.03)
ROA	0.085**	(2.23)	0.789**	(2.46)
Z-score	0.001	(0.41)	0.003	(0.27)
Age	0.000	(0.82)	0.001	(1.27)
RetStD	−2.068***	(−5.90)	−15.525***	(−7.45)
DealSize	0.034***	(7.03)	0.289***	(12.26)
Maturity	−0.000	(−0.05)	−0.001**	(−2.09)
Secured	−0.016**	(−2.27)	−0.108**	(−2.20)
NumOfLenders	0.009***	(7.51)	0.066***	(16.67)
DivRestrict	0.309***	(10.85)	1.594***	(33.11)
Sweep	0.119***	(7.20)	0.694***	(11.80)
CapexRestrict	0.029**	(2.14)	0.223***	(3.20)
Creditline	0.123***	(9.66)	0.870***	(27.29)
Const.	−0.206**	(−2.58)	−6.536***	(−10.05)
Industry fixed effect	Yes		Yes	
Year fixed effect	Yes		Yes	
N	33,872		32,489	
Adj./Pseudo R^2	0.323		0.295	
	Coefficient Test: Transitory Vol vs. Permanent Vol			
F-stat (*p*-value)	2.16 (0.150)		3.52 (0.061)	

consequences. To test this, we limit our sample to firm-year observations with a covenant violation by comparing a firm's actual covenant ratios during a loan's outstanding period with the contracted covenant benchmarks at loan initiation (Chava and Roberts (2008), Dichev and Skinner (2002)).[10] If any loan covenant is breached, a violation is identified. We then identify violations with more serious consequences based on whether any violations are subsequently disclosed in SEC filings (Nini et al. (2009)).[11] According to SEC Regulation S-X, firms need to report any breach of a covenant in a loan agreement that has not been cured as of the report date (SEC Regulation S-X, Rule 4-08). If a firm's circumstance is sufficiently serious as to prohibit it from receiving a waiver or favorable renegotiation from the lender, the

[10]As discussed in Dichev and Skinner (2002), this approach likely captures firms' reported and unreported covenant violations, providing a more comprehensive coverage of the phenomenon. Actual covenant values are calculated based on definitions given in Demerjian and Owens (2016).

[11]We use data from Nini et al. (2009) which identify violation disclosures within each firm's 10-K and 10-Q filings. As the data is not for each specific loan, our analyses are performed at firm-year level rather than at loan level.

TABLE 6

Violation Consequence with Transitory and Permanent Cash Flow Volatility

Table 6 reports the association between the disclosure of serious covenant violations and firms' transitory and permanent cash flow volatility, conditional on the existence of a covenant violation. A covenant violation is identified based on comparing firms' actual covenant ratios during the loan period with the covenant benchmarks recorded in DealScan at the initiation of the loan. As long as one of the loan covenants used in the loan contract were breached, a violation is identified. Conditional on a covenant violation exists, the sampled observations are classified as those with serious or not serious violation consequences. Violation with serious consequences is identified if it is disclosed in an SEC filing as recorded in the Nini et al. (2009) data set. In all columns, the dependent variable is a dummy variable equal to 1 if a disclosure of covenant violations was made by a firm in its SEC filings (deemed as violations with serious consequences), and 0 otherwise. The Logit estimation results are reported. Industry fixed effects are based on Fama and French 48-industry classification. All variables are as defined in Appendix B. *t*-stats are reported in parentheses. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively.

	Disclosure of Serious Violation			
	1		2	
CF Vol	2.172**	(2.40)		
Transitory Vol			−1.259*	(−1.80)
Permanent Vol			1.209*	(1.75)
Market Leverage	1.419***	(6.06)	1.313***	(5.77)
Dividend	0.787	(1.10)	0.784	(1.10)
Size	−0.393***	(−10.86)	−0.415***	(−11.64)
Market-to-book	−0.063	(−0.75)	−0.015	(−0.22)
CapEX	1.554**	(2.04)	1.678**	(2.24)
R&D	−1.667	(−1.22)	−1.426	(−1.05)
Depreciation	−1.983	(−1.41)	−2.165	(−1.52)
Tangible	0.017	(0.06)	−0.015	(−0.05)
Advertisement	−0.776	(−0.62)	−0.271	(−0.22)
Loss	0.756***	(7.04)	0.785***	(7.24)
ROA	−0.937	(−1.46)	−1.041	(−1.56)
Z-score	−0.032	(−0.98)	−0.044	(−1.34)
Age	−0.002	(−0.60)	−0.003	(−0.76)
RetStD	−0.740	(−0.24)	0.190	(0.06)
Const.	0.700	(1.21)	0.894	(1.56)
Industry fixed effect	Yes		Yes	
Year fixed effect	Yes		Yes	
N	4,043		4,043	
Pseudo R^2	0.156		0.155	
		Coefficient Test: Transitory Vol vs. Permanent Vol		
F-stat (*p*-value)		3.16 (0.075)		

firm is required to disclose this information in SEC filings. Prior research document that reported covenant violations indeed represent more serious cases (Beneish and Press (1993), Chen and Wei (1993), and Dichev and Skinner (2002)).

Table 6 presents the results from regressing the indicator for serious violation consequence on cash flow shocks. Column 1 shows the results for overall cash flow shocks and column 2 reports the results for the components of cash flow shocks. The coefficient estimate on the overall cash flow in column 1 is positive and significant, and so is the estimate in column 2 on permanent cash flow volatility. By contrast, the coefficient estimate is negative and significant on transitory cash flow volatility. Thus, while permanent cash flow volatility is associated with more serious violations, covenant violations of firms exposed to cash flow volatility of temporary nature are evaluated as less serious.

These results are in line with our argument that lenders provide financial flexibility for firms that are likely to experience temporary performance shocks to survive liquidity crunch without any serious consequences. This corresponds well to research evidence on loan renegotiations that a significant percentage of loans are renegotiated before maturity and renegotiations are normally not caused by borrowers in financial distress (Denis and Wang (2014), Roberts and Sufi (2009b),

and Roberts (2015)). This body of literature further finds that when financial covenants are breached, the covenant violations are commonly waived and rarely lead to bankruptcy or acceleration of the loan (Roberts and Sufi (2009b)), and renegotiated covenants tend to have more relaxed limits (Denis and Wang (2014), Garleanu and Zwiebel (2009).

To provide further evidence on the directional impact of cash flow shocks, we repeated the analysis replacing the transitory and permanent cash flow volatility with the changes (Δ) and levels of transitory and permanent cash flow. Conditional on a covenant violation, we expect the violation to have more serious consequences if there is a deterioration in the permanent cash flow component. We report this analysis in Table 7. First, we find that in the same year of the covenant violation, if the violation coincides with a more negative change in a firm's overall cash flow (column 1) or a lower level of cash flow (column 3), the probability of the firm subsequently disclosing the serious violation is significantly higher. Analyses based on the decomposed transitory and permanent components further show that the permanent cash flow component drives this

TABLE 7

Violation Consequence with Cash Flow Changes and Levels

Table 7 reports the association between the disclosure of serious covenant violations and the change/level of transitory and permanent cash flow, conditional on the existence of a covenant violation. A covenant violation is identified based on comparing firms' actual covenant ratios during the loan period with the covenant benchmarks recorded in DealScan at the initiation of the loan. As long as one of the loan covenants used in the loan contract were breached, a violation is identified. Conditional on a covenant violation exists, the sampled observations are classified as those with serious or not serious violation consequences. Violation with serious consequences is identified if it is disclosed in an SEC filing as recorded in the Nini et al. (2009) data set. In all columns, the dependent variable is a dummy variable equal to 1 if a disclosure of covenant violations was made by a firm in its SEC filings (deemed as violations with serious consequences), and 0 otherwise. The Logit estimation results are reported. Industry fixed effects are based on Fama and French 48-industry classification. All variables are as defined in Appendix B. *t*-stats are reported in parentheses. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively.

	Disclosure of Serious Violation							
	1		2		3		4	
ΔCF	−2.559***	(−4.96)						
ΔTransitory CF			−0.912	(−1.60)				
ΔPermanent CF			−13.523***	(−6.63)				
CF					−3.137***	(−4.46)		
Transitory CF							1.346	(1.40)
Permanent CF							−5.377***	(−6.01)
Market leverage	1.482***	(7.18)	1.394***	(6.59)	1.518***	(7.48)	1.503***	(7.32)
Dividend	−0.090	(−0.15)	−0.201	(−0.30)	0.062	(0.11)	0.144	(0.26)
Size	−0.392***	(−11.58)	−0.384***	(−11.23)	−0.386***	(−11.54)	−0.386***	(−11.41)
Market-to-book	−0.057	(−1.64)	−0.088**	(−2.02)	−0.045	(−1.39)	−0.070*	(−1.66)
CapEX	1.015	(1.47)	1.640**	(2.32)	0.932	(1.36)	1.056	(1.49)
R&D	−0.916	(−0.86)	−1.350	(−1.13)	−2.231*	(−1.92)	−3.151***	(−2.68)
Depreciation	−1.665	(−1.33)	−1.066	(−0.89)	0.534	(0.42)	2.066	(1.31)
Tangible	−0.043	(−0.16)	−0.114	(−0.41)	−0.003	(−0.01)	0.067	(0.24)
Advertisement	−0.614	(−0.53)	−1.015	(−0.78)	−0.557	(−0.45)	0.345	(0.27)
Loss	0.691***	(6.79)	0.622***	(6.05)	0.660***	(6.48)	0.696***	(6.69)
ROA	−0.702	(−1.36)	−0.676	(−1.44)	0.106	(0.23)	−0.046	(−0.09)
Z-score	0.003	(0.16)	0.000	(0.01)	0.005	(0.44)	0.008	(0.68)
Age	−0.003	(−0.82)	−0.005	(−1.45)	−0.003	(−0.93)	−0.003	(−0.97)
RetStD	2.133	(0.75)	1.939	(0.70)	−0.190	(−0.07)	−1.996	(−0.74)
Const.	0.624	(1.16)	0.772	(1.43)	0.929*	(1.76)	1.200**	(2.29)
Industry fixed effect	Yes		Yes		Yes		Yes	
Year fixed effect	Yes		Yes		Yes		Yes	
N	4,374		4,374		4,377		4,377	
Pseudo R^2	0.156		0.170		0.156		0.168	
			Coefficient Test: Transitory CF vs. Permanent CF					
F-stat (*p*-value)			32.96 (0.000)				35.33 (0.000)	

