The Long and Short of Cash Flow Shocks and Debt Financing*

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Abstract

We investigate how debt financing relates to exposure to long-lived and temporary cash flow shocks. We identify shocks and exposure using filtering methods that we demonstrate are highly effective for corporate finance data using simulations. The long-lived and temporary shocks we identify in our sample have distinct economic roots. Consistent with predictions from theoretical models, firms with more exposure to long-lived shocks maintain higher leverage. Firms also issue more debt following positive long-lived shocks as opposed to temporary ones. The differential response is economically large and long-lived. It is larger for firms that are more exposed to persistent shocks, more profitable, and more financially constrained.

Keywords: corporate leverage, debt issuance, persistent and transitory cash flow shocks
JEL classification: G32

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1 Introduction

The trade-off theory of capital structure predicts that firms exposed to more risk will maintain lower leverage. Traditionally this prediction has been expected to hold for cash flow risk as well. However, the empirical evidence has been mixed (Parsons and Titman, 2009). While some studies have produced evidence consistent with the prediction (Bradley, Jarrell, and Kim, 1984; Friend and Lang, 1988) others have produced conflicting evidence (Titman and Wessels, 1988). Recent papers provide insight into the lack of consensus by pointing out that there are different forms of cash flow risk which have potentially different implications for corporate policies, including leverage (Gorbenko and Strebulaev, 2010; Schwert and Strebulaev, 2014; Decamps, et. al., 2017). For example, Gorbenko and Strebulaev (2010) demonstrate that optimal leverage depends on the mix of risk arising from temporary shocks due to one-off factors and risk arising from long-lived shocks with long-lasting effects, and is lower when risk from temporary shocks is more prominent.

In this paper, we empirically investigate Gorbenko and Strebulaev's (2010) predictions. We find that, consistent with their prediction and the view emerging in the literature, long-lived and temporary shocks play fundamentally different roles in shaping firm policy. Specifically, firms that are more exposed to long-lived shocks maintain higher leverage, and firms issue substantially more debt after experiencing (positive) long-lived shocks than they do after temporary ones.

The main economic mechanism underlying the differential effects of temporary and long-lived (henceforth, persistent) shocks is the "expectations channel": While a persistent cash flow shock affects forward-looking expectations, a temporary one does not. This differential effect on expectation results in different optimal policy response to the two types of shocks. Consider debt financing: On one hand, higher cash flow risk, arising from either temporary or persistent shock, gives rise to an incentive for lower leverage by increasing the probability of distressed states in which the firm may incur dissipative costs (Leland, 1994). On the other hand, higher cash flow risk also raises the probability of good states in which debt financing yields benefits such as tax savings. When good states result from persistent shocks, the firm can expect to enjoy a long-lived stream of benefits along with high future profitability. In contrast, good states arising from temporary shocks constitute a short-lived windfall. Therefore, at the margin, greater exposure to persistent shocks provides a stronger incentive to rely on debt financing. Moreover, following positive persistent shocks, as expectations of future profits rise, firms have a strong incentive to issue debt. Positive temporary shocks yield neither the changes in expectations nor the incentive for debt issuance. In fact, they provide a windfall that can be used to preserve debt capacity until profitability experiences a sustained rise.

We employ two sets of tests to examine these hypotheses about debt policy and temporary and persistent cash flow shocks, which we identify using established filtering methods from macroeconomics literature. First, we analyze cross-sectional variation in leverage ("stock of debt financing") and the mix of shocks to which firms are exposed. Second, we compare debt issuance ("flow of debt financing") following persistent and temporary shock realizations.[1] This test identifies the effect of cash flow shocks on debt financing since, even though firms manage the extent of their exposure to external shocks through operational and financial hedging, the identity (temporary or persistent) and timing of the two types of shocks remain exogenous to firm actions. To further alleviate endogeneity concerns, we focus on measures of shocks to operating income rather than to net cash flow which may potentially be affected by financing choices.

When we analyze cross-sectional variation in leverage, we use the volatility (standard deviation) of firm assets to control for sources of risk other than that of cash flows. Consistent with the trade-off theory, we find firms with greater asset volatility have lower leverage. Once we control for asset volatility, the relationship between cash flow volatility and leverage is positive, although it is not always statistically significant. When we replace cash flow volatility with the volatility of its persistent component or the fraction of cash flow volatility accounted for by its persistent component, consistent with Gorbenko and Strebulaev's (2010) prediction, we find their relationships with leverage are positive. The relationships with these proxies for risk arising from persistent cash flow shocks are also highly statistically and economically significant. Moreover, the relationships are robust to the definition of leverage (market vs. book), fixed effects (year, year and industry, year and firm) and filtering methods. Thus, the mix of cash flow risk is tied to leverage, and this relationship is distinct from the negative relationship predicted by the trade-off theory when cash

[1] Models typically assume that managers observe the state variable, including the type of shock the firm experienced. In reality, managers may not be able to precisely distinguish shocks. If they are completely unable to do so, we will not see any relationship between shock type and debt issuance. If, on the other hand, managers can, even imperfectly, distinguish shocks in real time we will be able able to detect a relationship if they affect debt financing. Thus, the question of shock observability is an empirical one that is answered in the affirmative by our investigation.

flows are driven by a single type of cash flow shock.

To examine responses to shocks, we regress debt issuance over horizons of two and three years (from $t+1$ to $t+2$ and from $t+1$ to $t+3$) on the shocks to current cash flow (using change from $t-1$ to t) as well as the shocks to its persistent and temporary components. We find a significant positive relationship between future debt issuance and shocks to current cash flow, indicating that, on average, firms experiencing positive cash flow shocks tend to issue more debt in the next two to three years. We find an even stronger positive relationship between shocks to the persistent cash flow component and future debt issuance. In contrast, the coefficients on temporary cash flow component are much smaller in absolute value and are negative in most specifications. Thus, firms may use part of temporary windfalls to curtail debt issuance and conserve debt capacity and, conversely, offset temporarily lower cash flow by debt issuance. For the cross-section of firms, this pattern implies that debt issuance is significantly higher for firms that experience a positive persistent cash flow shock compared to firms with a positive temporary shock. This difference is highly statistically and economically significant. For example, following a positive one standard deviation shock to cash flow, depending on the fixed-effect specification, firms issue 4.3% to 6.5% more debt (relative to assets) in the subsequent three years when the shock is persistent rather than temporary. This difference is substantial in comparison with debt issuance over a three year horizon in our sample, which averages 8.8% and has a standard deviation of 20%.

We conduct several tests to better understand debt issuance patterns in the cross-section of firms and isolate the effect of the expectations channel from other factors that link cash flow shocks and debt issuance. These tests show that the differences between the effects of persistent and temporary cash flows vary significantly with firm characteristics we use as a proxy for intensity of financing constraints and with the relative importance of persistent cash flow component. The response of debt issuance to temporary shocks is more pronounced (more negative) for firms with high cash flows which have greater flexibility to manage debt capacity. We find a similar pattern for firms where persistent shocks account for a higher share of cash flow variation and thus they expect sustained runs of high profitability and investment. In contrast, the responses to persistent shocks do not vary significantly with these firm characteristics. The asymmetric changes in the response of debt issuance to shocks are consistent with the expectations channel: While positive temporary shocks are short-term windfalls that firms use to preserve debt capacity, especially when they have the flexibility to do so or anticipate sustained runs of future profitability, positive persistent shocks immediately raise the expected benefit of debt regardless of firm profit or risk exposure. We find evidence consistent with this explanation when we examine the effect of financing constraints: Smaller firms that face tighter financing constraints, while displaying a more pronounced (negative) response to temporary shocks, respond more strongly (positively) to persistent shocks. Thus, smaller financially constrained firms are more reactive to temporary windfalls and shortages and also time their debt issuance more aggressively to arrival of persistent shocks. Thus, in a manner consistent with the evidence in Dasgupta, Noe and Wang (2011), financially constrained firms show a stronger tendency to preserve debt capacity until when they can exploit it more profitably.

Our analysis relies on a methodological contribution: We identify temporary and persistent shocks to cash flows by applying the Hodrick and Prescott (1997) (henceforth, HP) and Baxter and King (1999) (henceforth BK) filters. While the HP and BK filtering procedures are commonly used in business cycles literature, to the best of our knowledge, we are the first to apply them in a corporate finance context and to systematically analyze their performance under the limitations imposed by available data. These filters have attractive properties that allow us to overcome important challenges that arise because (i) the mix of persistent and temporary shocks to firm cash flows is not directly observable; (ii) their stochastic structure is not known; (iii) the mix and shock structure may vary across firms. First, by design, the filters identify trend and cycle components of time-series that arise from long-lived and temporary shocks, respectively. Thus, by applying them we directly identify variation arising from persistent and temporary shocks to cash flows. Second, the filters are intended to handle broad classes of shock processes. Hence, we do not have to assume parametric structures for stochastic processes driving cash flow shocks and yet we can identify economically distinct components of the process which link to specific empirical predictions. Third, the filters are estimated at the firm level, allowing us to use cross-sectional variation in the mix and realizations of cash flow shocks to identify their effect on debt financing. This methodology may be helpful in broader context in empirical corporate finance because it imposes theoretically motivated constraints on the data while taking advantage of firm heterogeneity in empirical tests. It is thus complimentary to full structural estimation methods which require shocks to have homogeneous specification across firms as well as to traditional empirical methods which impose no restrictions on shock processes.

The application of HP and BK filters to long and relatively high frequency macroeconomic time series has been extensively validated. However, little is known about their performance in corporate finance settings with many heterogeneous firms and relatively short, low-frequency data series. Therefore, we perform three sets of analyses to assess their performance. First, we undertake an extensive Monte-Carlo simulation study and verify that the filters accurately identify shocks for a variety of process specifications in relatively short panels typical in corporate finance. Second, we verify that the temporary and persistent cash flow components we identify for our (real world) sample of firms have the expected time series properties. Finally, we show that these two components have distinct economic roots, by estimating their relationships with a broad economic conditions indicator from the Federal Reserve Board. Thus, by using the filters we both identify cash flow shocks with intuitive properties and capture exogenous variation in cash flow shocks, alleviating the ubiquitous endogeneity problem.

Our analysis complements recent models of the impact of cash flow shock persistence as well as the mix of long-lived and temporary shocks on corporate policies, including debt financing.[2] DeAngelo, DeAngelo and Whited (2010) estimate a dynamic capital structure model with (only) persistent shocks. They show that, to maintain flexibility, firms exposed to greater shock volatility choose lower leverage and this effect is stronger when shocks are more persistent. Gorbenko and Strebulaev (2010) demonstrate that models can deliver very different predictions when firms are exposed to both long-lived shocks and temporary shocks. They show that leverage is sensitive to the mix of these shocks, and exposure to long-lived shocks can increase leverage. Our evidence supports Gorbenko and Strebulaev's (2010) predictions.

There is a long history of research on the relation between uncertainty, cash flow risk, and leverage (e.g. Baxter (1967), Bradley, Jarrell, and Kim (1994), Kester (1986), Friend and Lang (1988),

[2] Another dimension of uncertainty that has been examined with respect to leverage includes the mix of systematic vs firm-specific risk (Schwert and Strebulaev, 2014). Other corporate policies are also affected by the persistence of cash flow shocks. Decamps et. al. (2017) construct a model that investigates differential effects of permanent and transitory shocks to cash flows on corporate liquidity, investment, and risk management policies. Byun, Polkovnichenko, and Rebello (2017) study empirically the effect of exposure to temporary and persistent cash flow shocks on corporate investment. Gryglewicz et. al. (2017) solve and estimate a model of corporate investments and cash savings decisions when firms face both permanent and temporary shock, and the shocks may be correlated.

Titman and Wessels (1988), Harris and Raviv (1991), Leland (1994)). However, it has produced mixed evidence on the relationship between cash flow risk and leverage (Parsons and Titman, 2009). For example, Bradley, Jarrell, and Kim (1984) and Friend and Lang (1988) document a negative relation between earnings volatility and leverage ratio. In contrast, Titman and Wessels (1988) find a negative but insignificant relation between earnings volatility and leverage. Relatedly, Minton and Schrand (1999) show that higher cash flow volatility is associated with reduced investment and higher cost of accessing external capital. Our paper is distinct in that, instead of examining the effects of cash flow risk itself, we focus on identifying the differential impact of its persistent and temporary components. In fact, we help reconcile past disagreements by showing that the relationship between cash flow volatility and leverage varies with the mix of persistent and temporary cash flow shocks. We also provide new insights into the response of debt financing to cash flow shocks. Dasgupta, Noe and Wang (2011) show that firms use positive cash flows to preserve debt capacity to exploit in the future. We show this precautionary pattern of behavior tends to be strong after temporary but not all cash flow shocks.

Gryglewicz et. al. (2017), and Chang et. al. (2014) also examine impact of the mix of cash flow shocks on corporate policy and complement our analysis. Unlike us, Gryglewicz et. al. (2017) employ structural estimation of a model with temporary and persistent shocks. They also focus their analysis on investment and cash savings. Chang et. al. (2014) highlight the effects of financing constraints on the contemporaneous allocation of cash flow. To capture these effects independent of changes in expectations of profitability or investment opportunities, they focus on uses (of realizations) of the temporary component of cash flow. In contrast, we highlight effects, including debt issuance in future years, of the expectations channel and show how these effects interact with financing constraints. We also use different cash flow decomposition methods than Chang et al. (2014). Instead of using the Beveridge and Nelson (1981) (henceforth BN) filter that they employ, we use the HP and BK filters, which our Monte Carlo simulation study indicates perform better. Overall, our analysis complements the existing literature and straddles the middle ground between full structural model estimation and standard empirical methods which impose no structural assumptions. The main advantages of our methodological approach is that it imposes additional theoretically motivated discipline on the explanatory variables and empirical predictions while still allowing us to use firm-level variation to test these predictions.

2 Filtering methods in a controlled experiment

We consider three commonly used filters—the HP filter, the BK filter, and the BN filter. They are typically used with long time-series and each uses a different approach to identify shocks. We are in uncharted territory because little is known about their accuracy in a corporate finance setting like ours: An unbalanced panel of firms with a potentially heterogeneous mix of cash flow shock structures and relatively short cash flow series. Hence, we start with a controlled experiment using Monte-Carlo simulations to assess whether the filters can accurately identify shocks in such a setting.

2.1 Filter descriptions

The HP filter is well defined for a generic integrated order two (I(2)) processes. It separates long-run slow-moving changes to a series (trend) from the higher frequency temporary fluctuations (cycle). Specifically, the filter isolates a smooth trend τ_t from a given data series y_t by solving the following minimization problem:

$$\min_{\{\tau_t\}} \sum_{t=1}^{T} \left[(y_t - \tau_t)^2 + \lambda \left((\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1}) \right)^2 \right]. \tag{1}$$

where $y_t - \tau_t$ is the cycle component that represents short lived changes to the time series. The parameter λ determines the smoothness of the trend and is chosen based on data frequency. In business cycle studies with quarterly data it is typical to set $\lambda = 1600$. To decompose our lower frequency annual cash flow data, we follow Ravn and Uhlig's (2002) recommendation and set λ to 6.25, which reflects the adjustment to maintain the same business cycle frequencies filtering range with annual data.

The BK filter belongs to a group of *band-pass* filters that explicitly aim to isolate shocks within a specific range of periodicity. The filter constructs the trend in a time series by choosing weights in a moving average process. In the business cycle literature it is typical to consider periodicities between 8 and 32 quarters (two to eight years) as those that are relevant for identifying long run business cycle trends, i.e. the shocks within these periodicities may drive the trend and shocks with shorter periodicities than the lower number are considered cyclical. In our study, with annual cash flows, we also restrict the filter to extract trend shocks with frequencies of two to eight years.

The BN filter identifies the stochastic trend in a time series assumed to be an integrated order one ($I(1)$) process. The difference of the process and the trend forms a stationary component (cycle). Chang et. al. (2014) use the BN decomposition to isolate long-lived and temporary shocks to cash flows by applying an ARMA(2,2) model. We examine their specification.

2.2 Monte-Carlo simulation design

There is no consensus about the shock structure of firm cash flows. Theoretical models typically impose structural assumptions to facilitate analytical solutions or numerical computations, but it is unclear how well the assumptions describe reality. Continuous time models typically assume cash flows shocks that contain permanent shocks to the asset base, i.e. the log of asset growth rate follows a diffusion process (e.g. Gorbenko and Strebulaev (2010) or Decamps et. al. (2016)). In contrast, discrete time models typically use autocorrelated persistent shocks to growth rates of asset productivity (e.g. Riddick and Whited (2009)). Therefore, out of an abundance of caution, we employ a variety of structural assumptions for cash flow shocks. We simulate continuous time processes sampled at infrequent discrete intervals, discrete time processes with permanent shocks, and discrete time processes with persistent (but not permanent) shocks with varying degrees of autocorrelation. We combine each of these types of processes with temporary shocks to cash flow. In the interest of brevity, we present details of the processes we simulate in Appendix B.

The continuous time processes we simulate feature permanent shock processes like those in models such as Decamps et. al. (2016) and Gorbenko and Strebulaev (2010): Firm assets follow a geometric Brownian motion so that the asset growth rate is stochastic and stationary, i.e., the asset base is subject to permanent shocks. The cash flow process is a product of asset value and a second arithmetic (additive) Brownian motion that represents temporary shocks. The permanent and temporary shocks may be correlated. While asset value always remains positive, cash flows can be negative because of the arithmetic component. Multiplying the arithmetic portion by asset value serves to scale cash flow levels and maintain a stationary relation between cash flow and firm size. We set one year as the unit of time and discretize the time interval to one day (i.e. $\Delta t = \frac{1}{365}$). Using base parameter values from Decamps et. al. (2016), we simulate daily asset and cash flow values and compute cumulative cash flows over the corresponding one year (365 day) intervals. To simulate discrete time processes with permanent shocks, we use the same cash flow processes but evaluate them at discrete 1 year intervals, that is, we set $\Delta t = 1$.

Discrete time models such as Riddick and Whited (2009) typically assume shocks to asset productivity that are persistent but non-permanent, and the (log of) asset productivity follows an AR(1) process. To simulate discrete time processes we multiply such an asset value process by a second temporary shock process, analogous to the permanent shock specifications. Thus, cash flows can be positive or negative and are scaled by the asset value for stationarity. We report results for simulations with annual observations where we set the autocorrelation of the productivity growth rate, θ, to 0.8. We also conduct simulations with $\theta = 0.6$ and obtain similar results, which we omit for brevity. These autocorrelation values include the range of calibrations considered in Riddick and Whited (2009) and are also comparable to the lower range of autocorrelations for persistent components we estimate in our sample.

For each cash flow process we simulate a panel of 300 firms (cash flow shock processes). To ensure that each panel contains a heterogeneous cross section of firms, we proceed as follows: We take permanent and temporary shock volatility values from the calibration in Decamps et. al. (2016) and randomly draw volatility values for each component from two uncorrelated lognormal distributions. Each draw represents a firm and each panel consists of 300 draws. We calibrate the randomization to ensure that log-ratio of randomized parameter to the base value has standard deviation of 50%, approximately in line with the observed cross-sectional variation of the volatilities of decomposed cash flows in our sample of firms. That is, if $\bar{x}$ is the base parameter value, then the parameters for the cross section of firms are generated by drawing $x_i = \bar{x}e^{z_i}$ where $z_i \sim N\left(-\frac{0.5^2}{2}, 0.5^2\right)$ i.i.d. For each firm, we simulate 30 cash flow paths. Each path lasts 10 years, which matches the minimum window length we require for our empirical estimation. By using 30 paths for each firm we can evaluate within-simulation errors from the filter estimation.