result, as evidenced by a significantly negative coefficient on ΔPermanent CF in column 2 and Permanent CF in column 4. In comparison, the coefficients for both the change and level of transitory cash flow in columns 2 and 4, respectively, are statistically insignificant. These findings demonstrate that when firms experience negative performance shocks of permanent nature, they tend to face more serious consequences of covenant violation.

2. Changes in Long-Term Credit Ratings

We also examine changes in borrowers' long-term credit ratings, as a proxy of how lenders would react to borrowers' exposure to transitory and permanent cash flow shocks. Long-term credit ratings reflect credit rating agencies' current opinions of a borrower's long-term creditworthiness. As transitory shocks do not reflect a firm's long-term profitability and value, we expect only permanent cash flow shocks to have a significant impact on future long-term credit rating changes. Moreover, credit rating literature suggests that most credit rating agencies including Standard & Poor's (S&P) conventionally implement a through-the-cycle methodology that focuses on the permanent component of default risk (Altman and Rijken (2006), Carey and Hrycay (2001), Löffler (2004), and Topp and Perl (2010)). Such a methodology helps rating agencies achieve rating stability and avoids quick reactions to temporary variations in firm performance (Altman and Rijken (2006), Topp and Perl (2010)). This contracts with point-in-time rating philosophy which aims to evaluate a firm's current creditworthiness by considering both cyclical and permanent effects (Topp and Perl (2010)). If credit rating agencies adopt a through-the-cycle model to estimate credit scores, permanent cash flow shock volatility should play a major role in explaining changes in S&P's long-term credit ratings, while transitory cash flow shock volatility would have a limited impact. We obtain S&P long-term credit ratings from Compustat and transform the letter ratings into numeric values coded from 1 (SD/D) to 22 (Aaa), with higher values indicating higher credit quality.

Table 8 presents the results using OLS in columns 1 and 2 and Ordered Probit in columns 3 and 4. The dependent variable is calculated as the absolute change in credit ratings over the following 12-month period, to capture the presence of either an increase or decrease in ratings as volatility increases. We document a positive and significant coefficient on overall cash flow volatility in column 1 and column 3. When we decompose the cash flow, the coefficient is positive and significant on permanent cash flow volatility in both columns 2 and 4. By contrast, the coefficient estimate is negative but not significant on transitory cash flow volatility in both columns 2 and 4. We interpret these results as evidence that credit rating agencies do not penalize or reward firms for variations in transitory cash flow shocks, but changes in long-term credit ratings are driven by cash flow shocks of a permanent nature.

We also performed analyses based on S&P short-term credit ratings changes over the following 1/3/6/9/12 months. Short-term credit ratings should better reflect changes in a firm's current credit risk and are less affected by a firm's long-term cash flow uncertainty. We find evidence consistent with these expectations. Untabulated results show that the significant effect of permanent cash flow volatility on subsequent changes in short-term credit ratings becomes much weaker, gradually disappearing from 12 months to 1 month.

TABLE 8

Changes in Credit Ratings with Transitory and Permanent Cash Flow Volatility

Table 8 reports the association between changes in subsequent credit ratings provided by credit rating agencies and firms' transitory and permanent cash flow volatility. In all columns, the dependent variable is calculated as the absolute change in credit ratings over the following 12-month period. Columns 1 and 2 report the OLS estimation results. Columns 3 and 4 report the Ordered Probit estimation results. Industry fixed effects are based on Fama and French 48-industry classification. All variables are as defined in Appendix B. *t*-stats are reported in parentheses. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively.

	Absolute Changes in Subsequent Credit Ratings							
	OLS				Ordered Probit			
	1		2		3		4	
CF Vol	0.920**	(2.31)			1.685***	(3.43)		
Transitory Vol			−0.405	(−0.84)			−0.314	(−0.48)
Permanent Vol			1.809***	(3.46)			2.535***	(4.13)
Market leverage	0.227*	(1.94)	0.213*	(1.85)	0.275**	(2.51)	0.248**	(2.27)
Dividend	1.891**	(2.62)	1.882**	(2.61)	2.561***	(3.33)	2.555***	(3.32)
Size	0.028***	(2.82)	0.027**	(2.69)	0.013	(1.12)	0.011	(0.90)
Market-to-book	−0.003	(−0.13)	−0.010	(−0.48)	−0.014	(−0.50)	−0.022	(−0.78)
CapEX	−0.266	(−0.81)	−0.272	(−0.77)	−0.574	(−1.56)	−0.594	(−1.59)
R&D	0.568*	(1.78)	0.671*	(2.01)	0.855	(1.33)	1.011	(1.57)
Depreciation	−0.759	(−1.25)	−0.686	(−1.11)	−0.908	(−1.35)	−0.766	(−1.14)
Tangible	0.111	(1.37)	0.134	(1.61)	0.176	(1.57)	0.209*	(1.85)
Advertisement	0.484	(1.51)	0.500	(1.58)	0.922	(1.56)	0.933	(1.58)
Loss	0.061	(1.20)	0.063	(1.23)	0.127***	(2.65)	0.130***	(2.72)
ROA	−0.938**	(−2.74)	−0.972***	(−2.84)	−0.643**	(−2.15)	−0.706**	(−2.35)
Z-score	0.007	(0.86)	0.008	(0.99)	−0.001	(−0.11)	−0.001	(−0.06)
Age	0.000	(0.81)	0.001	(1.23)	−0.000	(−0.45)	−0.000	(−0.05)
RetStD	11.649***	(6.41)	11.788***	(6.80)	13.126***	(7.06)	13.409***	(7.21)
Const.	−0.243**	(−2.18)	−0.245**	(−2.22)				
Industry fixed effect	Yes		Yes		Yes		Yes	
Year fixed effect	Yes		Yes		Yes		Yes	
N	8,742		8,742		8,742		8,742	
Adj./Pseudo R^2	0.065		0.066		0.038		0.039	
			Coefficient Test: Transitory Vol vs. Permanent Vol					
F-stat (*p*-value)			5.89 (0.021)				6.16 (0.013)	

We further investigate how the directional changes in credit ratings are impacted by cash flow changes and levels. We replace cash flow volatility with the changes and levels of transitory and permanent cash flow as alternative independent variables. We perform the same analysis on the directional changes of long-term credit ratings and report the results in Table 9. We find a strong positive association between a firm's overall change (column 1) or level (column 3) of cash flow and the subsequent change in long-term credit ratings. Results in columns 2 and 4 reveal that this relation is mainly driven by the permanent component. That is, when a firm experiences a positive change in permanent cash flow or a high level of permanent cash flow, there is greater improvement in the subsequent credit ratings. Relative to the impact of permanent cash flow, the effect of transitory cash flow on long-term credit ratings is much weaker.

V. Additional Analyses

A. Lender Experience

Our empirical findings suggest that U.S. private debt contracts are generally designed efficiently with an awareness of cash flow shocks of temporary and permanent nature. However, it is not clear how lenders drive the design. To shed light on this question, we examine the role of lead lender experience in moderating

TABLE 9

Changes in Credit Ratings with Cash Flow Changes and Levels

Table 9 reports the association between directional changes in subsequent credit ratings provided by credit rating agencies and the change/level of transitory and permanent cash flow. In all columns, the dependent variable is calculated as the change in credit ratings over the following 12-month period. The Ordered Probit estimation results are reported. Industry fixed effects are based on Fama and French 48-industry classification. All variables are as defined in Appendix B. *t*-stats are reported in parentheses. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively.