2.3 Filter performance in the simulation study

We can assess each filter's accuracy by comparing parameters we assumed to simulate cash flow paths with their estimated values after applying the filters. We focus on cash flow risk, i.e., the volatility of cash flows. Total cash flow volatility is known in the simulations. Hence, without loss of generality, to infer performance we focus on comparing each filter's estimates of the cycle component volatility with its assumed values. To make this comparison, we apply the filter to each path for each firm, compute the cycle component volatility for each path, and then average the volatility estimates across the 30 paths for a firm.

In Table 1, for each simulated panel of firms, we compare these firm-level estimators with their assumed values using several metrics, including Pearson and Spearman correlation coefficients, and the R^2 from a linear regression. As an additional indicator of filter performance across heterogeneous parameters, we compute the difference between the estimator of temporary volatility and its assumed value. We report this average error for each quartile of the distribution of assumed values.

The top two sets of rows in Table 1 contain estimates for the two specifications assuming permanent shocks (continuous discretely-sampled and discrete processes). The HP and BK filters provide reasonable estimates for both types of processes: The correlation between estimated and assumed values of cycle volatility is between 0.903 and 0.946 for the HP filter, and 0.862 and 0.957 for the BK filter. Across quartiles of assumed cycle volatility, the HP filter's average errors are typically smaller although the BK filter delivers lower errors for firms with higher than average volatility. The BN filter places a distant third. Its goodness of fit measures are much lower (correlations of 0.790-0.833) and its estimation errors, especially in the first three quartiles of assumed cycle volatility, are much more substantial.

The bottom rows of Table 1 show how the filters perform when we simulate persistent AR(1) asset productivity shocks at discrete time intervals. All three filters perform less efficiently than in the simulations with permanent shocks, indicating that they have a harder time separating truly temporary (i.i.d.) shocks from shocks that last several periods but are not permanent. However, the HP and BK filters continue to perform well and outperform the BN filter. The Pearson and Spearman correlations of HP filter estimates are 0.871 and 0.875 when the persistent component autocorrelation is $\theta = 0.8$. The BK filter correlations are similar, with the estimates of 0.819 and 0.876. In comparison, the correlations for the BN decomposition drop to 0.700 and 0.671 and the estimation errors are typically substantially higher than with the HP and BK filters.

As an additional check, we examine whether first order autocorrelations of the filtered trend and cycle align with economic intuition.We expect the trend component to be a relatively persistent process and the cycle to be less persistent because it is stationary by design and reverts to the trend.[3] The last two columns of Table 1 display the estimated first-order autocorrelations. The HP and BK filters produce relatively persistent trend components with autocorrelations in the ranges of 0.864-0.895 and 0.658-0.762, respectively. Their cyclical components are, on average, negatively autocorrelated indicating that temporary deviations tend to quickly revert to the trend. Thus, the trend and cycle components from both HP and BK filters are consistent with theoretical interpretations associated with them. In contrast, the BN filtered trend is not very persistent. In fact, its persistence is quite close to the cycle persistence: The trend autocorrelations range from 0.157 to 0.210 and the cyclical ones from 0.069 to 0.086.

The previous results show how the filters perform *across* simulated parameter pairs of persistent and temporary volatility. We also examine their performance *within* the different simulated paths of the same underlying cash flow process for each firm. Table 2 presents the average of standard errors of the temporary volatility estimators across 30 simulated paths per firm ($\sqrt{Var(\hat{\sigma}_i)}/\sqrt{30}$ where variance is computed across paths) computed within each quartile of assumed cyclical volatility. The HP filter typically has the lowest standard errors. With permanent shocks (top two sets of rows) its average standard error ranges between 0.4 to 0.8% compared with the assumed volatility range of 5.7% to 26.7%. The BK filter has slightly higher standard errors, but they largely remain at or below 1%, except in the higher temporary volatility quartiles where they are about 1.5%. In contrast, the BN standard error are the largest and range from 1.5 to 1.7% in all volatility quartiles. When the true underlying process contains persistent shocks (bottom set of rows), the errors are larger for all filters. However, the HP filter errors remain at around 1% in all quartiles, indicating that it is the most stable estimator of the three.

In summary, the HP and BK filters provide estimates of shock volatility that are highly correlated with their true assumed values. This correlation remains high for different structural specifications of cash flows shocks. These filters also provide accurate estimates across different realized paths of the same process specification, alleviating concerns about measurement errors in short histories of firm cash flows. Thus, we can expect relatively short cash flow series filtered using the HP and

[3] We do not expect the trend to be exactly a permanent unit root process because we estimate the components from cash flow levels, as we do in our sample, which are the product of temporary shocks to cash flow and permanent shocks to asset value. This results in a persistent process with autocorrelation dependent on the parameters of the two components and their correlation.

BK filters to represent the composition of cash flow shocks with reasonable accuracy. Moreover, the trend and cycle components from both HP and BK filters are consistent with their theoretical structures. Since the HP filter performs marginally better in our simulations, for brevity we present our empirical results using HP filter in the main text and present replications of the main results using the BK filter in the Internet Appendix A. Given the relatively poor performance of the BN filter in our simulations we omit it from further analysis.

3 Sample and variables construction

Our sample comprises of U.S. public firms between 1960 and 2014 from Compustat. We exclude financial firms and utilities, firms with negative book value of total assets, sales, or equity, firms with less than \$10 million in total book assets in 1982 dollars, and firms with zero leverage. To ensure that we have sufficiently long time series to accurately filter firm cash flows, we discard firms with fewer than 10 cash flow observations and firms with two or more consecutive missing cash flows. For single isolated missing cash flows, because the filters require consecutive observations without gaps, we fill in the gap by averaging the nearest neighboring cash flows. We have verified that our baseline estimates are robust to dropping all the time series that do not meet our requirements if we do not fill in these missing (7.8%) firm-year observations.

Before examining financing choices, we verify that the filters work well when we apply them to our sample firms' cash flows. While we can no longer compare parameter estimates from filtered cash flows against benchmarks like we do in the Monte Carlo study, we verify that the estimates have reasonable properties that align with economic intuition. We start by identifying cross-sectional variation in exposure to shocks. Then we show that the time series properties of the decomposed cash flows are intuitive. We also show that the temporary and persistent cash flow components have distinct economic roots and thus distinguishing between them is economically meaningful. For brevity we will only describe results using the HP filter. The BK filter yields decomposed cash flows with qualitatively similar properties.

3.1 Decomposed cash flows

We measure operating cash flow using operating income as in Kim, Mauer, and Sherman (1998) and Denis and Sibilkov (2010). We use operating income rather than cash flow measure based on net income (Almeida, Campello, and Weisbach, 2004; and Riddick and Whited, 2009) because the latter, through its dependence on firms' financing choices, may introduce endogeneity in leverage and debt issuance regressions.

To identify cash flow shocks more accurately, we apply the filters to the complete time series of operating cash flows for each firm (in dollar value, unscaled). While managers likely use more than just past cash flow realizations to infer shocks, by using the full sample in the filter we may have better information for identifying cash flow trend and cycle than is available in real time. However, so long as managers' inferences are correlated with our full time series estimates, we should be able to detect the relationship between the state variable and firm policy. In other words, by using a possibly more precise value of the state variable we cannot induce the appearance of its effects on corporate policies if none is present in the data. To verify that our estimation window choice does not introduce "look-ahead bias", in Section 7 we replicate our results using a variety of filter windows that use only cash flow information that is available to managers in real time. Because the estimation window for each firm changes over time in this series of robustness tests, they also demonstrate that our results are robust to changes in the structure of underlying shocks over time.

We scale filtered temporary and persistent cash flow components by total assets to obtain the variables *Temporary CF* and *Persistent CF*, respectively. By construction they add up to *Op. CF*, which is the operating cash flow divided by total assets. These measures of cash flow and its components reflect the cumulation of current and past shocks. To isolate current cash flow shocks, we compute annual changes in cash flow and its temporary and persistent components, which we refer to as *CF Shock*, *Temp. CF Shock* and *Pers. CF Shock*, respectively.

Temporary CF Volatility, *Persistent CF Volatility*, and *CF Volatility* are standard deviation estimates for *Temporary CF*, *Persistent CF*, and *Op. CF*, respectively. Following existing studies that examine the effects of cash flow volatilities (e.g., Opler, Pinkowitz, Stulz, and Williamson (1999) and Bates, Kahle, and Stulz (2009)), we estimate the standard deviations using ten year rolling-windows. We also compute *Persistent to Total CF Variance*, which is the ratio of the variance of *Persistent CF* to the variance of *Op. CF*. This variable captures the relative importance of persistent shocks. Our final HP filter-based sample of decomposed cash flows contains 62,226 firm-year observations with 5,458 unique firms from 1970 to 2014. When we consider cash flow volatilities, the window size requirements cut the sample size to 52,477 firm-year observations.[4]

Table 3 reports summary statistics for firm cash flows. *Op. CF* has a mean of 0.135, indicating that operating cash flow averages 13.5% of total assets for firms in our sample. The persistent component of cash flow accounts for a slightly larger ratio to assets as *Persistent CF* has a mean of 0.138. Consequently, average *Temporary CF* is negative but close to zero. Consistent with large cross-sectional variation in cash flow, *Op. CF* has a standard deviation of 0.096. The standard deviation of *Persistent CF* is smaller at 0.079. *Temporary CF* displays the smallest cross-sectional variation, with a standard deviation of 0.040. Average changes in cash flows are close to zero, with the means of *CF Shock*, *Temp. CF Shock*, and *Pers. CF Shock* equal to -0.002, 0.000, and -0.002, respectively. These estimates are consistent with cash flows consisting of a highly persistent component and a temporary one that is centered around zero. Consistent with large cross-sectional variation in cash flows, the standard deviations of *CF Shock*, *Temp. CF Shock*, and *Pers. CF Shock* equal 0.059, 0.055, and 0.030, respectively.

Average *CF Volatility* is 0.054, indicating that firms face a high level of cash flow risk on average. The large standard deviation of 0.051 for *CF Volatility* indicates that this risk varies markedly across firms. The volatilities of the persistent and temporary components display similar patterns. Their average volatilities and cross-sectional variation are comparable to one another: The means of *Temporary CF Volatility* and *Persistent CF Volatility* are 0.039 and 0.041, respectively, with standard deviations of 0.039 and 0.044.

3.1.1 Inter- and intra-industry variation, and time-series properties

Table 4 contains descriptive statistics for firm cash flows in industries with the ten highest and lowest levels of *Persistent to Total CF Variance*. These statistics provide insight into the validity and benefit of decomposing individual firm cash flows with the filters. *Persistent to Total CF Variance* varies considerably both across industries and within them. The correlations of (median values of) industry characteristics such as growth rates for cash flows, sales and assets with *Persistent to Total CF Variance* are weak and range between -0.2 and -0.3 (unreported). Hence, industry characteristics appear to be unrelated to the composition of shock exposure. The low correlation

[4]Because the BK filter utilizes moving average estimates of preceding and subsequent observations, the BK filter based-sample contains 52,182 firm-year observations with volatility estimates.

suggests that our inferences based on cash flow shock estimates using the filters will be very different from inferences that can be drawn from the Gryglewicz *et. al.* (2017) approach of grouping firms by industry characteristics and assuming that cash flow shock structures are homogenous within each group. Obviously, filtering firm cash flows also better facilitates cross-sectional inferences about the effects of shock composition.

Table 4 also presents statistics for *Persistent ACorrelation* and *Temporary ACorrelation*, the first-order autocorrelations of *Persistent CF* and *Temporary CF*, respectively. *Persistent ACorrelation* is uniformly and markedly larger than *Temporary ACorrelation*. The median value of *Persistent ACorrelation* averages 0.843, and typically ranges between 0.800 and 0.900. In comparison, the median for *Temporary ACorrelation* averages 0.106 and typically falls between -0.010 and 0.190. Thus, in line with our simulation results and with economic intuition, for our sample firms, the filters generate temporary shock proxies that are considerably less persistent than cash flows.

3.1.2 Persistent and temporary shocks have distinct sources

Persistent and temporary shocks are typically assumed to have economically distinct origins. Hence, as an additional validity check on our cash flow decompositions, we examine whether the temporary and persistent cash flow shocks we have identified in our sample indeed have distinct roots. We focus on their relationship with aggregate economic activity since firm cash flows are, at least to some degree, driven by aggregate economic activity. Theoretical models are silent on this relationship because they employ a partial equilibrium approach.

To investigate links between the shocks and aggregate economic activity, each year, we construct annual changes in asset-weighted averages of *Op. CF*, *Persistent CF* and *Temporary CF*. To capture the effect of cross-sectional differences in shock composition, we construct these series of annual average changes separately for firms in the top and bottom terciles of *Persistent to Total CF Variance*. We then regress each of these series of changes on annual changes in a data series on aggregate economic activity: The index of Industrial Production (*IP Index*) compiled by the Federal Reserve Board.[5] We also repeat these regression after decomposing the *IP Index* into its temporary

[5]The index is from St. Louis FRB's FRED database: `https://fred.stlouisfed.org/series/INDPRO/`. For information about the series methodology as well as current releases refer to: `https://www.federalreserve.gov/releases/g17/Current/default.htm`. HP filter is applied to annual index levels with the same smoothing parameter as used in cash flows. We use changes for stationarity of regressors.

and persistent components using the HP filter. We report the estimates in Table 5.

Panel A of Table 5 shows results for firms in the top tercile of *Persistent to Total CF Variance*. The 7% R^2 for the regression of changes in average *Op. CF* on changes in *IP Index* suggests they are only weakly related. Changes in the average temporary component are much more strongly tied to changes in *IP Index* (R^2 of 30%), while changes in the average trend component appear uncorrelated with *IP Index*. The regressions where we use the trend and cycle components of *IP Index* also suggest strong ties between economic cycles and the temporary component. The R^2 in the last column, which presents the estimate from regressing changes in the average temporary component on changes in the *IP Index* cycle components, is 35%. In contrast, changes in the trend component of cash flow and the trend component of the *IP Index* appear to be uncorrelated.

Cash flows of firms with lower exposure to persistent shocks in Panel B display a similar but stronger pattern of links with the *IP Index*. All of the R^2s where the dependent variable is either changes in total cash flow or its temporary component are much higher than in Panel A, reaching just over 60% in the last column. Thus, cash flows of firms with greater temporary shock exposure are more strongly correlated with aggregate economic cycles and this link operates through the temporary component of cash flows. Changes in the trend components of cash flows of both groups of firms are largely uncorrelated with aggregate economic activity, which is consistent with the notion that changes in the long-run prospects of individual firms or industries need not occur synchronously with aggregate economic growth.

The estimates in Table 5 demonstrate that there is substantial cross-sectional variation in exposure to different sources of cash flow shocks, and variation in *Persistent to Total CF Variance* captures economically meaningful differences in the mix of shock exposure. The results also show that the shocks underlying the temporary and persistent cash flow components have different economic roots. Temporary cash flow is more closely associated with economy-wide temporary fluctuations which is consistent with some temporary economic shocks affecting the fortunes of all firms simultaneously. Persistent shocks to firm cash flows, on the other hand, need not be correlated with economy-wide growth. They can arise from firm- or industry-specific developments in technology, successes or failure in research and development, changes in consumer tastes and other factors unrelated to aggregate economic activity.[6]

Overall the filters appear to work well. They produce cash flow components with reasonable and intuitive time-series properties. The shocks driving the temporary component appear to be tied to fluctuations in aggregate economic activity and economically distinct from shocks driving the persistent component. Moreover, our measure of the mix of cash flow risk captures meaningful variation across firms. Combined with the simulation evidence in Section 2, these results show that cash flow components identified using the filters can prove useful in our investigation of debt financing as well as in other corporate finance applications.

3.2 Dependent and Control Variables

We capture reliance on debt financing using two measures of firm leverage. *Book Leverage* is the book value of short-term debt plus long-term debt, divided by total book assets. *Market Leverage* is the book value of short-term debt plus long-term debt, divided by total book value net of book value of common equity, plus the market value of equity. To capture net debt issuance, we construct *Net Debt Issuance(t+1,t+2)*, defined as long-term debt issuance in year t+1 and t+2, minus debt retirement in year t+1 and t+2, divided by total assets in year t. Similarly, we construct *Net Debt Issuance(t+1,t+3)* to measure cumulative one to three year-ahead net debt issuance. We present details of variable construction in Table A.1 in Appendix A.

We employ several variables to control for influences on debt financing other than cash flow realizations and volatilities. For investment opportunities, we use the proxy *MB*, the total book assets minus book value of equity plus market value of equity, divided by the total book assets.[7] For firm size we use *Firm Size*, the natural log of the total book value of assets. For other financing options we use *AP*, the total accounts payables, divided by total book assets. For tangible assets, we use the ratio *PP&E*, gross property, plant, and equipment divided by total book assets. For firm investment we use *CAPX*, capital expenditure scaled by total assets. For cash holdings we use *Cash*, the sum of cash and cash equivalents scaled by the total book value of assets. For asset

[6] In the Internet Appendix A we present additional robustness evidence by splitting firms into manufacturing and non-manufacturing groups and performing the same analysis as we present here. The key results for both manufacturing and non-manufacturing sectors are consistent with our discussion here for the entire sample. Expectedly, the R^2's are lower for the non-manufacturing sector since *IP Index* reflects aggregate industrial production.

[7] Tobin's q is not a sufficient statistics for investment opportunities in the presence of financing constraints. Temporary and persistent cash flow components, our main explanatory variables, help further identify the effect of time-varying expected investment opportunities.

volatility (Gorbenko and Strebulaev, 2010), we use *Asset Volatility*, which we define as the volatility of residual Tobin's q net of the variations in the market risk premium to capture variation in asset values unrelated to the price of risk. We estimate the volatility based on ten year rolling windows, which is consistent with the estimation windows for our cash flow volatility measures. Residual Tobin's q is the residual from the regression of *MB* on the market excess return over the treasury bill which we use as a proxy for risk-premium.

Table 6 reports summary statistics for our measures of leverage and debt issuance, as well as our control variables. The means of *Book Leverage* and *Market Leverage* are 0.272 and 0.247, respectively. *Book Leverage* and *Market Leverage* have standard deviations of 0.164 and 0.202, respectively, which indicate considerable cross-sectional variation in reliance on debt financing. These estimates are consistent with existing studies (e.g, Lemmon, Roberts, and Zender, 2008; Frank and Goyal, 2009; DeAngelo and Roll, 2015; Graham, Leary, and Roberts, 2015). Average *Net Debt Issuance(t+1,t+2)* is 5.3% of total assets with a standard deviation of 20.0%. *Net Debt Issuance(t+1,t+3)* is larger with a mean of 8.8% and displays greater variation with a standard deviation of 28%, reflecting the longer issuance window. *Asset Volatility* has a markedly larger mean of 0.426 and standard deviation of 0.520 than our measures of cash flow volatility in Table 3. Sample statistics for other control variables are consistent with existing studies (e.g., Lemon, Roberts, and Zender, 2008; Frank and Goyal, 2009; Welch, 2011): The average (std. dev.) of *MB* ratio is 1.414 (0.936); the mean (std. dev) of *AP* is 9.5% (7.2%); the mean (std. dev) of *PP&E* is 0.604 (0.358); the mean (std. dev) of *Cash* is 9.2% (11.5%); the mean (std. dev) of *CAPX* is 0.082 (0.083).