	Directional Change in Subsequent Credit Ratings							
	1		2		3		4	
ΔCF	4.714***	(13.57)						
ΔTransitory CF			2.941***	(7.91)				
ΔPermanent CF			13.400***	(15.26)				
CF					1.555***	(4.05)		
Transitory CF							0.894	(1.60)
Permanent CF							1.711***	(4.10)
Market leverage	−0.551***	(−5.07)	−0.491***	(−4.56)	−0.524***	(−4.87)	−0.520***	(−4.83)
Dividend	−7.846***	(−10.10)	−6.927***	(−8.95)	−9.371***	(−12.08)	−9.451***	(−12.15)
Size	−0.011	(−0.96)	−0.006	(−0.53)	−0.008	(−0.75)	−0.008	(−0.69)
Market-to-book	0.177***	(6.44)	0.124***	(4.55)	0.167***	(5.76)	0.160***	(5.33)
CapEX	−1.511***	(−4.20)	−1.684***	(−4.61)	−1.559***	(−4.32)	−1.523***	(−4.21)
R&D	−1.056*	(−1.69)	−0.688	(−1.12)	−0.958	(−1.54)	−0.913	(−1.47)
Depreciation	0.510	(0.77)	0.349	(0.51)	−0.813	(−1.06)	−0.999	(−1.28)
Tangible	0.017	(0.16)	0.058	(0.54)	0.023	(0.22)	0.021	(0.20)
Advertisement	−0.988*	(−1.80)	−0.815	(−1.48)	−1.709***	(−3.09)	−1.760***	(−3.16)
Loss	−0.206***	(−4.04)	−0.204***	(−3.99)	−0.238***	(−4.76)	−0.240***	(−4.80)
ROA	1.056***	(2.82)	0.681*	(1.84)	1.479***	(3.35)	1.550***	(3.54)
Z-score	−0.071***	(−5.47)	−0.069***	(−5.58)	−0.081***	(−6.24)	−0.083***	(−6.43)
Age	−0.001*	(−1.80)	−0.000	(−0.61)	−0.002**	(−2.57)	−0.002***	(−2.59)
RetStD	9.274***	(4.41)	10.030***	(4.77)	10.755***	(5.20)	10.991***	(5.31)
Industry fixed effect	Yes		Yes		Yes		Yes	
Year fixed effect	Yes		Yes		Yes		Yes	
N	8,742		8,742		8,742		8,742	
Pseudo R^2	0.071		0.080		0.060		0.060	
			Coefficient Test: Transitory CF vs. Permanent CF					
F-stat (*p*-value)			120.56 (0.000)		2.19 (0.139)			

our key results on liquidity covenants. Table 10 presents results on lead lender experience measured based on a lender's participation in previous loan deals. This is captured by variables *repeat* and *repeatlead*, which respectively indicate whether the lead lender had prior lending or lead lending relationship with the borrower in the past 5 years. In panel A, we report the incremental effect of lender experience by incorporating the interaction terms of *TransitoryVol* × *LenderExp* and *PermanentVol* × *LenderExp* in the regressions, where *LenderExp* is either measured by variable *repeat* (in columns 1 and 3) or *repeatlead* (in columns 2 and 4). For the number and ratio of liquidity covenants, the coefficients of the interaction term *TransitoryVol* × *LenderExp* (*PermanentVol* × *LenderExp*) are all negative (positive). Although the level of statistical significance varies depending on the specific variable measurement, these results generally reveal that the previously documented relations of cash flow volatility with liquidity covenants are more pronounced for lenders who had greater lending experience with the borrowing firms. This is further confirmed by Panel B, which reports the estimated total effect of transitory/permanent cash flow volatility for inexperienced (*LenderExp* = 0) and experienced lenders (*LenderExp* = 1).[12] The impact of transitory and permanent

[12]In Panel A, the incremental effect is estimated by adding both the main effects of *TransitoryVol*, *PermanentVol*, *LenderExp*, and their interaction terms to equation (1). In Panel B, the total effect is estimated by adding only the interaction terms between *TransitoryVol*/*PermanentVol* and *LenderExp* to equation (1), without separately estimating their main effects.

TABLE 10

Moderating Effect of Lender Experience

Table 10 reports how lender experience moderates the impact of firms' transitory and permanent cash flow volatility on liquidity covenants. *Repeat* (*RepeatLead*) indicates lead lender had prior lending (lead lending) relationship with the borrower in the past 5 years. Panel A reports the incremental effect of lender experience, while Panel B reports the estimated total effect of transitory and permanent cash flow volatility on debt covenants for inexperienced (LenderExp = 0) and experienced (LenderExp = 1) lenders. The dependent variables are listed at the top of the columns. Industry fixed effects are based on Fama and French 48-industry classification. All variables are as defined in Appendix B. *t*-stats are reported in parentheses. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively.

Panel A. Incremental Effect

	Liquidity Covenant		Liquidity Ratio	
	Repeat	RepeatLead	Repeat	RepeatLead
	1	2	3	4
Transitory Vol	−1.583***	−1.538***	−0.572***	−0.570***
	(−4.25)	(−3.27)	(−4.56)	(−4.70)
Permanent Vol	0.905*	0.917	0.253*	0.286*
	(1.87)	(1.68)	(1.93)	(1.96)
LenderExp	−0.054	0.000	−0.034**	−0.019*
	(−1.67)	(0.02)	(−2.66)	(−1.78)
Transitory Vol × LenderExp	−0.821	−0.631	−0.560*	−0.341
	(−1.05)	(−0.81)	(−1.97)	(−1.23)
Permanent Vol × LenderExp	2.474**	1.295	1.131***	0.470
	(2.46)	(1.30)	(3.49)	(1.48)
Controls	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
N	14,748	14,748	14,585	14,585
Adj. R^2	0.324	0.323	0.329	0.328
Panel B. Total Effect				
Transitory Vol (LenderExp = 0)	−1.528***	−1.539***	−0.537***	−0.531***
	(−3.93)	(−3.15)	(−4.19)	(−4.34)
Permanent Vol (LenderExp = 0)	0.950*	0.916*	0.281**	0.307**
	(2.02)	(1.70)	(2.21)	(2.18)
Transitory Vol (LenderExp = 1)	−2.739***	−2.167***	−1.344***	−1.007***
	(−3.49)	(−3.52)	(−4.13)	(−3.55)
Permanent Vol (LenderExp = 1)	3.006***	2.215***	1.143***	0.661***
	(3.81)	(3.09)	(4.15)	(2.80)
Controls	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
N	14,748	14,748	14,585	14,585
Adj. R^2	0.324	0.323	0.328	0.328
	Coefficient Test (*p*-value): LenderExp = 0 vs. 1			
Transitory Vol	0.137	0.440	0.008	0.089
Permanent Vol	0.031	0.176	0.005	0.224

cash flow on debt covenants is more obvious in terms of both economic magnitude and statistical significance for experienced lenders.

Overall, our findings suggest that lead lenders' past experience with the borrower helps them better understand the borrower's exposure to transitory and permanent shocks so that they can design more efficient contracts to control credit risk while allowing financial flexibility. This result complements existing literature on the importance of lending relationships in shaping the terms of loan contracts, especially the nonprice component (Prilmeier (2017), Roberts (2015)).

B. Cash Flow- Versus Asset-Based Loans

The debt financing literature makes a distinction between cash flow–based and asset-based loans (Ivashina, Laeven, and Moral-Benito (2022), Kermani and Ma (2020), and Lian and Ma (2021)). Cash flow–based lending relies on evaluating the

past and expected cash flow generated from borrowers' continuing operations. For this type of loans, borrowers' cash flow largely determines creditors' payoffs in the event of bankruptcy and the loan is not backed by specific assets. In contrast, assets-based lending is generally tied to specific assets whose liquidation value can be assessed on a standalone basis and provides the key payoffs to creditors if there is bankruptcy. Since the former grants loans on the basis of firms' cash flow, we expect performance monitoring through liquidity covenants to be more pronounced for cash flow–based than asset-based loans.

Investigating detailed data on a large sample of U.S. nonfinancial corporate debt, Lian and Ma (2021) reported that lending decisions on over 80% of borrowing by U.S. nonfinancial firms are based on projected cash flow from firm operations in contrast to asset-based debt. Other studies also document that commercial banks typically specialize in granting cash flow–based loans, while other finance companies tend to provide more asset-based loans (e.g., Carey, Post, and Sharpe (1998)). Accordingly, with our sample dominated by U.S. nonfinancial syndicated loans with about 90% loans granted by commercial banks, most of the loans in our sample are likely cash flow–based loans where cash flow is monitored through liquidity covenants. Nevertheless, we make an attempt to distinguish the two types of loans in our sample and examine if cash flow volatility has a differentiated effect on covenant design.

Following Lian and Ma (2021), we classify a loan as cash flow–based loan if it is a term loan or an unsecured credit line and as asset-based loan if it is a secured credit line. As reported in Table 11, the previously documented negative impact of transitory cash flow volatility and positive impact of permanent cash flow volatility on liquidity covenants are present in both cash flow–based and assets-based loans. However, we find that the reduction (increase) in liquidity covenants for cash flow–based loans is much larger in economic magnitude than for asset-based loans when firms are exposed to more volatile transitory (permanent) cash flow. In other words, the use of liquidity covenants in cash flow–based loans is much more sensitive to the transitory and permanent nature of cash flow volatility. These results are generally consistent with the expectation that loans backed by assets are less exposed to borrowers' cash flow uncertainty; hence, their covenant design is less sensitive to cash flow volatility than loans backed by cash flow.

C. Lines of Credit Versus Other Loans

Prior literature on liquidity insurance has documented the role of lines of credit in providing short-term financial needs for borrowers (Acharya et al. (2014), Brown et al. (2021), and Shockley and Thakor (1997). Next, we examine whether the documented findings of transitory and permanent cash flow shock exposure on loan covenants are mainly driven by lines of credit. We re-estimate the liquidity covenant regression based on the subsamples of lines of credit and all other loan types. Untabulated results show that the documented negative result of transitory cash flow shocks is not limited to lines of credit but present in a wide range of commercial loans. This finding adds to our current understanding of how borrowers' liquidity needs are recognized and catered for in lending.

TABLE 11

Cash Flow–Based Versus Asset-Based Loans

Table 11 reports the association between the use of liquidity covenants and firms' transitory and permanent cash flow volatility based on subsamples of cash flow–based and asset-based loans. Columns 1 and 3 report the estimation results for cash flow–based loans. Columns 2 and 4 report the estimation results for asset-based loans. A loan is identified to be cash flow–based if it is a term loan or an unsecured credit line. A loan is identified to be asset-based if it is a secured credit line. In columns 1 and 2, the dependent variable is the number of liquidity covenants used in the loan contract. In columns 3 and 4, the dependent variable is the ratio between the number of liquidity covenants and the total number of liquidity and solvency covenants. Control variables of Secured and Creditline are not included as they cannot be estimated for analyses in columns 2 and 4 due to multicollinearity. Industry fixed effects are based on Fama and French 48-industry classification. All variables are as defined in Appendix B. *t*-stats are reported in parentheses. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively.

	Liquidity Covenants				Liquidity Ratio			
	Cash Flow–Based		Asset-Based		Cash Flow–Based		Asset-Based	
	1		2		3		4	
Transitory Vol	−2.147***	(−4.69)	−1.270***	(−3.73)	−0.736***	(−3.86)	−0.377***	(−2.83)
Permanent Vol	1.646***	(4.31)	0.920**	(2.21)	0.514***	(3.92)	0.380**	(2.66)
Market leverage	0.207*	(1.97)	0.191*	(1.96)	0.116***	(4.26)	0.085***	(3.22)
Dividend	−0.260	(−0.30)	0.133	(0.12)	0.101	(0.36)	−0.185	(−0.71)
Size	−0.100***	(−4.86)	−0.021	(−0.94)	−0.016*	(−1.96)	0.021***	(3.38)
Market-to-book	0.036	(1.68)	0.073***	(3.63)	0.042***	(5.22)	0.020**	(2.66)
CapEx	0.034	(0.10)	−0.104	(−0.33)	−0.095	(−0.73)	0.157	(1.24)
R&D	−2.431***	(−5.02)	−1.934***	(−5.00)	−0.334**	(−2.31)	−0.351***	(−3.07)
Depreciation	1.123*	(1.72)	1.028	(1.70)	0.503**	(2.76)	0.528***	(3.51)
Tangible	−0.471***	(−5.33)	−0.306**	(−2.53)	−0.230***	(−4.43)	−0.078**	(−2.42)
Advertisement	0.121	(0.18)	−1.035*	(−1.85)	0.186	(0.92)	−0.103	(−0.74)
Loss	−0.045	(−0.80)	−0.156***	(−3.55)	0.002	(0.11)	−0.006	(−0.46)
ROA	0.308	(0.97)	0.398**	(2.62)	0.023	(0.25)	0.017	(0.39)
Z-score	−0.012	(−1.68)	−0.023***	(−3.00)	−0.005*	(−1.80)	−0.005*	(−1.92)
Age	−0.003**	(−2.64)	−0.000	(−0.14)	−0.002***	(−3.15)	−0.000	(−0.92)
RetStD	−3.078*	(−2.02)	−3.157***	(−2.91)	−0.484	(−1.02)	0.238	(0.99)
DealSize	0.056***	(4.12)	0.014	(0.67)	0.019***	(3.83)	0.003	(0.51)
Maturity	0.004***	(4.25)	0.009***	(6.68)	0.001***	(3.45)	0.003***	(10.39)
NumOfLenders	0.005***	(2.97)	0.005**	(2.66)	0.001	(1.48)	0.000	(0.22)
DivRestrict	0.169***	(5.08)	0.155***	(3.83)	0.033**	(2.54)	0.047***	(3.45)
Sweep	0.362***	(5.79)	0.318***	(5.91)	0.086***	(6.60)	0.086***	(7.72)
CapexRestrict	0.195***	(3.46)	0.148***	(4.30)	0.045***	(3.85)	0.031***	(2.81)
PP Rating	−0.478***	(−10.84)	−0.414***	(−5.06)	−0.112***	(−6.22)	−0.118***	(−4.69)
PP Indicator	0.274***	(7.80)	0.267***	(5.18)	0.048***	(3.94)	0.064***	(5.16)
Const.	0.946***	(3.53)	0.870**	(2.63)	0.430***	(5.21)	0.289***	(3.38)
Industry fixed effect	Yes		Yes		Yes		Yes	
Year fixed effect	Yes		Yes		Yes		Yes	
N	7,278		5,418		7,212		5,326	
Adj. R-sq	0.346		0.286		0.306		0.411	
	Coefficient Tests Between Cash Flow–Based and Asset-Based Loans: Chi^2 (*p*-value)							
Transitory Vol	2.79 (0.095)				3.89 (0.049)			
Permanent Vol	2.46 (0.117)				0.61 (0.435)			

D. Variations Across Loan Maturities

To provide further evidence, we explore the loan maturities at which transitory and permanent cash flow shocks matter for the use of liquidity covenants. Lenders should be more concerned about borrowers' long-term economic fundamentals if the loan has a long maturity, hence more likely to use liquidity covenants to monitor performance when volatile permanent cash flow is expected. In untabulated results, we split our sample into loans with maturities of 2 years and under, more than 2 years to under 4 years, more than 4 years to 5 years, and greater than 5 years. We find that the negative and significant coefficients on transitory shocks persist when the liquidity covenants are for longer maturities, with the biggest negative estimate at greater than 5 years. This indicate that lenders are less concerned with transitory shocks when a loan has longer maturity. In line with our expectation, we find that permanent cash flow shocks are positive and significant only for maturities 4–5 years and over 5 years,

and the estimate on greater than 5 years is much bigger and more significant. This indicates that lenders are most concerned with stricter control for long-term borrowers who are exposed to permanent shocks.

VI. Robustness Tests

A. Endogeneity

There is a concern that the documented association between debt contracts and cash flow volatility may be due to some omitted variables, such as managerial behaviors or reactions, which simultaneously correlate with our dependent variable and independent variable of interest. To ease the omitted variable concern, we include control variables for various observable operating, investment, and financing decisions right before the initiation of loan contracts. In addition, in the following subsections, we adopt two approaches to evaluate and address endogeneity concerns.

1. Evaluating the Impact Threshold for a Confounding Variable

To evaluate the impact of the potential confounding variables on our statistical inferences, we calculate the impact threshold for a confounding variable (ITCV) following the method described in Frank (2000). Larcker and Rusticus (2010) indicated that ITCV is a useful evaluation procedure to assess the likelihood of omitted variables, especially in the absence of strong instrumental variables. This technique was first developed in sociological research and has been increasingly applied in business studies (e.g., Badertscher, Katz, and Rego (2013), Baker, Boulton, Braga-Alves, and Morey (2021), Busenbark, Gamache, Yoon, Certo, and Withers (2019), and Xiao, Chen, Fang, and Zhang (2021)). In our setting, the impact threshold is defined as the lowest product of the partial correlation between liquidity-based covenants and the confounding variables, and the partial correlation between transitory/permanent cash flow volatility and the confounding variable that would make the estimated coefficient statistically insignificant. The impact of other control variables on the coefficient of transitory/permanent cash flow volatility is also computed to serve as a benchmark. The statistics are reported in Table 12, where our baseline regression is analyzed with the number of liquidity covenants as the dependent variable.

As shown in column 1 of Table 12, ITCV for *Transitory Vol* is −0.0231, the magnitude of which is much bigger than the impact from other control variables based on partial correlations. This indicates that we would need a confounding variable with a much larger impact than the existing control variables to overturn the significantly negative coefficient estimate of *Transitory Vol.* Because of the negative value of ITCV, one of the confounding variable's correlations with liquidity-based covenants and transitory cash flow volatility needs to be negative. ITCV reported in column 4 for *Permanent Vol* shows a similar result. The impact from a confounding variable needs to be at least 0.0121 to overturn the significantly positive coefficient of *Permanent Vol* which is much larger than the impact of most control variables using partial correlation.[13] These results

[13]The only exceptions are *Market-to-Book* whose, impact is 0.0175, and our other key independent variable, *Transitory Vol*, whose impact is −0.0408. The positive impact from *Market-to-Book* indicates that including this control variable makes the coefficient on *Permanent Vol* more positive. The negative

TABLE 12

Impact Threshold of Confounding Variable

Table 12 reports the impact threshold of confounding variable for our independent variables of interest *Transitory Vol* (column 1) and *Permanent Vol* (column 4). Our baseline regression is analyzed with the number of liquidity covenants used in debt contracts as the dependent variable. ITCV is defined as the product of the partial correlation between dependent variable and the confounding variables and the partial correlation between our independent variable of interest and the confounding variable. The impact of the inclusion of other control variables on the coefficient of transitory/permanent cash flow volatility is reported in the table. Columns 2 and 5 report the product of partial correlations, while columns 3 and 6 report the product of raw correlations. The threshold for the percentage of bias in the estimate and the number of observations that would have to be replaced with zero effect cases to invalidate the statistical inference are also reported. All variables are as defined in Appendix B.