4 Leverage and cash flow composition

We want to examine whether the relationship between leverage and cash flow risk depends on the mix of temporary and persistent cash flow risk. To examine these relationships we undertake tests in the spirit of the comparative statics analysis in Gorbenko and Strebulaev (2010). Specifically, we estimate the following model of firm leverage as a function of cash flow risk:

$$Leverage_{i,t} = \alpha + \beta_1 Firm\ CF\ Risk_{i,t} + \beta_2 Asset\ Volatility_{i,t} + \gamma X_{i,t} + \epsilon_{i,t}, \tag{2}$$

where X is a vector of controls, i indexes firms, and t denotes time, and $Firm\ CF\ Risk_{i,t}$ is a place holder for measures of exposure to different types of cash flow risk. Like Gorbenko and Strebulaev (2010), we use *Asset Volatility* to control overall firm risk and isolate the effect of varying a particular type of cash flow risk.[8] In their model, asset value shocks are tied to permanent component of cash flow so their volatilities are substitutes. In reality *Asset Volatility* is a noisy estimate of asset value risk and including direct measures of cash flow volatility helps to identify the effect of their mixture on leverage. *Asset Volatility* also controls for risks that are not included in their model and are not reflected in our measures of cash flow risk. For example, it will capture risk associated with shocks to interest rates, inflation, and growth opportunities that are anticipated but cannot be captured by our cash flow risk measures that are computed using past cash flow data. While, overall, we expect that the effect of firm risk on capital structure to be consistent with the trade-off theory of capital structure, we expect cash flow volatility and its composition to play a distinct and significant role.

Table 7 contains several estimates of Model (2). These estimates differ along two dimensions. First, the measure of firm leverage: Panel A uses *Book Leverage*, which is the ratio of the book value of debt to the market value of equity, and Panel B uses *Market Leverage*, which is the ratio of the market values of debt and equity. Second, the measure of cash flow risk exposure: We use operating cash flow volatility, *CF Volatility* to establish a baseline estimate for cash flow risk exposure. To capture the mix of risk exposure we use either the volatility of the persistent component of cash flow, *Persistent CF Volatility*, or the ratio of the persistent component's variance to the variance of operating cash flow, *Persistent to Total CF Variance*.[9] To mitigate omitted variable bias arising from unobserved heterogeneity, we estimate each regression using three different sets of fixed-effects: A baseline OLS estimate with year fixed effects, an estimate that adds industry fixed effects (using two-digit SIC codes), and one that adds firm fixed effects. The reported standard errors are clustered by firm.

[8]The results are unchanged by using alternative measure of asset volatility based on leverage-adjusted equity return volatility. While often used in other contexts, this alternative measure is less desirable in our regression because it is inversely related to leverage, a dependent variable, and this may mechanically generate negative coefficients on asset volatility.

[9]The ratio *Persistent to Total CF Variance* is relatively persistent: The autocorrelations at three year and five year horizons are 68% and 49%, respectively, indicating that firms can expect the present mixture of shocks to be similar in the next several years. In the robustness section we show additional results which helps control for firm life cycle and its effect on cash flow mix.

Consider the estimates using *CF Volatility*, which account for the first three columns in each panel. The coefficient estimates on *Asset Volatility* show a robust and significant negative relation to leverage. Their magnitude and significance is consistent across leverage definitions and regression specifications. The negative sign is consistent with the standard trade-off theory implication that optimal leverage is lower for riskier firms. The effect of *CF Volatility* appears to be positive, although its value and statistical significance are sensitive to the fixed effects specification and definition of leverage. This suggests that cash flow risk potentially influences firm leverage independently of the other sources of risk incorporated in asset volatility.

The effect of the mix of risk exposure comes into much sharper focus in the second set of three regressions in each panel where we replace cash flow volatility with the volatility of the persistent component of cash flow. The coefficients on *Persistent CF Volatility* are all large, positive, and statistically significant. They indicate an economically meaningful effect of the same order of magnitude as that of market-to-book ratio or asset volatility. For example, in the book leverage regression using OLS with time fixed effects, a one standard deviation increase in *Persistent CF Volatility* increases leverage by 1.42% ($= 0.323 \times 0.044$). In comparison, similar changes in *Asset Volatility* and *MB* decrease leverage by 2.39% ($= -0.046 \times 0.520$) and 1.65% (-0.018×0.917), respectively. The coefficients on *Asset Volatility* remain negative. Thus, the volatility of the persistent component of cash flows does not merely substitute for asset volatility but captures an independent effect of cash flow risk composition on leverage.

Specifications where we replace *Persistent CF Volatility* with *Persistent to Total CF Variance*, the proportion of cash flow risk arising from the risk of persistent shocks, yield the same inference: The coefficients on *Persistent to Total CF Variance* are positive, indicating that a higher proportion of cash flow volatility arising from its persistent component is associated with higher leverage. In unreported results, we include both *Persistent CF Volatility* and *Temporary CF Volatility* with and without *Asset Volatility*. For these specifications we find that coefficients on *Persistent CF Volatility* are always positive while *Temporary CF Volatility* is negative, as are the coefficients on *Asset Volatility*, whenever it is included, are also negative.

The estimates in Table 7 indicate that firms with higher asset volatility have lower leverage and, holding asset volatility constant, firms exposed to more volatility from persistent cash flow shocks have higher leverage. The relationship between asset volatility and leverage is consistent with the traditional view that debt is less desirable for riskier firms because financial distress is costly (Leland 1994), even if the firms can avoid default (Asquith, Gertner, and Scharfstein, 1994; Pulvino, 1998). At first glance, one would expect cash flow risk to have a similar dampening effect on leverage. However, our results support Gorbenko and Strebulaev's (2010) predictions, and suggest that while exposure to temporary cash flow shocks might dampen leverage, exposure to persistent shocks can *promote* leverage.

Temporary and persistent shocks can have opposite effects on leverage because of their different relations to expectations of future profitability. Increased volatility of both temporary and persistent cash flow shocks increases the likelihood of bad states of distress and default, which will act as a force to limit leverage.[10] Firms will weigh this leverage-limiting force against the benefits of leverage, like tax savings, in good states. Higher volatility of both temporary and persistent cash flow shocks increases the likelihood of good states and the expected value of these benefits. However, good states reached via temporary shocks result in one-time windfalls but not higher expectation of future profits, while good states reached via persistent shocks indicate likely future continuation. Hence, on balance, leverage will generate greater benefits in good states that result from persistent shocks. Consequently, while either type of cash flow risk can result in distress states in the near term, positive persistent shocks are associated with long-term growth while positive temporary shocks of the same magnitude are not. In the next section we examine in more depth whether cross-sectional differences in leverage may emerge from systematically different debt financing policies of firms with different exposures to temporary and persistent shocks.

5 Debt Issuance and cash flow composition

The cross-sectional differences in leverage between firms we have documented probably did not emerge instantaneously. They likely emerged over time because of a combination of two forces: (i) Firms exposed to different mixes of cash flow risk experience systematically different histories of cash flow shocks; (ii) they respond differently to persistent and temporary shocks because of

[10]The detrimental effects of time spent in distress states on leverage are likely to be similar whether a firm faces primarily persistent or temporary shocks. Sufficiently negative shocks, whether they are persistent or temporary shocks, can cause the firm to reach a distress state. Distressed is typically resolved soon after the firm experiences distress, either through liquidation or debt restructuring. Once the firm is liquidated, shock exposure ceases to matter. If it is restructured, its debt is reset to move it out of distress.

their different implications for future profitability. To examine whether this is indeed the case, we test whether financing choices respond differently to persistent shocks than they do to temporary shocks. We also expect firms to tailor their responses depending on their exposure to persistent and temporary shocks. Hence, we examine whether firms with greater exposure to persistent shocks respond to cash flow shocks different than firms with greater exposure to temporary shocks.[11]

In this and subsequent sections we use filtered cash flow shock components as independent variables. This helps alleviate potential endogeneity problems which may arise because firms can, to some extent, manage their risk exposure through operational and financial hedging. However, firms cannot control the nature and timing of cash flow shocks and, as shown earlier, temporary cash flow shocks appear to be correlated with aggregate economic activity which is exogenous from the perspective of an individual firm. Thus, we identify the impact of temporary and persistent shocks by comparing the response of debt financing to realizations of each of these types of shocks.

5.1 The role of shock histories

To examine whether future debt financing responds differently to persistent shocks than to temporary shocks, we consider cash flow shocks in year t and look at debt issuance over the subsequent $k = 2$ years (in years $t+1$ and $t+2$) or $k = 3$ years (in years $t+1$ to $t+3$). Specifically, we estimate the following model:

$$\textit{Debt Issuance}_{i,t+1-t+k} = \alpha + \beta_0 \textit{Temp. CF Shock}_{i,t} + \beta_1 \textit{Pers. CF Shock}_{i,t} + \gamma X_{i,t} + \epsilon_{i,t}, \quad k = 2, 3 \tag{3}$$

where X is a vector of controls, i indexes firms, and t denotes time. To establish a baseline, we estimate Model (3) after replacing both persistent and temporary shocks with *CF Shock*. In addition, we also examine how debt issuance is tied to the levels of cash flow realization as it is generally examined in the existing literature (e.g., Baker and Wurgler, 2002; Kisgen, 2006; Lemmon, Roberts, and Zender, 2008) by estimating Model (3) by replacing the shocks to cash flow components with the levels of *Op. CF*, as well as with the levels of decomposed cash flow components *Persistent CF* and *Temporary CF*. Since cash flow and its components can be represented as a cumulation

[11] This aspect of our analysis distinguishes our analysis from Chang et. al. (2014) who only consider contemporaneous effects of cash flows in context of the firm's budget equation. They focus on the temporary component of cash flow, which is unrelated to future profitability, so as to uncover the contemporaneous effect of financing constraints. Our focus is instead on distinguishing the effects of temporary and persistent cash flow shocks which have different properties as indicators of future profitability, on subsequent financing decisions.

of past shocks, these tests provide insight into the role of longer histories of cash flow shocks on debt financing. In Section 7 we present tests that explicitly account for longer histories of cash flow shocks.

Panel A of Table 8 presents estimates of Model (3) with cash flow shocks and Panel B estimates with cash flow and its components. Our intent is to understand the cross-sectional differences in debt issuance among firms with different cash flow characteristics. Hence, we estimate the regressions with an unbalanced panel across firms and time. To mitigate omitted variable bias arising from unobserved heterogeneity, we estimate each regression using three different sets of fixed-effects: A baseline OLS estimate with year fixed effects, an estimate that adds industry fixed effects (using two-digit SIC codes), and one that adds firm fixed effects.

In Panel A, the coefficient estimates on *CF Shock* indicate that debt issuance is positively correlated with cash flow shocks, i.e., firms experiencing a larger cash flow shocks issue more debt in the following two to three years. When we use a two year issuance window, the coefficient estimate on *CF Shock* ranges from 0.022 when we use firm and year fixed-effects to 0.085 when we use only year fixed-effects. The coefficient estimates are larger when we use a three year issuance window and range from 0.049 to 0.152. With the exception of the two year window estimate with firm and year fixed-effects, all the estimates are highly statistically significant. The positive relationship between cash flow shocks and debt issuance is consistent with the trade-off theory: To the extent that cash flow shocks reflect persistent shocks, a positive cash flow shock indicates higher expected future profitability. As a result, a firm may issue more debt. If this is indeed the case we would expect a similar positive relationship between debt issuance and the shocks to the persistent component of cash flow but not necessarily the temporary component.

Now consider the estimates with *Temp. CF Shock* and *Pers. CF Shock*. The coefficient estimates on *Pers. CF Shock* are positive, highly statistically significant, and between 4.6 and 13 times higher than coefficients on *Op. CF* in a similar specification. Thus, on average, firms that experience higher cash flows shocks due to persistent shocks tend to issue more debt in the next two or three years. The estimates indicate significant cross-sectional variation in debt issuance as a function of persistent cash flow shocks. In stark contrast, the coefficients on *Temp. CF Shock* are all negative. While only the estimate using firm fixed-effects is statistically significant when we use a two year window, all three estimates are highly statistically significant when we use a three year window.

The coefficients on persistent and temporary component can be understood from an individual firm perspective or from the cross sectional perspective. Consider the individual firm first. Positive coefficients on the persistent shock indicate that the firm tends to issue more debt in the next 2-3 years after receiving positive persistent cash flow shock. This issuance is driven by expected higher future cash flows and can be viewed as a "benchmark" in the absence of other cash flow disturbances. To understand the additional effect of temporary shock, recall that persistent shocks are shocks to trend while temporary shocks are deviations from trend. Thus, when firms receive positive temporary shock so that cash flow is above the trend, they issue less debt than if the cash flow was at the trend.[12] This is consistent with firms using part of temporary cash flow windfall to preserve debt financing capacity. The reverse also holds: firms with cash flow below the trend (with negative temporary cash flow shock) issue more debt to compensate for lower internal resources. The combined effect of the cash flow shock on debt issuance is the sum of the shocks weighted by their respective coefficients with the permanent coefficient being the dominant force as it is typically almost an order of magnitude larger than the temporary one in absolute value. For illustration consider one standard deviation positive permanent shock (3.3%) and either positive or negative one standard deviation temporary shock (±5.5%). Then from firm fixed effect specification for three-year issuance we find that such a firm would issue additional debt of 1.5% or 2.5%, respectively, for positive or negative temporary shock $(2\% - (\pm 0.5\%) \approx 0.636 \times 3.3\% - 0.093 \times (\pm 5.5\%))$.

The second, cross-sectional, perspective is to compare two firms each receiving a shock of the same size, say 1%, but of different type. The gap in the coefficients then indicates the difference in issuance across such firms. These differences are significant and also appear to increase at a faster rate than the issuance window. For example, consider the firm fixed-effect specification for issuance over the two-year horizon $t+1$ to $t+2$ in Panel A of Table 8. The cross-sectional difference in debt issuance resulting from a switch from a 1% increase in temporary cash flow change to a 1% increase

[12]Here we use changes of both components as measures of shocks (innovations) for uniformity of treatment although temporary component itself is an indicator whether cash flow is above or below trend. Thus, positive change in the temporary component indicates that cash flow has increased temporarily but its relative position to trend would depend on where the temporary process was in the previous period. However, using temporary component without differencing also results in the negative coefficient, as shown in Panel B discussed next, which justifies our slight abuse of terminology here.

in the persistent change is associated with new debt amounting to 0.26% $(= 0.227 - (-0.036))$ of assets. This difference almost triples to 0.729% when the issuance window lengthens to three years. Thus, as time goes by, firms adjust their financing in response to changes in the operating environment and cash flow composition becomes an even more important determinant of debt issuance. To put the economic size of this difference in perspective, consider a thought experiment with one standard deviation of the total cash flow shock (5.9%) being either all persistent or all temporary for two different firms. Based on the firm fixed-effect specification for issuance over the three-year horizon, which is the most conservative out of the three with the smallest gap, the firm receiving persistent shock will issue 4.3% $(= 0.729 \times 0.059)$ more debt (relative to assets) in the subsequent three years than the firm receiving temporary shock. This is highly economically significant since average debt issuance equals, respectively, 5.3% and 8.8% of assets over two and three years.

The estimates in Panel B of Table 8, where we use the levels of cash flow and its components instead of their changes, display similar patterns. Debt issuance is positively correlated with operating cash flows. Based on the OLS estimates, which are the smallest and thus yield the most conservative inferences, a one standard deviation increase in operating cash flow translates to additional debt issuance of 0.91% $(= 0.095 \times 0.096)$ of assets over the following two years, or an additional 1.44% $(= 0.150 \times 0.096)$ over the following three years. The coefficient estimates on *Persistent CF* are positive, highly statistically significant, and about 2 to 4 times higher than coefficients on *Op. CF* in each specification. Thus, firms with higher permanent cash flow component issue significantly more debt.

As we already observed in Panel A, the coefficients on *Temporary CF* are negative and highly statistically significant in each specification. This confirms our interpretation of the result in panel A that firms with cash flow above trend curtail issuance while those below trend issue more debt. The cross-sectional interpretation of differences in components also applies in this specification but in a slightly different thought experiment. Consider two firms with the same operating cash flow relative to assets. Assume that for the first firm all of that cash flow is from the persistent component and the temporary component is zero while for another firm assume that it has lower permanent component by one 1% but makes it up through 1% higher temporary component. Then the difference in issuances of such firms is given by the gap in the coefficients, which for three-year issuance are 0.947% (= 0.394 − (−0.553)), 1.03% (= 0.456 − (−0.572)) and 1.28% (= 0.808 − (−0.475)) for OLS, industry and firm fixed effects, respectively. To see the economic significance of these differences, assume that the second firm's permanent cash flow is lower by 4% (which is the standard deviation of the temporary cash flow) and that it has also received positive one standard deviation temporary component so that its total cash flow is equal to that of the first firm. Then the first firm with all persistent cash flow would issue, depending on the fixed effect specification, between 3.8% (= 4 × 0.947) and 5.1% (= 4 × 1.28) more debt over the next three years.

The estimates in Table 8 show that debt issuance responds strongly to cash flow shocks. Higher persistent cash flow is associated with significantly higher debt issuance. Temporary cash flow is effectively used to manage debt issuance around the level dictated by the persistent component. Firms use part of temporary windfall to reduce borrowing and preserve debt capacity and compensate for cash flow below trend by borrowing more. The results are consistent whether we use shocks (changes) or levels of cash flow and its components.

5.2 The role played by shock exposure

To examine whether firms with greater exposure to persistent shocks respond differently to cash flow shocks than those with greater exposure to temporary shocks, we add interaction terms between cash flow shocks and an indicator for shock exposure to Model (3) as follows:

$$\begin{aligned} \textit{Debt Iss.}_{i,t+1-t+k} = {} & \alpha + \beta_0 \textit{Temp. CF Shock}_{i,t} + \beta_1 \textit{Pers. CF Shock}_{i,t} \\ & + \beta_2 \textit{Temp. CF Shock}_{i,t} \times \textit{High Pers. to Tot. Var.}_{i,t} \\ & + \beta_3 \textit{Pers. CF Shock}_{i,t} \times \textit{High Pers. to Tot. Var.}_{i,t} \\ & + \beta_4 \textit{High Pers. to Tot. Var.}_{i,t} + \gamma X_{i,t} + \epsilon_{i,t}, \end{aligned} \tag{4}$$

where X is a vector of controls, i indexes firms, and t denotes time. *High Pers. to Tot. Var.* is an indicator variable that takes the value of one when the firm's *Persistent to Total CF Variance* is higher than the sample median for the year and its value equals zero otherwise. It proxies for the mix of shock exposure.[13] The coefficients β_0 and β_1 capture how debt issuance responds to temporary

[13] We obtain qualitatively similar results when we compare issuance by firms in the top and bottom terciles of *Persistent to Total CF Variance* or if we replace *High Pers. to Tot. Var.* with *Persistent to Total CF Variance*.

and persistent cash flow shocks, respectively, for firms with relatively low exposure to persistent shocks. The coefficients on the interactions terms indicate whether firms with high persistent shock exposure respond differently. As we did previously, we estimate this model for both two ($k = 2$) and three ($k = 3$) year issuance windows. We use three different sets of fixed-effects: A baseline OLS estimate with year fixed effects, an estimate that adds industry fixed effects (using two-digit SIC codes), and one that adds firm fixed effects. We present the results in Table 9.

Like Table 8, the coefficient estimates on *Pers. CF Shock* are uniformly positive and highly statistically significant. In contrast, the *Temp. CF Shock* range from a high of 0.026 to a low of -0.030 and are uniformly statistically insignificant. The contrast between these coefficients indicates that, like the average firm in our sample, firms issue more debt following positive persistent cash flow shocks even when they have relatively low exposure to persistent shocks. However such firms appear not to manage debt issuance in response to temporary cash flow variation as we observed in the entire sample.