	Transitory Vol			Permanent Vol		
	ITCV	Impact (Partial)	Impact (Raw)	ITCV	Impact (Partial)	Impact (Raw)
	1	2	3	4	5	6
Transitory Vol	−0.0231				−0.0408	−0.0463
Permanent Vol		−0.0026	0.0087	0.0121		
Market leverage		−0.0072	−0.0117		0.0016	−0.0114
Dividend		0.0000	0.0107		0.0000	0.0088
Size		0.0027	0.0365		0.0013	0.0267
Market-to-book		0.0001	−0.0018		0.0175	−0.0028
CapEX		−0.0022	−0.0092		−0.0001	−0.0066
R&D		−0.0059	−0.0262		0.0046	−0.0187
Depreciation		0.0019	0.0043		0.0013	0.0030
Tangible		−0.0006	−0.0008		0.0043	0.0008
Advertisement		0.0003	−0.0001		−0.0003	−0.0004
Loss		0.0001	−0.0047		0.0000	−0.0029
ROA		−0.0042	−0.0091		0.0000	−0.0050
Z-score		0.0035	−0.0024		0.0008	−0.0058
Age		−0.0011	0.0312		0.0059	0.0325
RetStD		−0.0066	−0.0005		0.0002	−0.0003
DealSize		0.0002	0.0057		0.0003	0.0038
Maturity		−0.0063	−0.0336		−0.0013	−0.0219
Secured		0.0008	0.0475		0.0004	0.0358
NumOfLenders		−0.0002	−0.0035		0.0014	−0.0020
DivRestrict		0.0005	0.0259		0.0009	0.0222
Sweep		−0.0035	−0.0001		0.0061	0.0137
CapexRestrict		−0.0005	0.0151		−0.0023	0.0081
PP_Rating		−0.0011	0.0333		−0.0065	0.0199
PP_Indictor		−0.0084	−0.0186		0.0010	−0.0107
Creditline		−0.0018	−0.0006		0.0017	0.0017
	Threshold for % Bias to Invalidate/Sustain the Inference					
	58.87% (8,971 obervations)			42.92% (6,540 observations)		

suggest that confounding variables are unlikely given well-known determinants with significant economic impact on debt contract design are already included in the model.

The control variable impact calculated based on raw correlations is a more conservative measure which assumes that a confounding variable is relatively distinct and its correlation with the dependent variable is not absorbed by other control variables (Frank (2000), Larcker and Rusticus (2010)). As shown in columns 3 and 6, ITCV of variables *Transitory Vol* and *Permanent Vol* is only smaller than a handful of control variables in terms of magnitude such as whether a loan is secured, loan maturity, firm size, firm age, and R&D investment. We argue that it is hard to find confounding variables that may have a comparable to or larger impact than these variables on the use of debt covenants.

impact from *Transitory Vol* indicates that including this variable makes the coefficient on *Permanent Vol* more negative.

Further analysis reveals that 58.87% (42.92%) of the sampled observations would have to be replaced with cases for which the impact of temporary (permanent) cash flow volatility on liquidity covenants is zero, to invalidate the statistical inference of the estimated coefficient. We argue that it is unlikely for such high percentage of our sample to be bias. We repeat the ITCV analysis for other baseline regressions and obtain similar results. Taken together, we conclude that the impact from omitted confounding variables is trivial in our analysis.

2. Using Abnormal Snow to Capture Transitory Shock

To provide further evidence on causality, we exploit abnormal snow as an exogenous approach to capture the effects of transitory shocks on firms' cash flow. Existing anecdotal and empirical evidence show that abnormal weather events are associated with poor firm performance (Bloesch and Gourio (2015), Brown et al. (2021)). Brown et al. (2021) isolated the exogenous changes in cash flow through the occurrence of severe winter weather. Using a comprehensive data set of winter weather at the county level maintained by the National Oceanic and Atmospheric Administration (NOAA), they propose and document that abnormal snow cover has a temporary but substantial negative impact on firm-level cash flow. They argue that compared to highly destructive natural disaster events such as hurricanes or earthquakes, abnormal snow cover is less likely to affect firm fundamentals including investment opportunities and financing decisions, and a better indicator of transitory cash flow shocks (Brown et al. (2021)). Hence, in this section, we use the abnormal snow cover measure as an exogenous shock to firms' transitory cash flow which increases its short-term fluctuation. We repeat the main analysis of how cash flow shocks of temporary nature affect the use of liquidity covenants in subsequent loan contracts.

Following Brown et al. (2021), we measure abnormal snow cover based on the average daily snow cover during the first calendar quarter (CQ1) of each year (January, February, and March).[14] This is performed using NOAA data on daily snow cover (in inches) reported for each weather station in the United States. To capture the component of winter weather that is unexpected for firms, we carry out the following steps of calculations. First, we compute the average value of snow cover across weather stations for each day and county. Second, using the average daily snow cover for each county, we compute the average of snow cover in CQ1 for each county-year (*Average_CQ*1). Third, we compute the average snow cover over the past 10 years in each county (*Average*_10*yr*) as the normal level of snow expected by firms. We then define abnormal snow cover (*AbnSnow*) as the difference between the average snow cover in CQ1 for each county-year and the average snow cover over the past 10 years (i.e., $Average\_CQ1 - Average\_10yr$). Finally, we match this county-year abnormal snow cover data with the headquarter location information of sampled firms.[15]

[14]We keep firm observations whose fiscal year ends in December for consistency with Brown et al. (2021).

[15]The headquarter location information of U.S. listed firms is first sourced from University of Notre Dame Augmented 10-X Header Data which contains SEC 10-K/Qs filings header information from 1993 to 2021, available at https://sraf.nd.edu/sec-edgar-data/10-x-header-data/.. If headquarter county information is missing, we supplement the data using headquarter location information provided in Compustat. Unlike SEC filings header information, Compustat's headquarter location data is static and does not reflect the historical location changes.

TABLE 13

Impact of Abnormal Snow in Q1 on Annual Cash Flow and Subsequent Loan Covenants

Table 13 reports the impact of abnormal snow (*AbnSnow*) in calendar quarter 1 (CQ1) on change in annual cash flow (columns 1–4) and the number of liquidity covenants used in subsequent loans (columns 5–8). The sample is limited to firms with fiscal year ended in December. Regressions in columns 1–4 are performed at the firm-year level. Regressions in columns 5–8 are performed at the loan level. The control variables for loan characteristics are not tabulated for brevity and include loan characteristics: DealSize, Maturity, Secured, NumOfLenders, DivRestrict, Sweep, CapexRestrict, PP Rating, PP Indicator, and Creditline. These and all other variables are as defined in Appendix B. Industry fixed effects are based on Fama and French 48-industry classification. *t*-stats are reported in parentheses. *, **, and *** indicates 10%, 5%, and 1% significance levels, respectively.

	Annual Change in Cash Flow							
	Transitory		Permanent		Liquidity Covenants of Subsequent Loans			
	1	2	3	4	5	6	7	8
AbnSnow	−0.021**	−0.020**	0.006	0.004	−0.215	−0.114	−0.301**	−0.185*
	(−2.12)	(−2.12)	(1.70)	(1.41)	(−1.38)	(−0.91)	(−2.47)	(−1.72)
Market leverage	0.016**	0.017**	−0.004	−0.004		0.316**		0.436***
	(2.45)	(2.08)	(−1.44)	(−1.30)		(2.74)		(3.79)
Dividend	−0.134***	−0.108***	−0.159***	−0.148***		−0.727		−0.315
	(−3.72)	(−3.30)	(−6.11)	(−5.32)		(−0.74)		(−0.35)
Size	−0.001*	−0.001	−0.002***	−0.002***		−0.085***		−0.076***
	(−1.85)	(−1.68)	(−5.99)	(−5.57)		(−3.89)		(−3.61)
Market-to-book	0.006***	0.006***	0.010***	0.010***		0.049**		0.054**
	(3.19)	(3.10)	(10.66)	(10.28)		(2.40)		(2.28)
CapEX	−0.037*	−0.040	−0.008	−0.000		−0.283		−0.422
	(−1.71)	(−1.62)	(−0.57)	(−0.02)		(−0.97)		(−1.44)
R&D	0.082***	0.079***	0.002	−0.002		−2.312***		−2.006***
	(2.82)	(3.01)	(0.09)	(−0.07)		(−4.02)		(−3.62)
Depreciation	0.069	0.076	0.081***	0.079***		1.226*		1.687**
	(1.17)	(1.36)	(2.86)	(3.00)		(1.91)		(2.63)
Tangible	−0.003	−0.002	−0.002	−0.003		−0.280**		−0.376***
	(−0.52)	(−0.36)	(−0.53)	(−0.77)		(−2.60)		(−3.69)
Advertisement	−0.016	−0.003	−0.052**	−0.051**		−0.524		−0.284
	(−0.45)	(−0.10)	(−2.52)	(−2.50)		(−1.02)		(−0.51)
Loss	−0.012***	−0.010***	−0.006***	−0.006***		−0.087*		−0.128**
	(−3.26)	(−2.84)	(−3.79)	(−3.19)		(−1.85)		(−2.55)
ROA	0.171***	0.165***	0.062***	0.058***		0.551***		0.556**
	(8.10)	(8.07)	(7.11)	(7.33)		(2.87)		(2.47)
Z-score	−0.002***	−0.002***	−0.001***	−0.001***		−0.010		−0.011
	(−3.54)	(−3.01)	(−3.18)	(−2.84)		(−1.28)		(−1.29)
Age	0.000	0.000**	−0.000***	−0.000***		0.037**		0.034**
	(0.99)	(2.81)	(−2.91)	(−3.46)		(2.60)		(2.46)
RetStD	0.481***	0.440***	0.154***	0.170***		0.006***		0.005***
	(5.03)	(4.37)	(3.24)	(3.71)		(6.39)		(6.58)
Const.	−0.027***	−0.026***	0.007*	0.005	1.638***	1.005***	1.643***	1.045***
	(−3.10)	(−2.83)	(1.85)	(1.43)	(97.06)	(3.82)	(109.29)	(3.73)
Control loan characteristics	No	No	No	No	No	Yes	No	Yes
Industry fixed effects	Yes	No	Yes	No	Yes	Yes	No	No
Year fixed effects	Yes	No	Yes	No	Yes	Yes	No	No
Industry-year fixed effects	No	Yes	No	Yes	No	No	Yes	Yes
N	5,645	5,467	5,645	5,467	9,207	9,207	9,097	9.097
Adj. R^2	0.118	0.175	0.256	0.288	0.106	0.335	0.180	0.395