Now consider the interaction terms between *High Pers. to Tot. Var.* and *Temp. CF Shock*. They are all negative and highly statistically significant. For the two year issuance window they range from -0.107 to -0.145 and for the three year window from -0.149 to -0.210. Thus, firms adjust debt issuance more pro-actively in response to temporary cash flow shocks when they have greater persistent shock exposure. On the other hand, their response to persistent shocks appears unchanged: the coefficients on the interaction terms between *High Pers. to Tot. Var.* and *Pers. CF Shock* are smaller in magnitude and statistically insignificant with one exception. This pattern implies that cross-sectional difference in issuance between firms with similar persistent and temporary shocks which we discussed previously is wider for the high persistent shock exposure group.

Overall the response of debt issuance to persistent shocks does not appear to depend on the extent of exposure to these shocks. In contrast, debt issuance responds to temporary deviations from trend mainly among firms with high fraction of persistent variance. This pattern of conditional conservatism that is tied to shock exposure is consistent with the trade-off theory. Regardless of exposure mix, a positive persistent shock raises expected future profitability, and firms respond to

We use indicator variable rather than *Persistent to Total CF Variance* itself because in the continuous interaction case the coefficients β_0 and β_1 capture the effects of shocks when *Persistent to Total CF Variance* equals zero, which obscures interpretation of results since no firms in our sample display this shock structure.

it by issuing debt. A positive temporary shock is a windfall, and an opportunity to limit debt issuance and maintain debt capacity to exploit during a future sustained run of high profitability. Firms with greater exposure to persistent shocks, since they anticipate such runs of profitability to be more significant in magnitude, are more likely to exploit a temporary shock in this manner.

6 Additional tests of the effects of cash flow composition

With the help of three additional snapshots, we present a more in-depth analysis of the differences between debt issuance in response to persistent and temporary cash flow shocks. First, we examine the relationship between debt issuance and capital expenditure. Second, we distinguish between firms receiving large cash flows today versus firms receiving smaller, and even negative, cash flows. Third, we consider the role of financing constraints.

6.1 Debt issuance: Capital structure adjustment or investment needs

In Gorbenko and Sterbulaev's (2010) model firms make one-time initial investment and all subsequent debt issuance occurs in response to cash flow shocks purely as a result of capital structure adjustments to trade off distress costs and tax shields. In reality, firms also issue debt to meet their investment needs and this investment-related issuance may also systematically depend on the composition and timing of cash flow shock. We now attempt to separate these two effects and modify our model of debt issuance to include firm investment and its interactions with cash flows of each type. We use current investment expense, $CAPX_{i,t}$, as a proxy for ongoing and near-term investment needs and estimate the following model:

$$\begin{aligned} Debt\ Iss._{i,t+1-t+k} = {} & \alpha + \beta_0 Temp.\ CF\ Shock_{i,t} + \beta_1 Pers.\ CF\ Shock_{i,t} \\ & + \beta_2 Temp.\ CF\ Shock_{i,t} \times CAPX_{i,t} + \beta_3 Pers.\ CF\ Shock_{i,t} \times CAPX_{i,t} \\ & + \beta_4 CAPX_{i,t} + \gamma X_{i,t} + \epsilon_{i,t}, \end{aligned} \tag{5}$$

where $k = 2$ years or $k = 3$ years ahead debt issuance. The coefficients β_0 and β_1 capture the effect of cash flow shocks on debt issuance when the firm has no current investment. Thus, by comparing these coefficients for temporary and persistent cash flow shocks, we can assess purely capital structure-motivated differences in debt issuance across firms with temporary and persistent cash flows. The coefficients β_2 and β_3 will indicate debt issuance tied to investment for each cash flow type. By comparing these coefficients across temporary and persistent cash flow shocks, we can assess how much debt issuance by firms with temporary and persistent cash flow shocks diverges due to their investment needs. The results are presented in Table 10.

The coefficients on persistent component of cash flow shock are uniformly smaller than those we observed in Table 8, where we do not account for investment, but they remain sizable and highly statistically significant. Meanwhile the coefficients on the temporary component remain negative. Thus, even without investment, firms adjust debt issuance in response to the persistent shock and use temporary cash flow to manage debt capacity. The overall effect on the cross sectional differences in issuance based on type of shock is reduced somewhat but remains of similar order of magnitude. For example, in Table 8, in the firm fixed-effects specification with a three year issuance window, debt rises by 0.73% $(= 0.636 - (-0.093))$ if a 1% increase in temporary cash flow shock is replaced by a 1% increase in persistent cash flow shock. In comparison, in Table 10 for the same specification, with zero $CAPX$ the increase in issuance is 0.54% $(= 0.438 - (-0.101))$. Other specifications yield similar differences, suggesting that pure capital structure adjustments account for part of the response to cash flow shocks.

The coefficients on the interaction terms between $CAPX_{i,t}$ and the temporary shock are uniformly negative. The estimates with only year and year and industry fixed-effects are also statistically significant when we use a three year issuance window. In contrast, the coefficients on the interaction terms between $CAPX_{i,t}$ and the persistent shock are uniformly positive and statistically significant in most specifications. Interestingly, the interaction coefficients for both persistent and temporary shock are much larger for three-year window compared to the two-year window, consistent with lag in investment-driven issuance in response to persistent shock. Overall, the differences across firms with persistent and temporary shocks widens further when firms invest. Thus, firms issue debt at different rates after persistent and temporary cash flow shocks and only part of this divergence is due to purely capital structure adjustments. Issuance increases significantly after persistent shocks when firms also undertake capital investments. This is rather intuitive: Shocks to the persistent component of cash flow affect overall firm value whether or not there is an immediate investment need, and it appears that capital structure decisions respond strongly to this adjustment. The results also support the inferences we draw from Table 9 because they suggest that debt issuance increases with investment after persistent shocks, giving firms with high exposure to persistent shocks a stronger incentive to preserve debt capacity after temporary shocks in anticipation of future runs of positive profits and investment.

Some debt issuance that our estimates in Table 10 suggest is unrelated to capital expenditure may in fact be related to long term projects. To investigate this further, in unreported results, we replace $CAPX_{i,t}$ in equation (5) with: $CAPX_{i,t+1-t+2}$ or $CAPX_{i,t+1-t+3}$. This test is challenging because while these variables help control for continued investment, they are correlated with future cash flow shocks and other information which can reduce significance of the contemporaneous regressors. Nonetheless, even in these tests, the coefficients on the time-t persistent shocks remain positive, highly significant, and of magnitudes comparable to those shown in Table 10. Thus, there does indeed appear to be a distinct capital structure adjustment component to firms' responses to cash flow shocks.

6.2 Debt issuance and profitability

We have documented that firms experiencing positive persistent cash flow shocks tend to issue more debt over the next two to three years. Meanwhile temporary cash flow shocks substitute partly for debt issuance, consistent with the need to maintain debt capacity. Firms with higher overall level of cash flows, presumably, will have greater flexibility to adjust debt issuance in response to their needs, especially when they need to increase issuance to partially offset temporary cash flow shortfall. Hence we investigate the following question: Do firms experiencing high cash flows respond to persistent and temporary shocks differently than those that experience low, and possibly negative, cash flows? To answer this question we modify Model (4) by replacing the dummy variable for shock exposure with the dummy variable, *High CF*, that indicates whether the operating cash flow, *Op. CF*, is is above the sample median for the year. The results are reported in Table 11.

Systematically positive and significant coefficients on *High CF* suggest that high cash flows raise the propensity to issue debt, which is consistent with high cash flows indicating higher future profit and debt capacity. Now consider the effect of cash flow shocks. Across all specifications the coefficients on *Pers. CF Shock* are large, positive, and statistically significant. They are slightly smaller than in Table 8, where we did not account for the size of cash flow. In contrast, the interactions of *Pers. CF Shock* with the indicator *High CF* are an order of magnitude smaller and are uniformly statistically insignificant. Thus, our previous results linking debt issuance to persistent shocks appear to be unrelated to the level of current cash flows.[14]

We observe a completely different pattern when we consider the effect of temporary cash flow shocks: The coefficients on *Temp. CF Shock* are all less negative than those in Table 8, though only two out of six are statistically significantly different from zero. In contrast, the interaction terms of *Temp. CF Shock* with *High CF* are all negative, much larger in absolute value than the coefficients on *Temp. CF Shock* in this table and in Table 8, and highly statistically significant. Thus, debt issuance adjusts more strongly in response to temporary cash flow shocks for firms with high level of cash flow. This is consistent with these firms having more flexibility and adjusting debt issuance to maintain capacity to issue more debt in the future. These large interaction coefficients also imply that the cross-sectional differences in issuance arising from persistent and temporary shocks tend to be significantly larger for high cash flow firms.

Overall, these patterns suggest that, regardless of the level of current cash flow, firms are able to issue debt when they expect higher profitability after positive persistent shocks. Additionally, high cash flow firms appear to have more flexibility than low cash flow firms to adjust debt issuance in response to temporary cash flow shock.

6.3 Debt issuance and financing constraints

Financing constraints have an important influence on debt financing (Minton and Schrand, 1999; Hennessy and Whited, 2005, 2007). Our evidence on responses to temporary shocks may reflect a desire to preserve future funding capacity, which suggests that financing constraints may interact with cash flow composition to influence debt financing. Therefore, we examine the impact of financing constraints. Following the existing literature (Faulkender and Petersen, 2006; Riddick and Whited, 2009), we use firm size to capture the severity of financing constraints. We obtain qualitatively similar results (unreported) when we use SA index (Hadlock and Pierce, 2010) or the availability of ratings on a firm's publicly traded debt to capture the severity of financing constraints.

We compare how firms in the bottom tercile of *Firm Size* respond to cash flow shocks with the responses of firms in the top tercile. Specifically, we use the indicator variable *Small* which is set

[14] This is conditional on positive cash flow. In unreported results we also consider an indicator variable specification for positive cash flows. Persistent shock coefficient is positive and significant only among positive cash flow firms, i.e. only when it is interacted with the indicator variable. For negative cash flow firms, which is a small fraction of our sample, the coefficient is small and is statistically insignificant in most specifications.

to one for firms with in the bottom tercile of *Firm Size* for the year and is zero otherwise. Then, we estimate Model (4) using observations for the top and bottom terciles of firms each year after replacing the indicator variable for shock exposure with *Small*. Table 12 presents the estimates. For simpler exposition we will refer to firms in the top size tercile as "large firms" and ones in the bottom tercile as "small firms".

Consider the coefficients on *Pers. CF Shock* and *Temp. CF Shock*, which capture the issuance response for large firms. Consistent with our estimates for the entire sample from Table 8, the coefficients on *Pers. CF Shock* are large, positive, and highly statistically significant (with one exception). The coefficients on *Temp. CF Shock* are negative at three-year window but only statistically significant in one model with firm fixed effects and they are also smaller in absolute value than for the entire sample. Thus, large firms, which are likely to be financially unconstrained, issue significantly more debt following persistent shocks. Meanwhile, change in debt issuance after a temporary shock for these firms is somewhat muted compared to the entire sample, consistent with a less financially constrained position.

The coefficients on the interaction of *Small* with the persistent shock are all positive, though they are only statistically significant when we use a three year issuance window. With one exception, the coefficients on the interaction of *Small* with the temporary shock are all negative. Two of the three estimates with the three year issuance window are also statistically significant. Consequently, small firms display a consistently larger gap in their response to persistent and temporary shocks.[15]

The estimates in Table 12 suggest that financing constraints induce a somewhat larger "spread" in debt issuance from cash flow shocks because they have an asymmetric effect on the response to cash flow shocks: Constrained firms cut back on debt issuance more aggressively when they enjoy a windfall in the form of a positive temporary shocks. However, they issue debt more aggressively as soon as they experience positive persistent shocks and anticipate a sustained run of high profit. Thus, like Dasgupta, Noe and Wang (2011), we find that firms use cash flows to shore up their debt capacity to use it when their prospects improve. In contrast, we find that this precautionary behavior tends to be strong after temporary but not all cash flow shocks.

[15]We test for the difference in the gap between *Pers. CF Shock* and *Temp. CF Shock* for the small vs. big firms by testing for the difference in the coefficients of the two interaction terms *Pers. CF Shock * Small* and *Temp. CF Shock * Small* which is statistically significant for five out of six models.

7 Additional robustness tests

In this section we demonstrate that our results are robust to several changes in our methodology. In the main text we present results accounting for longer histories of cash flow shocks, persistence of investment, and changing the estimation windows for filtering cash flows. In the Internet Appendix A we also show additional robustness of our main results with respect to alternative filter method using BK filter and to alternative estimation method using Erickson, Jiang, and Whited's (2014) minimum distance estimator to correct for measurement error in Tobin's q. Our results remain robust to these alternative methodologies.

7.1 History of cash flows and debt issuance

Our analysis thus far shows that firms that experience positive persistent cash flow shocks tend to issue more debt while after positive temporary shocks they tend to lower debt issuance. It is reasonable to ask how robust this relationship is over time. Are the differences in issuance consistent over a longer history of cash flows? Or does the impact of cash flow shocks quickly decay and do firms reverse their policies? If persistent cash flow shocks are indeed informative of future prospects, we would expect their effect to be relatively long-lasting and to manifest itself over relatively long horizons. To analyze these questions we investigate issuance in response to longer histories of cash flow, by re-estimating Model (3) after including lagged values of the shocks to cash flow and its components. We report these results in Table 13.

The specifications with *CF Shock* and its lagged values show that lagged cash flow shock shocks have a long lasting positive cross-sectional relationship with future debt issuance: Firms tend to issue more debt in the future following positive cash flow shocks. This positive issuance response extends back to relatively distant cash flow shocks. Even the shocks two years in the past are significant for cross-sectional differences in debt issuance over the next two to three years. The coefficients decay somewhat for cash flow shocks further in the past, with the decay being more marked for the three year issuance window. This decay is consistent with more recent cash flow innovations being more informative about future firm expectations and profits.

When we consider the shocks to temporary and persistent components of cash flow, we again observe differences in their relations with debt issuance that are consistent over time. For every lag in every specification, firms issue more debt following a positive shock to the persistent cash flow component and reduce issuance following a similar shock to the temporary component. Interestingly, the coefficients on lagged persistent shocks are often slightly higher than those on contemporaneous persistent shocks. This is consistent with a delay in debt issuance because it takes time to issue new debt. Overall, the coefficients on persistent and temporary cash flow shocks remain robust and consistent over time. Moreover, the cross-sectional differences due to type of shocks remain economically sizable even for longer lags. For example, consider coefficients for a three year issuance window and two year lagged cash flow shocks using firm fixed effects: A 1% change in the persistent component compared with a similar innovation in the temporary component is related to expected higher debt issuance of 0.768% ($= 0.574 - (-0.194)$). Overall, these results are consistent with the intuition that persistent cash flow shocks contain long-lived information about expected future firm profitability and these expectations manifest themselves through debt financing policies in a manner consistent with the trade-off theory of capital structure.

7.2 Investment persistence

We argue that differences in our estimates of the relationships of debt issuance with persistent and temporary cash flow components arise from the differences in the information these cash flow components convey about future investment opportunities. A potential confounding factor could be persistence of investment. Since investment requires "time-to-build", a firm's commitment to long-term investment projects may create persistence in investment and the debt financing used to support it. This could potentially make persistent processes, like the one we filter out from cash flow, appear to be closely associated with debt issuance only because both series are autocorrelated. Therefore, to isolate the true informational content of the persistent cash flow component we re-estimate equations (3) by including current $CAPX$ and two lags of $CAPX$ to control for the effect of persistence arising from lagged investment implementation. The estimates are presented in Table 14 in Panels A and B, respectively.

Compare the estimates in Panel A of Table 14 with Table 8. Consistent with lags in implementation of investment, current investment has a strong relationship with future debt issuance as reflected in large and highly significant coefficients on $CAPX_{i,t}$ in all specifications. The inclusion of investment also lowers the coefficient on the persistent component of cash flow, consistent with our concern that lagged investment implementation may generate correlation of debt issuance with the persistent cash flow component. However, the coefficient estimates on the persistent component continue to be significantly positive and those on the temporary component remain significantly negative. Because the coefficients on the temporary component are more negative after including investment as a control, the differences in issuance between firms with persistent and temporary cash flow shocks remain sizable and significant and of the same order of magnitude as in Table 8 without the investment control. Thus, there remains considerable difference between debt issuance by firms with temporary and persistent cash flow shocks, supporting our interpretation that persistent cash flows contain information related to expected future profitability.

In Table 14, Panel B, we repeat the analysis of Table 13 by including $CAPX_{i,t}$ and its two lags as additional controls. Consistent with the results in Panel A, contemporaneous investment has a strong relation with future debt issuance. The coefficients on lagged investment are an order of magnitude smaller than for contemporaneous investment and are often insignificant in specifications with decomposed cash flow. Moreover, compared to Table 13, coefficients on the persistent shock at time t *increase* while those on its two lagged values *decrease*. This suggests that information in lagged changes of cash flow, to some extent, is already reflected in the current investment while the contemporaneous innovation to the persistent component retains its independent content and it is better identified in this specification. Overall, these results suggest that the persistent cash flow component contains independent information about future investment opportunities and its relationship with debt issuance is not driven solely by investment implementation lag.

7.3 Different estimation windows for filtering cash flows

We also implement a series of robustness tests using filters only on the data available at the time of observation t. To do so we use either rolling or expanding *lagged* filter windows. We use rolling windows with a fixed width of $\tau = 10$ or 15, and estimate the filters on cash flows from $t - \tau$ to t to identify time-t persistent and temporary cash flow components. To estimate the time $t + 1$ components we re-estimate the filter on cash flows from $t+1-\tau$ to $t+1$ and so on. Our expanding window filter estimates use all available observations until the current period t to identify the time t persistent and temporary cash flow components. To estimate the time $t + 1$ components we re-estimate the filter on all cash flows up to $t + 1$. We require the length of the initial window in the expanding series to equal either 10 or 15 years. Both approaches naturally reduce the number of available firm-years observations because a firm enters the sample only after accumulating sufficient observations.

These analyses address two potential concerns with our base line results. The first concern is that "look ahead" bias artificially induces correlation of persistent component with future debt issuance. This primarily applies to our regressions on debt issuance. The second concern is that firms may go through life cycle changes which alter the mix of persistent and temporary shocks and our full sample filter estimates fail to capture these changes.[16] This primarily applies to our results on the cross sectional analysis of leverage variation but may also affect inferences from the debt issuance regressions.

We believe the first issue is non-sequitur because using a more precise decomposition cannot induce a relation when none exist in the first place. The regressions use only data available up to time-t and the only additional information is about more precise decomposition into trend and cycle of the *current* cash flow.[17] Such decomposition can alternatively be done by simple autoregressive forecast which would differ from the full-sample filter in the accuracy of the decomposition but not in the information content of the cash flow itself. If debt issuance is actually independent from the decomposition then it would not matter whether we applied more accurate full sample filter to cash flow or a cruder and less precise forecast regression. If instead debt issuance does have a relationship with the component of cash flows, having more precise decomposition increases our chance of detecting it.

With regards to the second concern, our construction of volatilities for the cross-sectional leverage regressions already accounts for potential changes in the mix of shocks over time by using 10-year window to compute volatilities. Less precise estimates of cash flow components and their volatilities from shorter filter windows could mute the distinction across firms with different cash flow risk exposure and together with a smaller sample size reduce significance of some estimates. But

[16]This is a broader point and applies not only to our study. A prevalent assumption in the structural estimation corporate finance literature is to impose homogeneous and time-stationary model on a large panel of firms for estimation. Our approach allows for heterogeneity of cash flow processes across firms but in the base case implementation we chose to retain time-stationarity assumption. The estimation of filters of the moving window is designed to address this issue to the extent possible at the expense of data availability.

[17]Full sample filter also does not induce correlation of current persistent shock with future transitory components. Correlation of changes of persistent component with changes in temporary component for up to three periods ahead are low, less than 0.05 in absolute value.

we do find that overall our results hold reasonably well even when we impose additional constraints on the data used in the filters.

Table 15 panels A through C repeat our results for analyses of book and market leverage, and debt issuance. All regressions use either 10- or 15-year moving or expanding windows and include time and firm fixed-effects. The leverage regressions (Panels A and B) show that persistent volatility and its share of cash flow variance are positively associated with leverage, consistent with our previous results. Some specifications suffer from predictable loss of statistical significance, especially with the expanding 15-year window where the data requirements substantially reduce sample size. In these specifications, even asset volatility is marginally statistically significant but it remains negative while our variables for persistent volatility remain positive.

Panels C of Table 15, present estimates for debt issuance in response to cash flow shocks. Here, the coefficients on persistent the component range from 0.066 to 0.091 for two-year issuance and 0.119 to 0.160 for three-year issuance, all but one specifications are statistically significant. The coefficients on the temporary component are mostly negative, ranting from -0.069 to -0.051 for two-year issuance and -0.040 to 0.013 for three-year issuance and statistically insignificant in most specifications. Thus, we still find that firms issue more debt following persistent cash flow shocks while the effect of temporary shock is muted. As a result the difference in the coefficients on persistent and temporary cash flow is also smaller in these specifications. The shrinkage of temporary and persistent component coefficients toward zero compared with those estimates based on full-sample filter is consistent with lower filter precision and mis-classification of some portion of persistent shocks as temporary and vice versa. Here we are limiting the information for decomposition only to past cash flows with relatively short history which makes it hard to identify shocks to long-run trends. This is a somewhat artificially high bar because in reality firm management observes more than just past history of cash flows to judge whether cash flow changes are long-lasting or temporary. Thus, our real-time filters are bound to have high errors in identifying cash flow mix and yet we still find differences in debt issuance across firms. Overall, these results for real-time filters support our finding that firms issue more debt after persistent cash flow shocks than after temporary ones.

8 Conclusion

Our empirical analysis reveals important differences in capital structure decisions by firms arising from the composition of their cash flow risk. We find that, at the margin, the risk of persistent shocks is less detrimental to leverage decisions than similar risk from temporary shocks. This pattern is consistent with the trade-off theory of capital structure once we account for differences in implications of persistent and temporary components of cash flow for firm risk. We further show that firms tend to issue more debt when their cash flows are higher due to the persistent rather than the temporary shocks, consistent with long-lasting effect of persistent shocks on firm profitability. This effect of cash flow risk composition on corporate financing decisions is distinct from the role of cash flows as sources of cheaper internal financing that has traditionally been employed to explicate the relation between cash flows and corporate policies.

We apply well established filtering methods from the business cycle literature to decompose firm cash flow into persistent and temporary components and analyze the importance of cash flow composition for firm debt issuance. Our methodological contribution is to demonstrate that these filtering methods can be reliably applied in the context of low frequency and unbalanced corporate finance panel data of heterogeneous firms. The approach combines theoretically motivated restrictions on explanatory variables from structural models while retaining the richness of firm-level variation for empirical tests. Our application of filtering methodologies to corporate cash flows opens fruitful avenues for future research into the importance of the composition of shocks firms face for a broad range of corporate policies.

References

Almeida, Heitor, Murillo Campello, and Michael S Weisbach, 2004, The cash flow sensitivity of cash, *The Journal of Finance* 59, 1777–1804.

Asquith, Paul, Robert Gertner, and David Scharfstein, 1994, Anatomy of financial distress: An examination of junk-bond issuers, *The Quarterly Journal of Economics* 109, 625–658.

Baker, Malcolm, and Jeffrey Wurgler, 2002, Market timing and capital structure, *The journal of finance* 57, 1–32.

Bates, Thomas W., Kathleen M. Kahle, and Rene M. Stulz, 2009, Why do U.S. firms hold so much more cash than they used to?, *The Journal of Finance* 64, 1985 – 2021.

Baxter, Marianne, and Robert G King, 1999, Measuring business cycles: approximate band-pass filters for economic time series, *Review of Economics and Statistics* 81, 575–593.

Baxter, Nevins D, 1967, Leverage, risk of ruin and the cost of capital, *The Journal of Finance* 22, 395–403.

Beveridge, Stephen, and Charles R Nelson, 1981, 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, 151–174.

Bradley, Michael, Gregg A Jarrell, and E Kim, 1984, On the existence of an optimal capital structure: Theory and evidence, *The Journal of Finance* 39, 857–878.

Byun, Seong-Kyu, Valery Polkovnichenko, and Michael J. Rebello, 2017, Dynamics of firm savings and investment with temporary and persistent shocks, *Working Paper*.

Chang, Xin, Sudipto Dasgupta, GeorgeWong, and Jiaquan Yao, 2014, Cash-flow sensitivities and the allocation of internal cash flow, *Review of Financial Studies* 27, 3628–57.

Dasgupta, Sudipto, Thomas H Noe, and Zhen Wang, 2011, Where did all the dollars go? the effect of cash flows on capital and asset structure, *Journal of Financial and Quantitative Analysis* 46, 1259–1294.

DeAngelo, Harry, Linda DeAngelo, and Toni M Whited, 2011, Capital structure dynamics and transitory debt, *Journal of Financial Economics* 99, 235–261.

DeAngelo, Harry, and Richard Roll, 2015, How stable are corporate capital structures?, *The Journal of Finance* 70, 373–418.

Decamps, Jean-Paul, S Gryglewicz, Erwan Morellec, and Stephane Villeneuve, 2016, Corporate policies with temporary and permanent shocks, *Review of Financial Studies* forthcoming.

Denis, David J., and Valeriy Sibilkov, 2010, Financial constraints, investment, and the value of cash holdings, *Review of Financial Studies* 23, 247 – 269.

Frank, Murray Z, and Vidhan K Goyal, 2009, Capital structure decisions: which factors are reliably important?, *Financial Management* 38, 1–37.

Friend, Irwin, and Larry HP Lang, 1988, An empirical test of the impact of managerial self-interest on corporate capital structure, *The Journal of Finance* 43, 271–281.

Gorbenko, Alexander S., and Ilya A. Strebulaev, 2010, Temporary versus permanent shocks: Explaining corporate financial policies, *Review of Financial Studies* 23, 2591–2647.

Gryglewicz, Sebastian, Loriano Mancini, Erwan Morellec, Enrique J Schroth, and Philip Valta, 2017, Transitory versus permanent shocks: Explaining corporate savings and investment, *Working Paper*.

Harris, Milton, and Artur Raviv, 1991, The theory of capital structure, *The Journal of Finance* 46, 297–355.

Hennessy, Christopher A, and Toni M Whited, 2005, Debt dynamics, *The Journal of Finance* 60, 1129–1165.

——— , 2007, How costly is external financing? evidence from a structural estimation, *The Journal of Finance* 62, 1705–1745.

Hodrick, Robert J., and Edward C. Prescott, 1997, Postwar U.S. business cycles: An empirical investigation, *Journal of Money, Credit, and Banking* 29, 1–16.

Kester, W Carl, 1986, Capital and ownership structure: A comparison of united states and japanese manufacturing corporations, *Financial management* pp. 5–16.

Kim, Chang-Soo, David C Mauer, and Ann E Sherman, 1998, The determinants of corporate liquidity: Theory and evidence, *Journal of financial and quantitative analysis* 33, 335–359.

Kisgen, Darren J, 2006, Credit ratings and capital structure, *The Journal of Finance* 61, 1035–1072.

Leland, Hayne E, 1994, Corporate debt value, bond covenants, and optimal capital structure, *The Journal of finance* 49, 1213–1252.

Lemmon, Michael L, Michael R Roberts, and Jaime F Zender, 2008a, Back to the beginning: persistence and the cross-section of corporate capital structure, *The journal of finance* 63, 1575–1608.

———, 2008b, Back to the beginning: persistence and the cross-section of corporate capital structure, *The Journal of Finance* 63, 1575–1608.

Minton, Bernadette A, and Catherine Schrand, 1999, The impact of cash flow volatility on discretionary investment and the costs of debt and equity financing, *Journal of Financial Economics* 54, 423–460.

Opler, Tim C., Lee Pinkowitz, Rene Stulz, and Rohan Williamson, 1999, The determinants and implications of corporate cash holdings, *Journal of Financial Economics* 52, 3–46.

Parsons, Christopher, Sheridan Titman, et al., 2009, Empirical capital structure: A review, *Foundations and Trends® in Finance* 3, 1–93.

Pulvino, Todd C, 1998, Do asset fire sales exist? an empirical investigation of commercial aircraft transactions, *The Journal of Finance* 53, 939–978.

Ravn, Morten O., and Harald Uhlig, 2002, On adjusting the Hodrick-Prescott filter for the frequency of observations, *Review of Economics and Statistics* 84, 371–376.

Riddick, Leigh A, and Toni M Whited, 2009, The corporate propensity to save, *The Journal of Finance* 64, 1729–1766.

Schaefer, Stephen M, and Ilya A Strebulaev, 2008, Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds, *Journal of Financial Economics* 90, 1–19.

Schwert, Michael, and Ilya Strebulaev, 2014, Capital structure and systematic risk, *Working paper*.

Titman, Sheridan, and Roberto Wessels, 1988, The determinants of capital structure choice, *The Journal of Finance* 43, 1–19.

Welch, Ivo, 2011, Two common problems in capital structure research: The financial-debt-to-asset ratio and issuing activity versus leverage changes, *International Review of Finance* 11, 1–17.

Table 1: **Filter Performance in Simulated Panels**

This table reports diagnostic statistics for the performance of HP, BK and BN filters. The filters are applied to simulated cash flows of three panels of 300 firms, each constructed using a different model for long-lived shocks: A model with permanent shocks simulated continuously and sampled at discrete intervals; the same model simulated at discrete intervals; a discrete time AR(1) model with persistent but non-permanent shocks that have autocorrelation of 0.8 at annual frequency. Each model combines long-lived shocks with temporary shocks. Appendix B outlines detailed specifications for each model. For each filter, in the first three columns, we report Pearson and Spearman Correlations between assumed and filtered temporary volatilities (standard deviations of cash flow temporary component) and the R^2 from the regression of assumed on filtered temporary volatilities. In the next four columns we report the the average estimation error (the difference between estimated and assumed volatility) by quartiles of assumed volatilities. The range of assumed volatilities in each quartile is shown in parentheses. In the last two columns we report the average of estimated first-order autocorrelation of the trend and cyclical cash flows from each filter.

				Average Estimation Error					
Model	**Pearson Corr.**	**Spearman Corr.**	R^2	**Q1(0.026-0.082)**	**Q2(0.082-0.120)**	**Q3(0.120-0.165)**	**Q4(0.165-0.272)**	**Trend AR(1)**	**Cyclical AR(1)**
Permanent Shock (Continuous time)									
HP Decomposition	0.940	0.946	0.883	0.009	0.002	-0.004	-0.030	0.885	-0.341
BK Decomposition	0.909	0.957	0.814	0.012	0.008	0.004	-0.020	0.683	-0.339
BN Decomposition	0.790	0.833	0.625	0.060	0.046	0.037	-0.010	0.171	0.069
Permanent Shock (Discrete time)									
HP Decomposition	0.903	0.922	0.816	0.027	0.018	0.008	-0.022	0.864	-0.348
BK Decomposition	0.862	0.925	0.744	0.028	0.023	0.019	-0.010	0.658	-0.333
BN Decomposition	0.801	0.814	0.642	0.073	0.060	0.044	-0.009	0.157	0.069
Persistent Shock (AR(1) with $\theta = 0.8$)									
HP Decomposition	0.871	0.875	0.758	0.026	0.011	-0.010	-0.068	0.895	-0.301
BK Decomposition	0.819	0.876	0.671	0.031	0.022	0.013	-0.036	0.762	-0.280
BN Decomposition	0.700	0.671	0.490	0.089	0.065	0.045	-0.015	0.210	0.086

Table 2: **Standard Errors of Filter Estimates in Simulations**

This table reports additional diagnostic statistics for performance of HP, BK and BN filters. The filters are applied to simulated cash flows of three panels of 300 firms, each constructed using a different model for long-lived shocks: A model with permanent shocks simulated continuously and sampled at discrete intervals; the same model simulated at discrete intervals; a discrete time AR(1) model with persistent but non-permanent shocks that have autocorrelation of 0.8 at annual frequency. Each model combines long-lived shocks with temporary shocks. Appendix B outlines detailed specifications for each model. The table shows the average (within each quartile of assumed volatilities) of the standard error of the estimator of temporary volatility $\hat{\sigma_i}$ computed across 30 simulated cash flow paths for each firm i, i.e. $\sqrt{Var(\hat{\sigma_i})}/\sqrt{30}$ where the variance is computed across paths. The range of assumed volatilities in each quartile is shown in parentheses.

	Average St. Error of Temporary Volatility			
Model:	**Q1(0.026-0.082)**	**Q2(0.082-0.120)**	**Q3(0.120-0.165)**	**Q4(0.165-0.272)**
Permanent Shock (Continuous time)				
HP Decomposition	0.004	0.005	0.006	0.008
BK Decomposition	0.005	0.008	0.010	0.014
BN Decomposition	0.015	0.015	0.015	0.015
Permanent Shock (Discrete time)				
HP Decomposition	0.004	0.005	0.006	0.008
BK Decomposition	0.007	0.008	0.011	0.015
BN Decomposition	0.015	0.015	0.015	0.016
Persistent Shock (AR(1) with $\theta = 0.8$)				
HP Decomposition	0.008	0.009	0.010	0.011
BK Decomposition	0.012	0.014	0.016	0.019
BN Decomposition	0.018	0.017	0.017	0.017

Table 3: **Summary Statistics for Decomposed Firm Cash Flows.**

This table contains the summary statistics for operating cash flow as well as its temporary and persistent components and their volatilities. Our sample consists of U.S. public firms between 1970 and 2014, excluding utilities, financial firms, and unlevered firms. *Op. CF* is operating income before depreciation normalized by dividing by book value of firm assets. *Temporary CF* and *Persistent CF* are the temporary and persistent components of operating income before depreciation decomposed using the Hodrick and Prescott (1997) filter and then normalized by dividing by book value of firm assets. *CF Shock*, *Temp. CF Shock* and *Pers. CF Shock* are measured as the one year changes in *Op. CF*, *Temporary CF* and *Persistent CF*, respectively. Volatilities are computed using ten-year rolling windows. *CF Volatility*, *Temporary CF Volatility* and *Persistent CF Volatility* are the standard deviations of *Op. CF*, *Temporary CF* and *Persistent CF*, respectively. *Persistent to Total CF Variance* is the ratio of the variance of *Persistent CF* to the variance of *Op. CF*.

Variables	N	Mean	St. Dev.	25%-tile	75%-tile
Op. CF	62,226	0.135	0.096	0.092	0.186
CF Shock	62,226	-0.002	0.059	-0.025	0.024
Temporary CF	62,226	-0.002	0.040	-0.018	0.017
Temp. CF Shock	62,226	0.000	0.055	-0.021	0.023
Persistent CF	62,226	0.138	0.079	0.094	0.183
Pers. CF Shock	62,226	-0.002	0.030	-0.014	0.012
CF Volatility	52,477	0.054	0.051	0.027	0.065
Temporary CF Volatility	52,477	0.039	0.039	0.018	0.047
Persistent CF Volatility	52,477	0.041	0.044	0.019	0.047
Persistent to Total CF Variance	52,477	0.514	0.240	0.321	0.710

Table 4: **Shock Exposure and Autocorrelation by industry**

This table reports properties of cash flow components by two-digit SIC code industries. Our sample consists of U.S. public firms between 1970 and 2014, excluding utilities, financial firms, and unlevered firms. *Op. CF* is operating income before depreciation normalized by dividing by book value of firm assets. *Temporary CF* and *Persistent CF* are the temporary and persistent components of operating income before depreciation decomposed using the Hodrick and Prescott (1997) filter and then normalized by dividing by book value of firm assets. (see Section 2 for details). *Persistent to Total CF Variance* is the variance of *Persistent CF* divided by the variance of *Op. CF*. *Persistent ACorrelation* and *Temporary ACorrelation* are the first order auto-correlation of the persistent and temporary components. The table also presents annual growth rates for operating cash flows, sales, and assets. All statistics are reported for the industries with the ten highest and ten lowest median *Persistent to Total CF Variance*.

	Pers. Var./Total Var.			Persistent ACorr.			Temporary ACorr.			CF growth	Sales growth	Asset growth
Industry	Med.	25th%	75th%	Med.	25th%	75th%	Med.	25th%	75th%	Med.	Med.	Med.
Communications	0.700	0.529	0.851	0.811	0.668	0.913	0.153	-0.084	0.363	0.145	0.185	0.125
Personal Services	0.698	0.505	0.822	0.868	0.756	0.945	0.128	-0.128	0.335	0.058	0.100	0.084
Tobacco Products	0.696	0.367	0.910	0.581	0.581	0.954	0.129	-0.176	0.283	0.087	0.066	0.079
Building Materials	0.646	0.415	0.789	0.884	0.784	0.902	0.196	-0.013	0.460	0.143	0.112	0.071
Printing & Publishing	0.640	0.414	0.804	0.841	0.729	0.912	0.110	-0.083	0.285	0.086	0.091	0.093
Eating & Drinking Places	0.639	0.447	0.800	0.833	0.712	0.915	0.118	-0.066	0.313	0.102	0.128	0.110
Auto Repair, Services, & Parking	0.639	0.513	0.747	0.796	0.785	0.858	0.302	0.013	0.456	0.089	0.111	0.115
Amusement & Recreation Services	0.638	0.428	0.805	0.832	0.724	0.926	0.207	-0.036	0.384	0.117	0.126	0.105
General Merchandise Stores	0.636	0.472	0.788	0.883	0.799	0.929	0.114	-0.101	0.311	0.081	0.097	0.085
Chemical & Allied Products	0.618	0.410	0.784	0.846	0.734	0.917	0.129	-0.107	0.341	0.098	0.111	0.084
⋮		⋮			⋮			⋮			⋮	
Wholesale Trade - Durable	0.468	0.286	0.649	0.853	0.739	0.916	0.089	-0.132	0.306	0.086	0.101	0.097
Oil & Gas Extraction	0.453	0.277	0.641	0.866	0.743	0.911	0.097	-0.095	0.302	0.167	0.159	0.136
Industrial Machinery & Equipment	0.449	0.259	0.647	0.873	0.789	0.934	0.105	-0.094	0.305	0.085	0.096	0.086
Electronic & Other Electric Equipment	0.444	0.261	0.644	0.866	0.783	0.920	0.064	-0.131	0.269	0.081	0.093	0.084
Textile Mill Products	0.434	0.282	0.613	0.823	0.743	0.918	-0.003	-0.227	0.223	0.053	0.066	0.050
Agricultural Production - Crops	0.423	0.267	0.625	0.897	0.888	0.959	-0.021	-0.329	0.144	0.055	0.082	0.071
Petroleum & Coal Products	0.403	0.236	0.601	0.902	0.817	0.922	0.073	-0.139	0.260	0.096	0.116	0.092
Primary Metal Industries	0.386	0.244	0.581	0.882	0.810	0.921	0.127	-0.096	0.305	0.049	0.059	0.056
Metal, Mining	0.360	0.185	0.590	0.876	0.840	0.941	0.064	-0.257	0.296	0.132	0.103	0.098
Special Trade Contractors	0.350	0.239	0.566	0.856	0.725	0.920	0.201	-0.098	0.414	0.121	0.078	0.067
Average	0.534	0.346	0.711	0.849	0.759	0.920	0.130	-0.097	0.326	0.092	0.106	0.091

Table 5: **Persistent and Temporary Cash Flow Shocks and Aggregate Economic Activity**

This table examines the sources of time-series variations in operating cash flow and its components. Specifically, we examine time series variation in cash flows attributable to the Industrial Production Index (*IP Index*) obtained from Federal Reserve Economic Database (FRED), which measures business cycle fluctuations in the US economy. *Op. CF* is operating income before depreciation normalized by dividing by book value of firm assets. *Temporary CF* and *Persistent CF* are the temporary and persistent components of operating income before depreciation decomposed using the Hodrick and Prescott (1997) filter and then normalized by dividing by book value of firm assets. (see Section 2 for details). *Persistent to Total CF Variance* is the variance of *Persistent CF* divided by the variance of *Op. CF*. To examine how the link between cash flows and business cycle fluctuations depends on the level of exposure to persistent and temporary shocks to cash flows, we split firms into "High" and "Low" groups by the top and bottom terciles of *Persistent to Total CF Variance* each year. Panel A and B separately report estimates for the High and Low groups, respectively. In each panel, we regress changes in yearly asset-weighted averages of *Op. CF*, *Persistent CF*, and *Temporary CF* on changes in *IP Index* (Columns (1)-(3)), and on the changes in persistent and temporary components of the *IP Index* (Columns (4)-(6)) obtained using the Hodrick and Prescott (1997) filter.