Table 13 presents our findings on the direct impact of abnormal snow on annual cash flow and subsequent loan covenants. Columns 1 and 2 show the results from regressing change in transitory cash flow on abnormal snow and firm characteristics in the contemporary year. Columns 3 and 4 show the results for change in permanent cash flow. Columns 5 and 7 show the results from regressing the number of liquidity covenants (*LiqCov*) on abnormal snow, and columns 6 and 8 show the

same regression with firm and loan characteristics controls. Following existing literature (e.g., Brown et al. (2021)), we alternately employ specifications with industry-year fixed effects, in addition to separate industry and year fixed effects.

First, we find that an increase in abnormal winter snow cover in a given county is associated with a decrease in the transitory annual cash flow of firms headquartered in that county, as evidenced by the negative and significant coefficients in columns 1 and 2. We do not find a significant impact of abnormal snow cover on permanent annual cash flow, as evidenced by positive but insignificant coefficients in columns 3 and 4. These results support the proposition that abnormally severe weather has a temporary but substantial negative impact on firm-level cash flow (Brown et al. (2021)). Furthermore, columns 5 to 8 show that the direct impact of abnormal snow as a measure of temporary shock to cash flow is fewer liquidity covenants used in loan contracts. The coefficients on abnormal snow are negative across all the specifications, although they are only statistically significant in columns 7 and 8 with industry-year fixed effects. Overall, the results are consistent with our primary findings that transitory shocks to cash flow are associate with a decrease in the use of liquidity covenants.

B. Alternative Cash Flow Measures

In our main analyses, we decompose cash flow based on HP filter. As a robustness test, we use an alternative Beveridge and Nelson (1981) model to decompose cash flow. Under this decomposition model, permanent cash flow shock is taken as a random walk with a drift and transitory shock is treated as a stationary process with zero mean. Similar to our previous findings, transitory shocks are negatively associated with liquidity covenants and liquidity ratio, and positively associated with solvency covenants. Conversely, permanent shocks are positively associated with liquidity covenants and negatively associated with solvency covenants. Overall, our inferences remain unchanged and hence are untabulated here.

We use alternative time windows to measure cash flow volatility. We change the estimation window from the past 5 years to a shorter 3-year or longer 10-year period. We also apply alternative definitions to measure firms' cash flow, including using operating cash flow reported in the cash flow statement and the cash flow definition used in Chang et al. (2014). Our findings and inferences remain qualitatively the same with slight changes in statistical significance.

C. Alternative Model Estimations

As another robustness test, we perform our analyses at the loan package level rather than the facility level. We summarize facility-level control variables and take the mean value for each loan package. Untabulated results confirm our main findings that the use of liquidity-based covenants is associated with lower temporary cash flow volatility but higher permanent cash flow volatility. The opposite results hold for solvency-based covenants in debt contracts. For regressions using the number of debt covenants as the dependent variable, there may be a concern about censored data at the value of 0 and counted data. Hence, we also apply Tobit and Poisson models as alternative estimation methods for our key analyses which provide the same findings. Our results are also robust to the inclusion of lead

lender's fixed effect and simultaneous regression analysis of the cash flow impact on the use of financial covenants and loan pricing as reflected in the interest spread (e.g., Dennis, Nandy, and Sharpe (2000)).

VII. Conclusion

We study the differential effects of transitory and permanent cash flow shocks on various debt contract designs, especially the choice and use of covenants. Our empirical results show that debt contracting is generally efficient in a sense that the covenant design allows firms to survive a temporary liquidity crunch but at the same time provides appropriate mechanisms for lenders to closely monitor performance and limit agency risk. Thus, our results highlight that considerations for both transitory and permanent shocks are important in evaluating firms' credit risk and have important practical implications for creditors and borrowing firm managers. Given the significant influence debt contracts and creditors have over borrowers' activities, recognizing the implications of the performance shocks of different nature would facilitate financial flexibility to the borrowers and capital allocation in the economy. Acting on this distinction is particularly important in the current business environment, where rapid market changes of transitory and permanent nature are prevalent.

Appendix A. HP Decomposition

This appendix provides the details of Hodrick and Prescott (1997) decomposition. Assume that a firm's cash flow CF at time t is given by

$$CF_t = s_t + g_t + \epsilon_t \tag{2}$$

where s_t is the permanent cash flow shock, g_t is the transitory cash flow shock, and ϵ_t is the white noise, and $t = 1, \ldots, T$. The HP filter computes the permanent cash flow shock s by minimizing the variance of cash flow CF around its permanent component s, subject to a penalty that constrains the second difference of the permanent cash flow shocks. That is, the HP filter chooses s to minimize:

$$\sum_{t=1}^{T} (CF_t - s_t)^2 + \lambda \sum_{t=3}^{T} [(s_t - s_{t-1}) - (s_{t-1} - s_{t-2})]^2 \tag{3}$$

where the penalty parameter λ controls the smoothness of the cash flow series. The larger the λ, the smoother the series is. As $\lambda = 0$, the permanent cash flow shock s would just be the cash flow series CF itself; As $\lambda = \infty$, the permanent cash flow shock s approaches a linear trend (that is, a series whose second difference is exactly 0). Following Ravn and Uhlig (2002) and Byun et al. (2019a), we use the penalty parameter $\lambda = 6.25$ since our cash flow series is annual. Then we obtain the estimated permanent component $\hat{s}_t$, the transitory component $\hat{g}_t$ is given by subtracting the $\hat{s}_t$ from total cash flow (i.e., $\hat{g}_t = CF_t - \hat{s}_t$).

Besides HP decomposition, there are two other standard decomposition methods used in the literature, namely Beveridge and Nelson (1981) filter and Baxter and King (1999) filter. We use HP filter because Gryglewicz et al. (2022) and Byun et al. (2019a)

showed that HP filter provides more desirable decomposition and produces orthogonal transitory and permanent components. Because we intend to examine how the use of debt covenants changes when either transitory or permanent cash flow is volatile, HP filter allows us to focus on the variations of individual component without worrying about their comovement.

Gryglewicz et al. (2022) developed a structural estimation approach to obtain cash flow estimates. This approach categorizes firms into groups and can only estimate industry level parameters that govern the evolution of cash flow shocks. We do not use their method but instead adopt a reduced-form approach as we require decomposed cash flow components for each firm-year observation for our loan-level analysis.

Appendix B. Variable Definitions

Cash Flow	
CF	Operating income before depreciation, scaled by total assets
Transitory CF	Transitory component of cash low, scaled by total assets
Permanent CF	Permanent component of cash low, scaled by total assets
CF Vol	Volatility of cash flow over the past 5 years
Transitory Vol	Volatility of transitory component of cash flow over the past 5 years
Permanent Vol	Volatility of permanent component of cash flow over the past 5 years
Covenants	
LiqCov	Number of liquidity covenants which include debt-to-EBITDA, senior debt-to-EBITDA, cash interest coverage, debt service coverage, EBITDA, fixed service coverage, and interest coverage
LiqCovInd	An indicator variable equal to 1 if *LiqCov* > 0, and 0 otherwise
LiqCovRatio	Number of liquidity covenants (*LiqCov*) divided by the total number of financial covenants
LiqCovSlack	Slack of the interest coverage ratio is calculated as the difference between the firm's actual ratio value when the loan was initiated, and the minimum covenant threshold recorded in DealScan; slack of the debt/EBITDA ratio is calculated as the difference between the maximum covenant threshold recorded in DealScan and the firm's actual ratio value when the loan was initiated
SolCov	Number of solvency covenants which include debt-to-equity, debt-to-tangible networth, leverage ratio, loan-to-value, net debt-to-assets, senior leverage, total debt-to-tangible networth, equity-to-asset ratio, networth-to-total asset, networth, tangible networth
Firm Characteristics	
Market leverage	The sum of long-term debt and short-term debt, scaled by the sum of long-term debt, short-term debt, and closing price times common shares outstanding
Dividend	Common dividends scaled by closing price times common shares outstanding
Size	Logarithm of total assets
Market-to-book	The sum of long-term debt, short-term debt, preference stock, and closing price times common shares outstanding, scaled by total assets
CapEX	Capital expenditure scaled by total assets
R&D	Research and development expense scaled by total assets
Depreciation	Depreciation and amortization expense scaled by total assets
Tangible	Net property, plant, and equipment scaled by total assets
Advertisement	Advertising expense, scaled by total assets
Loss	A dummy variable equal to 1 if net income is negative, and 0 otherwise
ROA	Income before extraordinary items scaled by total assets
Z-score	Altman's credit risk score computed as 1.2× (CurrentAssets - Current Liabilities) Total Assets +1.4 × Retained Earnings/Total Assets +3.3× Pretax Income/Total Assets +0.6 × Market Capitalization/Total Liabilities +0.999 × Revenue/Total Assets
Age	Logarithm of the number of years the firm has been covered by CRSP
RetStD	Logarithm of the standard deviation of daily returns over the fiscal year
Loan Characteristics	
DealSize	Logarithm of facility amount plus one
Maturity	Maturity of the loan (in months)
Secured	A dummy variable equal to1 if the loan is secured, and 0 otherwise
NumOfLenders	Number of lenders for the loan
DivRestrict	A dummy variable equal to 1 if dividend restriction covenant exist in the loan contract, and 0 otherwise
Sweep	A dummy variable equal to 1 if sweep covenants exist in the loan contract, and 0 otherwise
CapexRestrict	A dummy variable equal to 1 if capital expenditure restriction covenants exist in the loan contract, and 0 otherwise
PP_Rating	A dummy variable equal to 1 if performance pricing is based on credit ratings, and 0 otherwise
PP_Indictor	A dummy variable equal to 1 if performance pricing exists in the loan contract, and 0 otherwise
Creditline	A dummy variable equal to 1 if the loan type is line of credit or revolving loan, and 0 otherwise