Panel A. High Persistent to Total CF Variance

	Changes in asset-weighted average			Changes in asset-weighted average		
	Op. CF/AT	Pers. CF/AT	Temp. CF/AT	Op. CF/AT	Pers. CF/AT	Temp. CF/AT
Changes in IP Index	0.001*	-0.000	0.001***			
	(2.01)	(-0.01)	(4.31)			
Changes in IP Index-Persistent				0.001	0.001	-0.000
				(0.45)	(0.56)	(-0.26)
Changes in IP Index-Temporary				0.002*	-0.000	0.002***
				(1.75)	(-0.38)	(4.78)
Constant	-0.002	-0.000	-0.002	-0.001	-0.002	0.001
	(-0.69)	(-0.02)	(-1.44)	(-0.26)	(-0.46)	(0.45)
N	42	42	42	42	42	42
adj. R-sq	0.069	-0.025	0.300	0.048	-0.041	0.351

Panel B. Low Persistent to Total CF Variance

	Changes in asset-weighted average			Changes in asset-weighted average		
	Op. CF/AT	Pers. CF/AT	Temp. CF/AT	Op. CF/AT	Pers. CF/AT	Temp. CF/AT
Changes in IP Index	0.004***	-0.001**	0.005***			
	(4.40)	(-2.03)	(6.20)			
Changes in IP Index - Persistent				-0.002	-0.001	-0.001
				(-0.93)	(-0.54)	(-0.70)
Changes in IP Index - Temporary				0.006***	-0.001*	0.007***
				(5.60)	(-1.73)	(7.80)
Constant	-0.007**	0.000	-0.007***	0.001	-0.000	0.001
	(-2.36)	(0.11)	(-2.71)	(0.27)	(-0.08)	(0.37)
N	41	41	41	41	41	41
adj. R-sq	0.315	0.073	0.483	0.426	0.050	0.604

Table 6: **Dependent and Control Variable Summary Statistics.**

This table contains summary statistics of dependent and control variables used in our analyses of debt financing. Our sample consists of U.S. public firms between 1970 and 2014, excluding utilities, financial firms, and unlevered firms. *Book Leverage* is the sum of the book value of short-term and long-term debt scaled by total assets. *Market Leverage* is the sum of book value of short-term and long-term debt, scaled by the sum of book value of total debt plus the market value of equity. *Net Debt Issuance (t+1, t+2)* is the sum one to two year-ahead debt issuance minus one to two year-ahead debt retirement, scaled by the total book assets in the current year. *Net Debt Issuance (t+1, t+3)* is the sum one to three year-ahead debt issuance minus one to three year-ahead debt retirement, scaled by the total book assets in the current year. *Cash* is cash and cash equivalents, scaled by total assets. *MB* is total book assets minus book value of equity plus market value of equity, divided by the total book assets. *Firm Size* is the natural log of the total book value of assets. *AP* is the total accounts payable, divided by total book assets. *PP&E* is the gross property, plant, and equipment, divided by total book assets. *CAPX* is the capital expenditure, scaled by total assets. *Asset Volatility* is the volatility of the past ten year residual Tobin's q (proxied by *MB*) net of the variations in the market excess return over the t-bill rate.

Variables	N	Mean	St. Dev.	25%-tile	75%-tile
Book Leverage	62,226	0.272	0.161	0.153	0.372
Market Leverage	62,226	0.247	0.173	0.108	0.358
Net Debt Issuance (t+1,t+2)	62,226	0.053	0.199	-0.036	0.091
Net Debt Issuance (t+1,t+3)	55,013	0.088	0.280	-0.043	0.137
Cash	62,226	0.092	0.115	0.022	0.117
MB	62,226	1.402	0.917	0.911	1.571
Firm Size	62,226	5.517	1.889	4.032	6.800
AP	62,226	0.095	0.072	0.048	0.121
PP&E	62,226	0.608	0.353	0.346	0.826
CAPX	61,726	0.082	0.083	0.030	0.103
Asset Volatility	52,477	0.426	0.520	0.156	0.479

Table 7: **Leverage and the Source of Cash Flow Volatility**

This table reports the estimated coefficients from the OLS regression of cash flow volatilities on corporate leverage levels. The dependent variable in Panel A is *Book Leverage*, the book value of short-term debt plus long-term debt, divided by total book assets. The dependent variable in Panel B is *Market Leverage*, the book value of short-term debt plus long-term debt, divided by the market value of firm, which is the total book value minus the book value of common equity, plus the market value of equity. The main independent variables are *CF Volatility*, *Persistent CF Volatility*, and *Persistent to Total CF Variance* which are, respectively, the standard deviations of *Op. CF* (operating income before depreciation normalized by firm assets), its persistent component, and the ratio of the variance of the persistent component to the variance of *Op. CF*. Cash flows are decomposed into temporary and persistent components using the Hodrick and Prescott (1997) filter. Volatilities are estimated using ten-year rolling windows. Columns 1, 4, and 7 present OLS estimates with year fixed effects. Columns 2, 5, and 8 use year and industry fixed effects. Columns 3, 6, and 9 use year and firm fixed effects. Additional control variables are defined in Appendix A Table A.1. t-statistics based on firm-clustered standard errors are reported in the parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels, respectively.

Panel A. Book Leverage

	Book Leverage								
	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE
CF Vol.	0.059	0.097**	0.231***						
	(1.45)	(2.50)	(4.62)						
Persistent CF Vol.				0.323***	0.244***	0.274***			
				(7.68)	(5.72)	(4.45)			
Persistent to Total CF Var.							0.054***	0.033***	0.020***
							(7.99)	(5.25)	(3.21)
Asset Vol.	-0.036***	-0.031***	-0.016***	-0.046***	-0.037***	-0.017***	-0.036***	-0.029***	-0.012**
	(-9.75)	(-8.73)	(-3.42)	(-12.42)	(-10.16)	(-3.61)	(-10.13)	(-8.49)	(-2.57)
MB	-0.018***	-0.016***	-0.008***	-0.018***	-0.017***	-0.009***	-0.019***	-0.016***	-0.008***
	(-9.13)	(-8.65)	(-4.88)	(-9.08)	(-8.63)	(-4.95)	(-9.45)	(-8.76)	(-4.86)
Firm Size	0.009***	0.007***	0.035***	0.010***	0.007***	0.034***	0.007***	0.006***	0.032***
	(7.97)	(6.46)	(11.13)	(8.80)	(6.83)	(10.83)	(6.69)	(5.30)	(10.31)
Op. CF	-0.284***	-0.275***	-0.316***	-0.266***	-0.269***	-0.320***	-0.300***	-0.290***	-0.326***
	(-14.96)	(-14.84)	(-20.28)	(-14.03)	(-14.49)	(-20.53)	(-15.94)	(-15.79)	(-21.22)
AP	-0.259***	-0.209***	-0.212***	-0.254***	-0.206***	-0.208***	-0.247***	-0.198***	-0.207***
	(-10.80)	(-8.08)	(-6.75)	(-10.63)	(-7.94)	(-6.68)	(-10.24)	(-7.60)	(-6.70)
PP&E	0.032***	-0.008	0.011	0.032***	-0.006	0.012	0.035***	-0.006	0.011
	(5.66)	(-1.16)	(1.11)	(5.73)	(-0.87)	(1.27)	(6.16)	(-0.94)	(1.13)
Constant	0.245***	0.280***	0.170***	0.236***	0.275***	0.174***	0.227***	0.271***	0.176***
	(24.07)	(8.66)	(10.00)	(23.62)	(8.60)	(10.22)	(22.55)	(8.44)	(10.43)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	52,477	52,477	52,477	52,477	52,477	52,477	52,477	52,477	52,477
adj. R-sq	0.096	0.205	0.110	0.101	0.207	0.110	0.102	0.207	0.108

Panel B. Market Leverage

	Market Leverage								
	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE
CF Vol.	-0.039	-0.013	0.111**						
	(-0.98)	(-0.36)	(2.53)						
Persistent CF Vol.				0.195***	0.119***	0.163***			
				(4.93)	(3.17)	(3.40)			
Persistent to Total CF Var.							0.032***	0.015***	0.013**
							(5.25)	(2.59)	(2.33)
Asset Vol.	-0.036***	-0.028***	-0.017***	-0.046***	-0.033***	-0.018***	-0.040***	-0.030***	-0.015***
	(-10.65)	(-8.70)	(-4.11)	(-13.21)	(-10.18)	(-4.40)	(-12.18)	(-9.78)	(-3.75)
MB	-0.057***	-0.053***	-0.040***	-0.057***	-0.053***	-0.040***	-0.058***	-0.053***	-0.040***
	(-18.04)	(-17.68)	(-14.99)	(-18.05)	(-17.72)	(-15.00)	(-18.10)	(-17.76)	(-15.02)
Firm Size	0.003***	0.001	0.040***	0.004***	0.002*	0.039***	0.003**	0.001	0.038***
	(2.99)	(1.14)	(14.31)	(3.98)	(1.74)	(14.19)	(2.56)	(0.92)	(13.83)
Op. CF	-0.382***	-0.373***	-0.394***	-0.362***	-0.363***	-0.394***	-0.382***	-0.373***	-0.398***
	(-20.21)	(-20.43)	(-25.51)	(-19.34)	(-20.07)	(-25.65)	(-20.37)	(-20.58)	(-26.09)
AP	-0.250***	-0.233***	-0.267***	-0.248***	-0.232***	-0.265***	-0.244***	-0.229***	-0.265***
	(-11.34)	(-9.96)	(-9.34)	(-11.27)	(-9.95)	(-9.31)	(-11.04)	(-9.79)	(-9.33)
PP&E	0.041***	0.005	0.032***	0.040***	0.006	0.033***	0.041***	0.005	0.032***
	(7.87)	(0.80)	(3.72)	(7.80)	(0.90)	(3.82)	(8.08)	(0.86)	(3.74)
Constant	0.342***	0.376***	0.185***	0.332***	0.369***	0.186***	0.327***	0.368***	0.187***
	(36.04)	(12.17)	(11.82)	(35.42)	(12.08)	(11.88)	(34.76)	(12.01)	(11.99)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	52,477	52,477	52,477	52,477	52,477	52,477	52,477	52,477	52,477
adj. R-sq	0.270	0.361	0.252	0.271	0.361	0.253	0.271	0.361	0.252

Table 8: **Net Debt Issuance and the Composition of Cash Flows**

This table reports the estimated coefficients from the OLS regression of temporary and persistent cash flow on net debt issuance. The dependent variable in Columns 1 - 6 is *Net Debt Issuance(t+1,t+2)*, defined as debt issuance minus debt retirement in years t+1 to t+2, then scaled by total assets in year t. The dependent variable in Columns 7-12 is cumulative three year-ahead net debt issuance, *Net Debt Issuance(t+1,t+3)*, defined as debt issuance minus debt retirement in years t+1, t+2, and t+3, then scaled by total assets in year t. In Panel A, the main independent variables are *CF Shock(t)*, *Temp. CF Shock(t)* and *Pers. CF Shock(t)*, which are the year-to-year changes in *Operating CF (t)*, *Temporary CF (t)* and *Persistent CF (t)*, respectively. *Op. CF* is operating income before depreciation normalized by dividing by book value of firm assets. *Temporary CF* and *Persistent CF* are the temporary and persistent components of operating income before depreciation decomposed using the Hodrick and Prescott (1997) filter and then normalized by dividing by book value of firm assets. In Panel B, we use level of cash flows (i.e., *Operating CF (t)*, *Temporary CF (t)* and *Persistent CF (t)*) in place of the cash flow shocks. In both panels, columns 1, 4, 7, and 10 present OLS regression with year fixed effects; Columns 2, 5, 8, and 11 use year and industry fixed effects; Columns 3, 6, 9, and 12 use year and firm fixed effects. Additional control variables in year t are also included. The detailed definitions of each variable is contained in Appendix A Table A.1. t-statistics based on firm-clustered standard errors are reported in the parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels, respectively.

Panel A. Cash flow shocks

	Net Debt Issuance(t+1,t+2)						Net Debt issuance(t+1,t+3)					
	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE
CF Shock(t)	0.085***	0.076***	0.022				0.152***	0.132***	0.049**			
	(5.89)	(5.30)	(1.63)				(6.89)	(6.04)	(2.46)			
Temp. CF Shock(t)				-0.008	-0.015	-0.036**				-0.087***	-0.101***	-0.093***
				(-0.45)	(-0.85)	(-2.28)				(-3.09)	(-3.59)	(-3.84)
Pers. CF Shock(t)				0.394***	0.381***	0.227***				1.017***	0.982***	0.636***
				(8.76)	(8.57)	(5.21)				(13.82)	(13.62)	(9.41)
Book Leverage(t)	-0.031***	-0.097***	-0.439***	-0.031***	-0.096***	-0.439***	-0.008	-0.112***	-0.597***	-0.007	-0.111***	-0.596***
	(-3.23)	(-9.89)	(-29.06)	(-3.20)	(-9.85)	(-29.06)	(-0.47)	(-7.00)	(-25.02)	(-0.45)	(-6.99)	(-25.03)
Cash(t)	-0.042***	-0.066***	-0.112***	-0.040***	-0.064***	-0.109***	-0.023	-0.068***	-0.151***	-0.019	-0.064***	-0.141***
	(-3.30)	(-5.00)	(-6.02)	(-3.18)	(-4.89)	(-5.85)	(-1.06)	(-3.02)	(-5.22)	(-0.89)	(-2.86)	(-4.90)
Firm Size(t)	-0.005***	-0.008***	-0.040***	-0.004***	-0.007***	-0.036***	-0.011***	-0.016***	-0.086***	-0.010***	-0.014***	-0.076***
	(-7.53)	(-9.87)	(-10.98)	(-7.05)	(-9.45)	(-9.92)	(-9.63)	(-11.57)	(-13.46)	(-8.91)	(-10.94)	(-11.93)
MB(t)	0.031***	0.031***	0.030***	0.031***	0.032***	0.031***	0.047***	0.047***	0.040***	0.049***	0.049***	0.043***
	(14.93)	(15.00)	(12.49)	(15.04)	(15.15)	(12.71)	(14.02)	(14.15)	(11.15)	(14.25)	(14.46)	(11.59)
AP(t)	-0.016	-0.019	0.018	-0.017	-0.020	0.020	-0.016	-0.027	0.012	-0.018	-0.029	0.019
	(-1.04)	(-0.93)	(0.53)	(-1.09)	(-0.99)	(0.59)	(-0.60)	(-0.78)	(0.22)	(-0.69)	(-0.85)	(0.36)
PP&E(t)	0.016***	-0.029***	-0.027***	0.013***	-0.032***	-0.032***	0.037***	-0.029***	-0.023	0.030***	-0.038***	-0.036**
	(4.10)	(-5.55)	(-2.90)	(3.46)	(-6.17)	(-3.37)	(5.56)	(-3.19)	(-1.43)	(4.60)	(-4.24)	(-2.22)
Constant	0.035***	0.098***	0.337***	0.033***	0.096***	0.323***	0.052***	0.153***	0.603***	0.046***	0.148***	0.564***
	(5.28)	(12.25)	(18.07)	(4.95)	(12.01)	(17.19)	(4.81)	(11.72)	(18.55)	(4.27)	(11.36)	(17.36)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	62,226	62,226	62,226	62,226	62,226	62,226	55,013	55,013	55,013	55,013	55,013	55,013
adj. R-sq	0.044	0.070	0.122	0.047	0.073	0.123	0.049	0.087	0.145	0.061	0.098	0.151

Panel B. Levels of cash flows

	Net Debt Issuance(t+1,t+2)						Net Debt issuance(t+1,t+3)					
	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE
Operating CF(t)	0.095***	0.104***	0.114***				0.150***	0.167***	0.189***			
	(6.04)	(6.52)	(5.76)				(5.38)	(5.96)	(6.01)			
Temporary CF(t)				-0.253***	-0.268***	-0.251***				-0.553***	-0.572***	-0.475***
				(-7.14)	(-7.67)	(-8.41)				(-9.58)	(-10.16)	(-10.52)
Persistent CF(t)				0.225***	0.260***	0.452***				0.394***	0.456***	0.808***
				(10.28)	(11.50)	(12.74)				(10.42)	(11.79)	(13.90)
Book Leverage(t)	-0.019*	-0.083***	-0.424***	-0.009	-0.072***	-0.404***	0.011	-0.091***	-0.570***	0.029*	-0.072***	-0.535***
	(-1.95)	(-8.34)	(-27.24)	(-0.90)	(-7.17)	(-25.82)	(0.64)	(-5.54)	(-23.15)	(1.70)	(-4.37)	(-21.57)
Cash(t)	-0.020	-0.046***	-0.108***	-0.002	-0.027**	-0.097***	0.009	-0.037	-0.146***	0.044**	-0.002	-0.126***
	(-1.56)	(-3.41)	(-5.84)	(-0.12)	(-1.98)	(-5.22)	(0.40)	(-1.62)	(-5.07)	(1.96)	(-0.07)	(-4.41)
Firm Size(t)	-0.005***	-0.009***	-0.041***	-0.006***	-0.009***	-0.036***	-0.011***	-0.017***	-0.087***	-0.012***	-0.017***	-0.079***
	(-8.38)	(-10.79)	(-11.28)	(-8.68)	(-11.26)	(-10.14)	(-10.29)	(-12.34)	(-13.77)	(-10.43)	(-12.67)	(-12.53)
MB(t)	0.029***	0.028***	0.027***	0.026***	0.025***	0.022***	0.043***	0.042***	0.035***	0.038***	0.036***	0.026***
	(13.33)	(13.21)	(10.88)	(12.01)	(11.67)	(8.74)	(12.46)	(12.42)	(9.62)	(11.07)	(10.77)	(7.13)
AP(t)	-0.006	-0.005	0.024	0.003	0.009	0.028	-0.000	-0.005	0.019	0.016	0.022	0.029
	(-0.38)	(-0.24)	(0.72)	(0.17)	(0.42)	(0.83)	(-0.01)	(-0.15)	(0.37)	(0.61)	(0.65)	(0.55)
PP&E(t)	0.013***	-0.032***	-0.027***	0.006	-0.042***	-0.041***	0.032***	-0.034***	-0.024	0.020***	-0.052***	-0.051***
	(3.31)	(-6.20)	(-2.94)	(1.61)	(-7.95)	(-4.43)	(4.83)	(-3.80)	(-1.50)	(3.03)	(-5.80)	(-3.22)
Constant	0.024***	0.087***	0.324***	0.006	0.069***	0.263***	0.035***	0.136***	0.583***	-0.000	0.101***	0.468***
	(3.63)	(10.88)	(17.41)	(0.88)	(8.49)	(13.81)	(3.20)	(10.32)	(17.83)	(-0.04)	(7.59)	(14.12)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	62,226	62,226	62,226	62,226	62,226	62,226	55,013	55,013	55,013	55,013	55,013	55,013
adj. R-sq	0.045	0.072	0.123	0.052	0.081	0.138	0.050	0.088	0.147	0.065	0.105	0.172

Table 9: **Net Debt Issuance and the Decomposition of Cash Flows - High vs. Low Persistent to Total Variance**
This table examines the difference in the effects of persistent and temporary cash flow shocks on debt issuance for firms exposed to high vs. low relative exposure to persistent cash flow shocks. We define a dummy variable, *High Persistent to Total Variance*, which equals one if *Persistent to Total CF Variance*, the ratio of the variance of the persistent component of cash flow to the variance of *Op. CF*, is above median in year t, and zero otherwise. The main independent variables are the shocks to the scaled (by assets) temporary and persistent components of operating income before depreciation, *Temp. CF Shock(t)* and *Pers. CF Shock(t)*, respectively, and their respective interaction terms with *High Persistent to Total Variance*. Operating income is decomposed into its temporary and persistent components using the Hodrick and Prescott (1997) filter. Shocks are measured by the year-to-year changes in their respective cash flow components. The dependent variable in Columns 1 - 3 is *Net Debt Issuance(t+1,t+2)*, defined as debt issuance minus debt retirement in years t+1 to t+2, divided by total assets in year t. The dependent variable in Columns 4-6 is cumulative three year-ahead net debt issuance, *Net Debt Issuance(t+1,t+3)*, defined as debt issuance minus retirement in years t+1, t+2, and t+3, divided by total assets in year t. Columns 1 and 4 present OLS estimates with year fixed effects. Columns 2 and 5 use year and industry fixed effects. Columns 3 and 6 use year and firm fixed effects. Additional control variables in year t are also included. More detailed definitions are reported in Appendix A Table A.1. t-statistics based on firm-clustered standard errors are reported in the parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels, respectively.

	Net Debt Issuance(t+1,t+2)			Net Debt issuance(t+1,t+3)		
	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE
Temp. CF Shock(t)	0.026	0.022	-0.018	0.013	0.001	-0.030
	(1.07)	(0.91)	(-0.87)	(0.35)	(0.03)	(-0.91)
*Temp. CF Shock(t) * High Pers. to Total Var.(t)*	-0.143***	-0.145***	-0.107**	-0.210***	-0.210***	-0.149**
	(-2.76)	(-2.83)	(-2.37)	(-2.80)	(-2.89)	(-2.41)
Pers. CF Shock(t)	0.392***	0.388***	0.215**	1.146***	1.123***	0.732***
	(3.98)	(3.97)	(2.43)	(6.61)	(6.57)	(5.08)
*Pers. CF Shock(t) * High Pers. to Total Var.(t)*	0.129	0.107	0.176*	-0.158	-0.171	-0.054
	(1.09)	(0.91)	(1.66)	(-0.78)	(-0.87)	(-0.32)
High Pers. Var. to Total Var.(t)	0.005*	0.004	0.007**	0.003	0.002	0.008*
	(1.96)	(1.59)	(2.43)	(0.79)	(0.54)	(1.72)
Book Leverage(t)	-0.053***	-0.107***	-0.436***	-0.044**	-0.124***	-0.587***
	(-4.32)	(-8.64)	(-22.23)	(-2.10)	(-6.23)	(-20.51)
Cash(t)	-0.040***	-0.058***	-0.080***	-0.037	-0.072***	-0.134***
	(-2.66)	(-3.67)	(-3.29)	(-1.53)	(-2.83)	(-3.66)
Firm Size(t)	-0.002***	-0.005***	-0.035***	-0.005***	-0.010***	-0.068***
	(-3.22)	(-5.70)	(-6.32)	(-4.17)	(-6.26)	(-7.38)
MB(t)	0.027***	0.029***	0.030***	0.039***	0.042***	0.041***
	(9.68)	(10.07)	(7.78)	(8.98)	(9.51)	(7.36)
AP(t)	-0.005	-0.015	0.006	-0.013	-0.037	-0.013
	(-0.30)	(-0.60)	(0.13)	(-0.45)	(-0.89)	(-0.19)
PP&E(t)	0.012***	-0.013**	-0.007	0.024***	-0.011	-0.005
	(2.88)	(-2.19)	(-0.60)	(3.33)	(-1.14)	(-0.26)
Constant	0.081***	0.107***	0.272***	0.040***	0.084***	0.404***
	(10.47)	(6.73)	(9.57)	(3.14)	(3.58)	(8.34)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	36,893	36,893	36,893	32,099	32,099	32,099
adj. R-sq	0.041	0.064	0.122	0.051	0.085	0.150

Table 10: **Net Debt Issuance and the Composition of Cash Flows - CAPX Interaction**

This table examines the difference in the effects of persistent and temporary cash flow shocks on debt issuance conditional on the level of firms' capital expenditures. To do so, we introduce *CAPX(t)* and the interaction terms between *Pers. CF Shock(t)* and *CAPX(t)* and between *Temp. CF Shock(t)* and *CAPX(t)*. *Temp. CF Shock* and *Pers. CF Shock* are the shocks to the temporary and persistent components of operating income before depreciation decomposed using the Hodrick and Prescott (1997) filter and then normalized by dividing by book value of firm assets. *CAPX(t)* is defined as firm's capital expenditure scaled by total assets. The dependent variable in Columns 1 - 3 is *Net Debt Issuance(t+1,t+2)*, defined as debt issuance minus debt retirement in years t+1 to t+2, divided by total assets in year t. The dependent variable in Columns 4-6 is cumulative three year-ahead net debt issuance, *Net Debt Issuance(t+1,t+3)*, defined as debt issuance minus retirement in years t+1, t+2, and t+3, divided by total assets in year t. Columns 1 and 4 present OLS estimates with year fixed effects. Columns 2 and 5 use year and industry fixed effects. Columns 3 and 6 use year and firm fixed effects. Additional control variables in year t are also included. The detailed definitions of each variable is contained in Appendix A Table A.1. t-statistics based on firm-clustered standard errors are reported in the parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels, respectively.

	Net Debt Issuance(t+1,t+2)			Net Debt issuance(t+1,t+3)		
	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE
Temp. CF Shock(t)	-0.031	-0.042*	-0.083***	-0.019	-0.039	-0.101***
	(-1.22)	(-1.71)	(-3.98)	(-0.54)	(-1.10)	(-3.15)
*Temp. CF Shock (t) * CAPX(t)*	-0.347	-0.279	-0.019	-1.402***	-1.275***	-0.376
	(-1.16)	(-0.94)	(-0.08)	(-3.62)	(-3.33)	(-1.11)
Pers. CF Shock(t)	0.322***	0.293***	0.206***	0.786***	0.729***	0.438***
	(5.32)	(4.88)	(3.61)	(8.13)	(7.63)	(4.90)
*Pers. CF Shock(t) * CAPX(t)*	0.812	0.888*	0.562	2.019***	2.159***	2.150***
	(1.56)	(1.72)	(1.32)	(2.81)	(3.05)	(3.59)
CAPX(t)	0.946***	0.964***	0.905***	1.236***	1.220***	1.002***
	(39.35)	(40.86)	(36.94)	(32.62)	(33.28)	(26.21)
Book Leverage(t)	-0.039***	-0.073***	-0.370***	-0.018	-0.081***	-0.515***
	(-4.59)	(-8.46)	(-25.67)	(-1.27)	(-5.67)	(-22.43)
Cash(t)	-0.054***	-0.055***	-0.112***	-0.044**	-0.056***	-0.146***
	(-4.43)	(-4.49)	(-6.31)	(-2.11)	(-2.68)	(-5.29)
Firm Size(t)	-0.002***	-0.005***	-0.026***	-0.006***	-0.011***	-0.064***
	(-4.10)	(-7.32)	(-7.95)	(-6.54)	(-9.54)	(-10.93)
MB(t)	0.011***	0.012***	0.016***	0.022***	0.023***	0.027***
	(6.67)	(6.79)	(7.34)	(8.11)	(8.46)	(8.11)
AP(t)	-0.039***	-0.020	-0.009	-0.051**	-0.031	-0.019
	(-2.73)	(-1.11)	(-0.29)	(-2.15)	(-1.04)	(-0.40)
PP&E(t)	-0.089***	-0.096***	-0.038***	-0.105***	-0.122***	-0.043***
	(-23.42)	(-20.14)	(-4.53)	(-16.81)	(-15.11)	(-2.91)
Constant	0.045***	0.065***	0.206***	0.063***	0.109***	0.428***
	(7.86)	(9.45)	(12.35)	(6.84)	(9.59)	(14.45)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	61,726	61,726	61,726	54,569	54,569	54,569
adj. R-sq	0.163	0.178	0.199	0.162	0.183	0.202

Table 11: **Net Debt Issuance and the Decomposition of Cash Flows - High vs. Low Cash Flows**

This table examines the difference in the effects of persistent and temporary cash flow shocks on debt issuance for firms experiencing high vs. low operating cash flows. We define a dummy variable, *High CF*, which equals one if operating income before depreciation scaled by total assets, *Op. CF*, is above the median in year t, and zero otherwise. The main independent variables are the shocks to the scaled (by book assets) temporary and persistent components of operating income before depreciation, *Temp. CF Shock(t)* and *Pers. CF Shock(t)*, respectively, and their respective interaction terms with *High CF*. Operating income is decomposed into its temporary and persistent components using the Hodrick and Prescott (1997) filter. The dependent variable in Columns 1 - 3 is *Net Debt Issuance(t+1,t+2)*, defined as debt issuance minus debt retirement in years t+1 to t+2, divided by total assets in year t. The dependent variable in Columns 4-6 is cumulative three year-ahead net debt issuance, *Net Debt Issuance(t+1,t+3)*, defined as debt issuance minus retirement in years t+1, t+2, and t+3, divided by total assets in year t. Columns 1 and 4 present OLS estimates with year fixed effects. Columns 2 and 5 use year and industry fixed effects. Columns 3 and 6 use year and firm fixed effects. Additional control variables in year t are also included. More detailed definitions are reported in Appendix A Table A.1. t-statistics based on firm-clustered standard errors are reported in the parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels, respectively.

	Net Debt Issuance(t+1,t+2)			Net Debt issuance(t+1,t+3)		
	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE
Temp. CF Shock(t)	0.034	0.024	-0.011	-0.043	-0.067*	-0.072**
	(1.58)	(1.10)	(-0.54)	(-1.20)	(-1.89)	(-2.32)
*Temp. CF Shock(t) * High CF(t)*	-0.197***	-0.208***	-0.180***	-0.235***	-0.243***	-0.210***
	(-4.54)	(-4.85)	(-4.58)	(-3.56)	(-3.74)	(-3.63)
Pers. CF Shock(t)	0.339***	0.321***	0.217***	0.908***	0.863***	0.570***
	(4.97)	(4.78)	(3.35)	(7.26)	(7.06)	(5.04)
*Pers. CF Shock(t) * High CF(t)*	0.030	0.031	-0.054	0.104	0.112	0.024
	(0.35)	(0.35)	(-0.67)	(0.70)	(0.78)	(0.18)
High CF(t)	0.019***	0.023***	0.024***	0.029***	0.036***	0.035***
	(7.88)	(9.66)	(9.19)	(7.42)	(9.45)	(8.95)
Book Leverage(t)	-0.018*	-0.080***	-0.423***	0.013	-0.086***	-0.572***
	(-1.85)	(-8.13)	(-27.81)	(0.76)	(-5.33)	(-23.80)
Cash(t)	-0.028**	-0.052***	-0.106***	-0.001	-0.045**	-0.138***
	(-2.22)	(-3.96)	(-5.75)	(-0.03)	(-2.01)	(-4.83)
Firm Size(t)	-0.005***	-0.008***	-0.036***	-0.010***	-0.015***	-0.077***
	(-7.82)	(-10.31)	(-10.01)	(-9.42)	(-11.55)	(-12.02)
MB(t)	0.029***	0.029***	0.029***	0.045***	0.044***	0.040***
	(13.64)	(13.70)	(11.92)	(13.02)	(13.23)	(10.99)
AP(t)	-0.005	-0.003	0.027	-0.001	-0.003	0.028
	(-0.32)	(-0.16)	(0.80)	(-0.02)	(-0.10)	(0.53)
PP&E(t)	0.010**	-0.037***	-0.033***	0.025***	-0.047***	-0.039**
	(2.46)	(-7.17)	(-3.57)	(3.67)	(-5.18)	(-2.41)
Constant	0.027***	0.089***	0.310***	0.036***	0.136***	0.544***
	(4.07)	(11.22)	(16.60)	(3.37)	(10.54)	(16.85)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	62,226	62,226	62,226	55,013	55,013	55,013
adj. R-sq	0.049	0.076	0.126	0.063	0.102	0.153

Table 12: **Net Debt Issuance and the Decomposition of Cash Flows - Small vs. Big Firms**

This table reports the estimated coefficients from the OLS regression of cash flow shocks on net debt issuance for two subsample of firms based on firm size. Firms are grouped into *Small* if the total assets is in the bottom tercile in a given year, and into *Big* if the total assets is in the top tercile in a given year. The main independent variables are the shocks to the scaled (by book assets) temporary and persistent components of operating income before depreciation, *Temp. CF Shock(t)* and *Pers. CF Shock(t)*, respectively, and their respective interaction terms with *Small* dummy with *Big* firms as the baseline case. Operating income is decomposed into its temporary and persistent components using the Hodrick and Prescott (1997) filter. The dependent variable in Columns 1 - 3 is *Net Debt Issuance(t+1,t+2)*, defined as debt issuance minus debt retirement in year t+1 to t+2, divided by total assets in year t. The dependent variable in Columns 4-6 is cumulative three year-ahead net debt issuance, *Net Debt Issuance(t+1,t+3)*, defined as debt issuance minus debt retirement in year t+1, t+2, and t+3, divided by total assets in year t. Columns 1 and 4 present OLS estimates with year fixed effects. Columns 2 and 5 use year and industry fixed effects. Columns 3 and 6 use year and firm fixed effects. Additional control variables in year t are also included. More detailed definitions are reported in Appendix A Table A.1. t-statistics based on firm-clustered standard errors are reported in the parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels, respectively.

	Net Debt Issuance(t+1,t+2)			Net Debt issuance(t+1,t+3)		
	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE
Temp. CF Shock(t)	0.030	0.018	-0.018	-0.010	-0.035	-0.064*
	(0.98)	(0.58)	(-0.64)	(-0.23)	(-0.80)	(-1.65)
*Temp. CF Shock (t) * Small(t)*	-0.060	-0.051	0.009	-0.130**	-0.114*	-0.007
	(-1.49)	(-1.28)	(0.25)	(-2.07)	(-1.85)	(-0.14)
Pers. CF Shock(t)	0.258***	0.244***	0.108	0.639***	0.607***	0.305***
	(3.99)	(3.80)	(1.62)	(6.84)	(6.63)	(3.69)
*Pers. CF Shock(t) * Small(t)*	0.144	0.136	0.094	0.443***	0.423***	0.368***
	(1.46)	(1.41)	(1.01)	(2.72)	(2.66)	(2.59)
Small(t)	-0.009*	-0.009	0.009	-0.005	-0.008	0.048
	(-1.80)	(-1.63)	(0.46)	(-0.59)	(-0.79)	(1.54)
Book Leverage(t)	-0.041***	-0.099***	-0.430***	-0.023	-0.118***	-0.582***
	(-3.51)	(-8.58)	(-22.93)	(-1.18)	(-6.17)	(-19.99)
Cash(t)	-0.054***	-0.070***	-0.104***	-0.045*	-0.076***	-0.136***
	(-3.62)	(-4.51)	(-4.69)	(-1.83)	(-2.95)	(-4.12)
Firm Size(t)	-0.006***	-0.009***	-0.035***	-0.010***	-0.015***	-0.065***
	(-5.43)	(-5.97)	(-7.54)	(-5.47)	(-6.07)	(-8.51)
MB(t)	0.029***	0.030***	0.029***	0.046***	0.049***	0.041***
	(12.11)	(12.50)	(10.02)	(11.69)	(12.23)	(9.41)
AP(t)	-0.025	-0.015	0.010	-0.023	-0.020	-0.018
	(-1.43)	(-0.66)	(0.29)	(-0.77)	(-0.52)	(-0.33)
PP&E(t)	0.012***	-0.027***	-0.033***	0.028***	-0.029***	-0.029
	(2.90)	(-4.44)	(-2.93)	(3.97)	(-2.77)	(-1.62)
Constant	0.050***	0.103***	0.310***	0.060***	0.148***	0.493***
	(4.83)	(8.59)	(11.00)	(3.53)	(7.42)	(10.89)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	41,646	41,646	41,646	36,811	36,811	36,811
adj. R-sq	0.044	0.069	0.113	0.058	0.095	0.136

Table 13: **Net Debt Issuance and the Past 3 Yr. Shocks to Cash Flows**

This table reports the estimated coefficients from the OLS regression of past three year cash flow shocks on net debt issuance. The dependent variable in Columns 1 - 6 is cumulative one and two year-ahead net debt issuance, *Net Debt Issuance(t+1,t+2)*, defined as debt issuance minus debt retired in year t+1 and t+2, divided by total assets in year t. The dependent variable in Columns 7-12 is cumulative one to three year-ahead net debt issuance, *Net Debt Issuance(t+1,t+3)*, defined as debt issuance minus debt retirement in year t+1 through t+3, divided by total assets in year t. The main independent variables are the following: *CF Shock(t)*, *CF Shock(t-1)*, and *CF Shock(t-2)*, which are the annual change in scaled (by book assets) operating income before depreciation (*Op. CF*) in year t, t-1, and t-2, respectively; *Temp. CF Shock(t)*, *Temp. CF Shock(t-1)*, and *Temp. CF Shock(t-2)* are the scaled (by book assets) changes in the temporary component of operating income before depreciation in year t, t-1, and t-2; *Pers. CF Shock(t)*, *Pers. CF Shock(t-1)*, and *Pers. CF Shock(t-2)* are the changes in persistent component of operating income (scaled by book assets) before depreciation in year t, t-1, and t-2. The temporary and persistent components are estimated using the Hodrick and Prescott (1997) filter. Columns 1, 4, 7, and 10 present OLS estimates with year fixed effects. Columns 2, 5, 8, and 11 use year and industry fixed effects. Columns 3, 6, 9, and 12 use year and firm fixed effects. We employ the same year t control variables as in previous tables but do not report their coefficient estimates for brevity. The detailed definitions of each variable is contained in Appendix A Table A.1. t-statistics based on firm-clustered standard errors are reported in the parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels, respectively.