Declaration of interest

None declared.

References

Acharya, V., H. Almeida, F. Ippolito, and A. Perez. "Credit Lines as Monitored Liquidity Insurance: Theory and Evidence." *Journal of Financial Economics*, 112 (2014), 287–319.

Acharya, V. V., H. Almeida, F. Ippolito, and A. Perez-Orive. "Credit Lines and the Liquidity Insurance Channel." *Journal of Money, Credit and Banking*, 53 (2021), 901–938.

Acharya, V. V., and S. Steffen. "The Risk of Being a Fallen Angel and the Corporate Dash for Cash in the Midst of COVID." *Review of Corporate Finance Studies*, 9 (2020), 430–471.

Altman, E. I., and H. A. Rijken. "A Point-in-Time Perspective on Through-the-Cycle Ratings." *Financial Analysts Journal*, 62 (2006), 54–70.

Asquith, P., A. Beatty, and J. Weber. "Performance Pricing in Bank Debt Contracts." *Journal of Accounting and Economics*, 40 (2005), 101–128.

Badertscher, B. A., S. P. Katz, and S. O. Rego. "The Separation of Ownership and Control and Corporate Tax Avoidance." *Journal of Accounting and Economics*, 56 (2013), 228–250.

Baker, E. D., T. J. Boulton, M. V. Braga-Alves, and M. R. Morey. "ESG Government Risk and International IPO Underpricing." *Journal of Corporate Finance*, 67 (2021), 101,913.

Baker, M., and J. Wurgler. "Investor Sentiment and the Cross-Section of Stock Returns." *Journal of Finance*, 61 (2006), 1645–1680.

Baker, M., and J. Wurgler. "Investor Sentiment in the Stock Market." *Journal of Economic Perspectives*, 21 (2007), 129–151.

Ball, R., R. M. Bushman, and F. P. Vasvari. "The Debt-Contracting Value of Accounting Information and Loan Syndicate Structure." *Journal of Accounting Research*, 46 (2008), 247–287.

Baxter, M., and R. G. King. "Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series." *Review of Economics and Statistics*, 81 (1999), 575–593.

Beneish, M. D., and E. Press. "Costs of Technical Violation of Accounting-Based Debt Covenants." *Accounting Review*, 68 (1993), 233–257.

Beveridge, S., and C. R. Nelson. "A New Approach to Decomposition of Economic Time Series into Permanent and Transitory Components with Particular Attention to Measurement of the 'Business Cycle'." *Journal of Monetary Economics*, 7 (1981), 151–174.

Black, F., and M. Scholes. "The Valuation of Option Contracts and a Test of Market Efficiency." *Journal of Finance*, 27 (1972), 399–417.

Bloesch, J., and F. Gourio. "The Effect of Winter Weather on US Economic Activity." *Economic Perspectives*, 39 (2015), 1–20.

Bolton, P., N. Wang, and J. Yang. "Leverage Dynamics and Financial Flexibility." NBER Working Paper No. 26802 (2020).

Botshekan, M., and A. Lucas. "Long-Term Versus Short-Term Contingencies in Asset Allocation." *Journal of Financial and Quantitative Analysis*, 52 (2017), 2277–2303.

Bradley, M., and M. R. Roberts. "The Structure and Pricing of Corporate Debt Covenants." *Quarterly Journal of Finance*, 5 (2015), 1550,001.

Brogaard, J., T. H. Nguyen, T. J. Putnins, and E. Wu. "What Moves Stock Prices? The Roles of News, Noise, and Information." *Review of Financial Studies*, 35 (2022), 4341–4386.

Brown, J. R., M. T. Gustafson, and I. T. Ivanov. "Weathering Cash Flow Shocks." *Journal of Finance*, 76 (2021), 1731–1772.

Busenbark, J. R., D. Gamache, E. H. Yoon, S. T. Certo, and M. C. Withers. "How Much of a Problem is Omitted Variable Bias Really? Examining Strategy Research with the ITCV." *Academy of Management Proceedings*, 2019 (2019), 15,526.

Byun, S. K., V. Polkovnichenko, and M. J. Rebello. "Composition of Cash Flow Shocks, Firm Investment, and Cash Holdings." Working Paper, available at https://ssrn.com/abstract=2852545 (2019a).

Byun, S. K., V. Polkovnichenko, and M. J. Rebello. "The Long and Short of Cash Flow Shocks and Debt Financing." Working Paper, available at https://ssrn.com/abstract=3222960 (2019b).

Campello, M., E. Giambona, J. R. Graham, and C. R. Harvey. "Liquidity Management and Corporate Investment During a Financial Crisis." *Review of Financial Studies*, 24 (2011), 1944–1979.

Carey, M., and M. Hrycay. "Parameterizing Credit Risk Models with Rating Data." *Journal of Banking & Finance*, 25 (2001), 197–270.

Carey, M., M. Post, and S. A. Sharpe. "Does Corporate Lending by Banks and Finance Companies Differ? Evidence on Specialization in Private Debt Contracting." *Journal of Finance*, 53 (1998), 845–878.
Chang, X., Y. Chen, and R. W. Masulis. "Bank Lines of Credit as a Source of Long-Term Finance." *Journal of Financial and Quantitative Analysis*, 58 (2023), 1701–1733.
Chang, X., S. Dasgupta, G. Wong, and J. Yao. "Cash-Flow Sensitivities and the Allocation of Internal Cash Flow." *Review of Financial Studies*, 27 (2014), 3628–3657.
Chava, S., P. Kumar, and A. Warga. "Managerial Agency and Bond Covenants." *Review of Financial Studies*, 23 (2010), 1120–1148.
Chava, S., and M. R. Roberts. "How Does Financing Impact Investment? The Role of Debt Covenants." *Journal of Finance*, 63 (2008), 2085–2121.
Chava, S., R. Wang, and H. Zou. "Covenants, Creditors' Simultaneous Equity Holdings, and Firm Investment Policies." *Journal of Financial and Quantitative Analysis*, 54 (2019), 481–512.
Chen, K. C., and K. J. Wei. "Creditors' Decisions to Waive Violations of Accounting-Based Debt Covenants." *Accounting Review*, 68 (1993), 218–232.
Christensen, H. B., D. Macciocchi, A. Morris, and V. V. Nikolaev. "Financial Shocks to Lenders and the Composition of Financial Covenants." *Journal of Accounting and Economics*, 73 (2022), 101, 426.
Christensen, H. B., and V. V. Nikolaev. "Capital Versus Performance Covenants in Debt Contracts." *Journal of Accounting Research*, 50 (2012), 75–116.
De Bondt, W. F., and R. Thaler. "Does the Stock Market Overreact?" *Journal of Finance*, 40 (1985), 793–805.
Décamps, J.-P., S. Gryglewicz, E. Morellec, and S. Villeneuve. "Corporate Policies with Permanent and Transitory Shocks." *Review of Financial Studies*, 30 (2017), 162–210.
DeMarzo, P. M., M. J. Fishman, Z. He, and N. Wang. "Dynamic Agency and the q Theory of Investment." *Journal of Finance*, 67 (2012), 2295–2340.
Demerjian, P., J. Donovan, and M. F. Lewis-Western. "Income Smoothing and the Usefulness of Earnings for Monitoring in Debt Contracting." *Contemporary Accounting Research*, 37 (2020), 857–884.
Demerjian, P. R. "Accounting Standards and Debt Covenants: Has the "Balance Sheet Approach" Led to a Decline in the Use of Balance Sheet Covenants?" *Journal of Accounting and Economics*, 52 (2011), 178–202.
Demerjian, P. R. "Uncertainty and Debt Covenants." *Review of Accounting Studies*, 22 (2017), 1156–1197.
Demerjian, P. R., and E. L. Owens. "Measuring the Probability of Financial Covenant Violation in Private Debt Contracts." *Journal of Accounting and Economics*, 61 (2016), 433–447.
Denis, D. J., and V. Sibilkov. "Financial Constraints, Investment, and the Value of Cash Holdings." *Review of Financial Studies*, 23 (2010), 247–269.
Denis, D. J., and J. Wang. "Debt Covenant Renegotiations and Creditor Control Rights." *Journal of Financial Economics*, 113 (2014), 348–367.
Dennis, S., D. Nandy, and L. G. Sharpe. "The Determinants of Contract Terms in Bank Revolving Credit Agreements." *Journal of Financial and Quantitative Analysis*, 35 (2000), 87–110.
Dey, A., V. Nikolaev, and X. Wang. "Disproportional Control Rights and the Governance Role of Debt." *Management Science*, 62 (2016), 2581–2614.
Dichev, I. D., and D. J. Skinner. "Large-Sample Evidence on the Debt Covenant Hypothesis." *Journal of Accounting Research*, 40 (2002), 1091–1123.
Dou, Y. "The Debt-Contracting Value of Accounting Numbers and Financial Covenant Renegotiation." *Management Science*, 66 (2020), 1124–1148.
Dyreng, S. D., R. Vashishtha, and J. Weber. "Direct Evidence on the Informational Properties of Earnings in Loan Contracts." *Journal of Accounting Research*, 55 (2017), 371–406.
Fama, E. F., and M. H. Miller. *The Theory of Finance*. Austin, TX: Holt Rinehart & Winston (1972).
Fitch Ratings. "Noble's Liquidity Crunch Temporary." *Fitch Ratings - Hong Kong, NON-RATING ACTION COMMENTARY*, Aug. 15, 2016. Available at https://www.fitchratings.com/research/corporate-finance/noble-liquidity-crunch-temporary-15-08-2016, accessed on Mar. 30, 2022 (2016).
Frank, K. A. "Impact of a Confounding Variable on a Regression Coefficient." *Sociological Methods & Research*, 29 (2000), 147–194.
Franke, R., J. Kukacka, and S. Sacht. "Is the Hamilton Regression Filter Really Superior to Hodrick-Prescott Detrending?" *Macroeconomic Dynamics*, 29 (2025), 1–14.
Frankel, R., C. Seethamraju, and T. Zach. "GAAP Goodwill and Debt Contracting Efficiency: Evidence from Net-Worth Covenants." *Review of Accounting Studies*, 13 (2008), 87–118.
Garleanu, N., and J. Zwiebel. "Design and Renegotiation of Debt Covenants." *Review of Financial Studies*, 22 (2009), 749–781.

Gorbenko, A. S., and I. A. Strebulaev. "Temporary Versus Permanent Shocks: Explaining Corporate Financial Policies." *Review of Financial Studies*, 23 (2010), 2591–2647.
Graham, J. R. "Presidential Address: Corporate Finance and Reality." *Journal of Finance*, 77 (2022), 1975–2049.
Gryglewicz, S., L. Mancini, E. Morellec, E. Schroth, and P. Valta. "Understanding Cash Flow Risk." *Review of Financial Studies*, 35 (2022), 3922–3973.
Gryglewicz, S., S. Mayer, and E. Morellec. "Agency Conflicts and Short- Versus Long-Termism in Corporate Policies." *Journal of Financial Economics*, 136 (2020), 718–742.
Guay, W., and J. Harford. "The Cash-Flow Permanence and Information Content of Dividend Increases Versus Repurchases." *Journal of Financial economics*, 57 (2000), 385–415.
Guney, Y., A. Karpuz, and N. Ozkan. "R&D Investments and Credit Lines." *Journal of Corporate Finance*, 46 (2017), 261–283.
Hackbarth, D., A. Rivera, and T.-Y. Wong. "Optimal Short-Termism." *Management Science*, 68 (2022), 6477–6505.
Hamilton, J. D. "Why You Should Never Use the Hodrick-Prescott Filter." *Review of Economics and Statistics*, 100 (2018), 831–843.
Hodrick, R. J. "An Exploration of Trend-Cycle Decomposition Methodologies in Simulated Data." NBER Working Paper No. 26750 (2020).
Hodrick, R. J., and E. C. Prescott. "Postwar US Business Cycles: An Empirical Investigation." *Journal of Money, Credit, and Banking*, 29 (1997), 1–16.
Houston, J. F., J. Itzkowitz, and A. Naranjo. "Borrowing Beyond Borders: Foreign Assets, Lender Choice, and Loan Pricing in the Syndicated Bank Loan Market." *Journal of Corporate Finance*, 42 (2017), 315–334.
Infuehr, J., and V. Laux. "Managerial Optimism and Debt Covenants." *Journal of Accounting Research*, 60 (2022), 353–371.
Ivashina, V., L. Laeven, and E. Moral-Benito. "Loan Types and the Bank Lending Channel." *Journal of Monetary Economics*, 126 (2022), 171–187.
Jensen, M. C., and W. H. Meckling. "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure." *Journal of Financial Economics*, 3 (1976), 305–360.
Kermani, A., and Y. Ma. "Two Tales of Debt." NBER Working Paper No. 27641 (2020).
Larcker, D. F., and T. O. Rusticus. "On the Use of Instrumental Variables in Accounting Research." *Journal of Accounting and Economics*, 49 (2010), 186–205.
Lee, B.-S., and O. M. Rui. "Time-Series Behavior of Share Repurchases and Dividends." *Journal of Financial and Quantitative Analysis*, 42 (2007), 119–142.
Lian, C., and Y. Ma. "Anatomy of Corporate Borrowing Constraints." *Quarterly Journal of Economics*, 136 (2021), 229–291.
Löffler, G. "An Anatomy of Rating Through the Cycle." *Journal of Banking & Finance*, 28 (2004), 695–720.
Lou, Y., and C. A. Otto. "Debt Heterogeneity and Covenants." *Management Science*, 66 (2020), 70–92.
Manso, G., B. Strulovici, and A. Tchistyi. "Performance-Sensitive Debt." *Review of Financial Studies*, 23 (2010), 1819–1854.
Moody's. "Rating Symbols and Definitions." Moody's Investors Services, June 29, 2021. Available at https://www.moodys.com/researchdocumentcontentpage.aspx?docid=PBC_79004, accessed on Oct. 11, 2021 (2021).
Moura, A. "Why You Should Never Use the Hodrick-Prescott Filter. A Comment on Hamilton (The Review of Economics and Statistics, 2018)." *Journal of Comments and Replications in Economics*, 3 (2024), 1–17.
Murro, P., T. Oliviero, and A. Zazzaro. "Relationship Lending and Employment Decisions in Firms' Bad Times." *Journal of Financial and Quantitative Analysis*, 58 (2023), 2657–2691.
Nini, G., D. C. Smith, and A. Sufi. "Creditor Control Rights and Firm Investment Policy." *Journal of Financial Economics*, 92 (2009), 400–420.
Prilmeier, R. "Why Do Loans Contain Covenants? Evidence from Lending Relationships." *Journal of Financial Economics*, 123 (2017), 558–579.
Ravn, M. O., and H. Uhlig. "On Adjusting the Hodrick-Prescott Filter for the Frequency of Observations." *Review of Economics and Statistics*, 84 (2002), 371–376.
Roberts, M. R. "The Role of Dynamic Renegotiation and Asymmetric Information in Financial Contracting." *Journal of Financial Economics*, 116 (2015), 61–81.
Roberts, M. R., and A. Sufi. "Financial Contracting: A Survey of Empirical Research and Future Directions." *Annu. Rev. Financ. Econ.*, 1 (2009a), 207–226.
Roberts, M. R., and A. Sufi. "Renegotiation of Financial Contracts: Evidence from Private Credit Agreements." *Journal of Financial Economics*, 93 (2009b), 159–184.

Shockley, R. L., and A. V. Thakor. "Bank Loan Commitment Contracts: Data, Theory, and Tests." *Journal of Money, Credit, and Banking*, 29 (1997), 517–534.
Smith Jr, C. W., and J. B. Warner. "On Financial Contracting: An Analysis of Bond Covenants." *Journal of Financial Economics*, 7 (1979), 117–161.
S&P. "S&P Global Ratings Definitions." S&P Global Ratings, Jan. 5, 2021. Available at https://disclosure.spglobal.com/ratings/en/regulatory/article/-/view/sourceId/504352, accessed on Oct. 11, 2021 (2021).
Topp, R., and R. Perl. "Through-the-Cycle Ratings Versus Point-in-Time Ratings and Implications of the Mapping Between Both Rating Types." *Financial Markets, Institutions & Instruments*, 19 (2010), 47–61.
Tukey, J. *Exploratory Data Analysis*, vol. 2, Reading, MA: Wesley (1977).
Xiao, H., X. Chen, H. Fang, and Y. Zhang. "Insider Share Pledging and Firm Value Consequences Under the COVID-19: Evidence from China." *Applied Economics*, 53 (2021), 6522–6534.
Zhang, Z. "Bank Interventions and Trade Credit: Evidence from Debt Covenant Violations." *Journal of Financial and Quantitative Analysis*, 54 (2019), 2179–2207.