	Net Debt Issuance(t+1,t+2)						Net Debt issuance(t+1,t+3)					
	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE
CF Shock(t)	0.120***	0.104***	0.028				0.243***	0.214***	0.082***			
	(6.90)	(6.05)	(1.60)				(9.24)	(8.17)	(3.18)			
CF Shock(t-1)	0.154***	0.133***	0.060***				0.226***	0.194***	0.066**			
	(8.28)	(7.18)	(3.20)				(8.02)	(6.95)	(2.57)			
CF Shock(t-2)	0.117***	0.099***	0.043***				0.182***	0.153***	0.063***			
	(6.73)	(5.75)	(2.66)				(6.79)	(5.80)	(2.58)			
Temp. CF Shock(t)				-0.090***	-0.097***	-0.133***				-0.250***	-0.265***	-0.270***
				(-3.69)	(-4.05)	(-6.17)				(-6.15)	(-6.57)	(-7.88)
Temp. CF Shock(t-1)				-0.082***	-0.093***	-0.117***				-0.260***	-0.274***	-0.275***
				(-3.02)	(-3.44)	(-4.77)				(-6.11)	(-6.51)	(-7.83)
Temp. CF Shock(t-2)				-0.089***	-0.096***	-0.102***				-0.212***	-0.222***	-0.194***
				(-3.79)	(-4.12)	(-5.03)				(-5.95)	(-6.31)	(-6.45)
Pers. CF Shock(t)				0.175***	0.172***	0.168***				0.708***	0.699***	0.611***
				(3.53)	(3.49)	(3.41)				(9.20)	(9.21)	(8.44)
Pers. CF Shock(t-1)				0.453***	0.430***	0.348***				0.792***	0.752***	0.609***
				(10.58)	(10.11)	(8.23)				(12.63)	(12.23)	(10.14)
Pers. CF Shock(t-2)				0.507***	0.464***	0.352***				0.825***	0.762***	0.574***
				(12.24)	(11.44)	(8.71)				(12.83)	(12.17)	(9.53)
Additional Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	50,743	50,743	50,743	50,743	50,743	50,743	44,778	44,778	44,778	44,778	44,778	44,778
adj. R-sq	0.044	0.071	0.121	0.057	0.083	0.131	0.048	0.088	0.144	0.076	0.114	0.164

Table 14: **Net Debt Issuance with Past CAPX Controls**

This table examines the relation between net debt issuance and the composition of cash flows with lagged capital expenditures as additional controls. In Panel A, we follow Table 8 and examine the effects of *CF Shock(t)*, *Pers. CF Shock(t)* and *Temp. CF Shock(t)* on future debt issuance but include capital expenditure in year t (*CAPX(t)*) as an additional control. *CF Shock* is the annual change in the operating income before depreciation normalized by dividing by book value of firm assets. *Temp. CF Shock* and *Pers. CF Shock* are the annual changes in the temporary and persistent components of operating income before depreciation decomposed using the Hodrick and Prescott (1997) filter and then normalized by dividing by book value of firm assets. The temporary and persistent components are estimated using the Hodrick and Prescott (1997) filter. In Panel B, we examine the effects of past 3 year *CF Shock*, *Pers. CF Shock* and *Temp. CF Shock* on future debt issuance by following Table 13 but including additional controls for capital expenditures in year t, t-1, and t-2. Control variables in year t are included but not reported for brevity in Panel B. The detailed definitions of each variable is contained in Appendix A Table A.1. t-statistics based on firm-clustered standard errors are reported in the parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels, respectively.

Panel A. One Year Lag

	Net Debt Issuance(t+1,t+2)						Net Debt issuance(t+1,t+3)					
	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE
CF Shock(t)	-0.054***	-0.042***	-0.017				-0.051*	-0.024	0.043			
	(-3.51)	(-2.72)	(-0.92)				(-1.85)	(-0.89)	(1.41)			
Temp. CF Shock(t)				-0.313***	-0.316***	-0.291***				-0.630***	-0.631***	-0.514***
				(-9.40)	(-9.58)	(-10.10)				(-11.46)	(-11.68)	(-11.66)
Pers. CF Shock(t)				0.022	0.051**	0.228***				0.126***	0.190***	0.566***
				(1.05)	(2.33)	(6.71)				(3.44)	(5.05)	(9.94)
CAPX(t)	0.951***	0.967***	0.898***	0.937***	0.948***	0.861***	1.231***	1.211***	0.975***	1.200***	1.168***	0.897***
	(38.95)	(40.20)	(36.48)	(38.36)	(39.40)	(34.94)	(31.35)	(31.73)	(25.02)	(30.54)	(30.56)	(22.84)
Book Leverage(t)	-0.047***	-0.080***	-0.372***	-0.040***	-0.073***	-0.360***	-0.026*	-0.086***	-0.510***	-0.012	-0.073***	-0.486***
	(-5.33)	(-8.93)	(-25.22)	(-4.53)	(-8.14)	(-24.23)	(-1.74)	(-5.79)	(-21.55)	(-0.80)	(-4.86)	(-20.29)
Cash(t)	-0.069***	-0.065***	-0.116***	-0.053***	-0.050***	-0.108***	-0.059***	-0.064***	-0.156***	-0.027	-0.034	-0.138***
	(-5.60)	(-5.25)	(-6.55)	(-4.31)	(-4.05)	(-6.05)	(-2.85)	(-3.05)	(-5.59)	(-1.30)	(-1.59)	(-4.97)
Firm Size(t)	-0.002***	-0.005***	-0.030***	-0.003***	-0.005***	-0.028***	-0.007***	-0.012***	-0.076***	-0.007***	-0.013***	-0.070***
	(-4.11)	(-7.34)	(-9.35)	(-4.45)	(-7.85)	(-8.58)	(-7.14)	(-10.16)	(-12.87)	(-7.36)	(-10.58)	(-11.90)
MB(t)	0.012***	0.012***	0.015***	0.011***	0.011***	0.012***	0.022***	0.022***	0.022***	0.019***	0.019***	0.016***
	(6.96)	(6.87)	(6.71)	(6.19)	(5.92)	(5.12)	(7.78)	(7.80)	(6.68)	(6.68)	(6.45)	(4.56)
AP(t)	-0.042***	-0.023	-0.012	-0.036**	-0.014	-0.007	-0.052**	-0.030	-0.024	-0.038	-0.008	-0.012
	(-2.95)	(-1.26)	(-0.40)	(-2.53)	(-0.77)	(-0.24)	(-2.12)	(-0.97)	(-0.49)	(-1.55)	(-0.27)	(-0.24)
PP&E(t)	-0.085***	-0.091***	-0.033***	-0.087***	-0.096***	-0.042***	-0.097***	-0.110***	-0.029*	-0.102***	-0.121***	-0.051***
	(-22.65)	(-19.29)	(-3.84)	(-22.89)	(-19.68)	(-4.88)	(-15.50)	(-13.80)	(-1.94)	(-16.25)	(-14.86)	(-3.41)
Constant	0.053***	0.071***	0.227***	0.041***	0.060***	0.188***	0.075***	0.118***	0.474***	0.047***	0.092***	0.387***
	(9.14)	(10.27)	(13.66)	(6.87)	(8.56)	(11.00)	(7.79)	(10.09)	(15.71)	(4.78)	(7.80)	(12.63)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	61,726	61,726	61,726	61,726	61,726	61,726	54,569	54,569	54,569	54,569	54,569	54,569
adj. R-sq	0.158	0.174	0.196	0.162	0.178	0.204	0.146	0.169	0.193	0.155	0.179	0.211

Panel B. Three Year Lags

	Net Debt Issuance(t+1,t+2)						Net Debt issuance(t+1,t+3)					
	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE
CF Shock(t)	0.027	0.017	-0.025				0.128***	0.105***	0.029			
	(1.55)	(0.98)	(-1.45)				(4.73)	(3.92)	(1.14)			
CF Shock(t-1)	0.060***	0.047**	0.011				0.097***	0.075***	0.007			
	(3.21)	(2.51)	(0.56)				(3.35)	(2.63)	(0.27)			
CF Shock(t-2)	0.063***	0.050***	0.013				0.107***	0.087***	0.022			
	(3.71)	(2.97)	(0.81)				(3.99)	(3.26)	(0.85)			
Temp. CF Shock(t)				-0.135***	-0.137***	-0.164***				-0.303***	-0.308***	-0.289***
				(-5.65)	(-5.78)	(-7.75)				(-7.43)	(-7.58)	(-8.54)
Temp. CF Shock(t-1)				-0.108***	-0.113***	-0.130***				-0.309***	-0.312***	-0.300***
				(-4.07)	(-4.25)	(-5.38)				(-7.35)	(-7.48)	(-8.54)
Temp. CF Shock(t-2)				-0.082***	-0.085***	-0.097***				-0.215***	-0.219***	-0.205***
				(-3.49)	(-3.68)	(-4.78)				(-5.97)	(-6.13)	(-6.62)
Pers. CF Shock(t)				0.225***	0.218***	0.242***				0.877***	0.852***	0.749***
				(4.16)	(4.04)	(4.44)				(10.02)	(9.85)	(9.02)
Pers. CF Shock(t-1)				0.278***	0.266***	0.267***				0.593***	0.561***	0.536***
				(6.03)	(5.81)	(5.76)				(8.65)	(8.30)	(7.89)
Pers. CF Shock(t-2)				0.281***	0.250***	0.181***				0.528***	0.487***	0.395***
				(6.97)	(6.26)	(4.48)				(8.50)	(7.94)	(6.45)
CAPX(t)	0.992***	0.992***	0.893***	0.945***	0.947***	0.861***	1.274***	1.243***	0.962***	1.148***	1.125***	0.891***
	(37.59)	(38.18)	(33.30)	(36.49)	(37.02)	(32.58)	(29.98)	(30.53)	(23.53)	(28.42)	(28.81)	(22.39)
CAPX(t-1)	-0.073***	-0.061***	-0.010	-0.040**	-0.028	0.032*	-0.085***	-0.079***	-0.033	0.044	0.051*	0.083***
	(-4.46)	(-3.73)	(-0.61)	(-2.21)	(-1.52)	(1.73)	(-3.32)	(-3.07)	(-1.21)	(1.54)	(1.77)	(2.71)
CAPX(t-2)	-0.090***	-0.072***	0.015	-0.053***	-0.036**	0.055***	-0.081***	-0.072***	0.002	-0.012	-0.003	0.081***
	(-5.40)	(-4.37)	(0.84)	(-2.97)	(-2.01)	(2.79)	(-3.23)	(-2.89)	(0.08)	(-0.45)	(-0.12)	(2.73)
Additional Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	47,298	47,298	47,298	47,298	47,298	47,298	41,865	41,865	41,865	41,865	41,865	41,865
adj. R-sq	0.156	0.173	0.195	0.163	0.179	0.202	0.141	0.168	0.187	0.165	0.190	0.206

Table 15: **Alternative Estimation Windows**

This table reports the robustness tests of our baseline regressions using alternative estimation windows for decomposing persistent and temporary cash flows. Specifically, we examine four alternative estimation windows: 10- and 15-year rolling windows and expanding windows starting from 10 or 15 years of initial observations. Panels A and B report the estimates from the book and market leverage regressions, respectively, using these alternative measures of temporary and persistent cash flows, while Panel C reports the estimates from the debt issuance regressions. All specifications include year and firm fixed-effects. Additional control variables are defined in Appendix A Table A.1. t-statistics based on firm-clustered standard errors are reported in the parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels, respectively.

Panel A. Book Leverage

	Book Leverage							
	Rolling10		Rolling15		Expd10		Expd15	
Persistent CF Vol.	0.223***		0.316***		0.252***		0.259*	
	(4.74)		(4.33)		(4.94)		(1.65)	
Persistent to Total CF Var.		0.013***		0.017***		0.016***		0.015*
		(2.59)		(2.70)		(3.00)		(1.86)
Asset Vol.	-0.017***	-0.012**	-0.027***	-0.021***	-0.017***	-0.012**	-0.023**	-0.018*
	(-3.59)	(-2.50)	(-4.34)	(-3.31)	(-3.64)	(-2.56)	(-2.46)	(-1.92)
MB	-0.008***	-0.008***	-0.009***	-0.009***	-0.009***	-0.008***	-0.008**	-0.009**
	(-4.93)	(-4.88)	(-4.04)	(-4.10)	(-4.97)	(-4.91)	(-2.42)	(-2.56)
Firm Size	0.034***	0.033***	0.034***	0.033***	0.034***	0.033***	0.032***	0.031***
	(10.72)	(10.43)	(8.51)	(8.17)	(10.81)	(10.36)	(4.83)	(4.73)
Op. CF	-0.316***	-0.325***	-0.295***	-0.306***	-0.314***	-0.324***	-0.330***	-0.338***
	(-20.38)	(-21.19)	(-15.95)	(-16.62)	(-20.18)	(-21.07)	(-11.06)	(-11.66)
AP	-0.208***	-0.209***	-0.221***	-0.223***	-0.208***	-0.208***	-0.230***	-0.232***
	(-6.70)	(-6.73)	(-5.96)	(-6.00)	(-6.69)	(-6.72)	(-4.43)	(-4.47)
PP&E	0.011	0.010	0.004	0.002	0.011	0.010	0.016	0.016
	(1.15)	(1.08)	(0.31)	(0.20)	(1.18)	(1.08)	(0.97)	(0.99)
Constant	0.175***	0.177***	0.126***	0.136***	0.173***	0.176***	0.139***	0.145***
	(10.33)	(10.48)	(5.19)	(5.65)	(10.22)	(10.39)	(2.86)	(3.00)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	52,590	52,590	34,551	34,551	52,590	52,590	15,636	15,636
adj. R-sq	0.110	0.108	0.119	0.116	0.110	0.108	0.119	0.118

Panel B. Market Leverage

	Market Leverage							
	Rolling10		Rolling15		Expd10		Expd15	
Persistent CF Vol.	0.116***		0.150***		0.131***		0.134	
	(3.03)		(2.59)		(3.20)		(1.23)	
Persistent to Total CF Var.		0.005		0.010*		0.008*		0.009
		(1.21)		(1.77)		(1.72)		(1.28)
Asset Vol.	-0.017***	-0.014***	-0.025***	-0.022***	-0.017***	-0.015***	-0.011*	-0.008
	(-4.26)	(-3.67)	(-4.51)	(-3.99)	(-4.31)	(-3.71)	(-1.70)	(-1.28)
MB	-0.040***	-0.040***	-0.043***	-0.043***	-0.040***	-0.040***	-0.043***	-0.043***
	(-15.08)	(-15.07)	(-12.49)	(-12.54)	(-15.03)	(-15.06)	(-7.65)	(-7.70)
Firm Size	0.039***	0.039***	0.039***	0.038***	0.039***	0.039***	0.040***	0.040***
	(14.14)	(13.97)	(11.10)	(10.88)	(14.19)	(13.91)	(7.05)	(6.97)
Op. CF	-0.393***	-0.397***	-0.378***	-0.383***	-0.391***	-0.396***	-0.422***	-0.426***
	(-25.54)	(-26.11)	(-19.07)	(-19.48)	(-25.41)	(-26.00)	(-12.78)	(-13.11)
AP	-0.266***	-0.266***	-0.256***	-0.257***	-0.265***	-0.265***	-0.261***	-0.262***
	(-9.32)	(-9.34)	(-7.50)	(-7.53)	(-9.31)	(-9.34)	(-5.24)	(-5.26)
PP&E	0.032***	0.031***	0.023**	0.023**	0.032***	0.031***	0.034**	0.034**
	(3.74)	(3.71)	(2.32)	(2.27)	(3.76)	(3.71)	(2.30)	(2.31)
Constant	0.187***	0.189***	0.130***	0.134***	0.186***	0.188***	0.120***	0.122***
	(12.03)	(12.13)	(5.96)	(6.14)	(11.95)	(12.04)	(2.77)	(2.82)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	52,590	52,590	34,551	34,551	52,590	52,590	15,636	15,636
adj. R-sq	0.253	0.252	0.256	0.255	0.253	0.252	0.298	0.298

Panel C. Debt Issuance

	Net Debt Issuance(t+1,t+2)				Net Debt issuance(t+1,t+3)			
	Rolling10	Rolling15	Expd10	Expd15	Rolling10	Rolling15	Expd10	Expd15
Temp. CF Shock(t)	-0.051	-0.069*	-0.052	-0.063	-0.034	-0.040	-0.035	0.013
	(-1.57)	(-1.69)	(-1.58)	(-1.49)	(-0.72)	(-0.70)	(-0.74)	(0.22)
Pers. CF Shock(t)	0.087**	0.066	0.088**	0.091*	0.159***	0.119*	0.160***	0.129**
	(2.37)	(1.44)	(2.39)	(1.90)	(3.06)	(1.91)	(3.08)	(2.01)
Book Leverage(t)	-0.443***	-0.479***	-0.443***	-0.479***	-0.586***	-0.620***	-0.585***	-0.625***
	(-22.24)	(-20.95)	(-22.23)	(-19.45)	(-20.09)	(-18.91)	(-20.09)	(-17.86)
Cash(t)	-0.082***	-0.085***	-0.082***	-0.092***	-0.135***	-0.151***	-0.135***	-0.150***
	(-3.36)	(-3.01)	(-3.36)	(-2.92)	(-3.58)	(-3.39)	(-3.58)	(-3.17)
Firm Size(t)	-0.039***	-0.038***	-0.039***	-0.033***	-0.076***	-0.073***	-0.076***	-0.067***
	(-7.02)	(-5.46)	(-7.02)	(-4.51)	(-7.37)	(-6.16)	(-7.37)	(-5.46)
MB(t)	0.028***	0.034***	0.028***	0.032***	0.038***	0.044***	0.038***	0.042***
	(7.05)	(7.20)	(7.05)	(6.64)	(6.56)	(6.81)	(6.55)	(6.52)
AP(t)	0.005	-0.015	0.005	-0.003	-0.004	-0.013	-0.004	0.009
	(0.11)	(-0.27)	(0.11)	(-0.05)	(-0.05)	(-0.14)	(-0.05)	(0.10)
PP&E(t)	0.001	0.013	0.001	0.014	0.007	0.022	0.007	0.019
	(0.12)	(0.92)	(0.12)	(0.98)	(0.36)	(1.01)	(0.37)	(0.86)
Constant	0.276***	0.280***	0.276***	0.261***	0.460***	0.405***	0.460***	0.386***
	(9.13)	(6.88)	(9.12)	(5.94)	(8.34)	(5.92)	(8.34)	(5.36)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	34,241	22,160	34,241	20,006	29,727	19,135	29,727	17,430
adj. R-sq	0.121	0.135	0.121	0.135	0.143	0.161	0.143	0.162

Appendix A Variables definitions

Table A.1 provides definitions of the variables we use in our empirical analysis. All variables were obtained from Compustat and pertain to U.S publicly listed firms between 1960 and 2014, excluding utilities and financial firms. The first ten years of data are dropped after they are used to calculate volatility measures, so the final sample consists of variables from 1970 to 2014. Volatility in subsequent periods is calculated using 10-year rolling windows. All variables except dividend dummy and volatilities are winsorized at the 1% level.

Table IA.1 repeats the analysis of relation between decomposed cash flows and aggregated fluctuations separately for manufacturing and non-manufacturing firms. The results are qualitatively similar to the combined analysis presented in the main text.

Table A.1: **Variable definitions.**

We report the definitions of the variables from our empirical analysis. The sample is constructed based on the accounting and financial information obtained from publicly listed U.S. firms from Compustat from 1960 and 2014 (with first ten years used to construct initial volatility observations), excluding utilities and financial firms. All variables are winsorized at 1% level.

Variable Name	Description
Total Assets	Book value of total assets (at)
Book Leverage	Short-term debt (dlc) + long-term debt (dltt), divided by *Total Assets*.
Market Leverage	Short-term debt (dlc) + long-term debt (dltt), divided by *Total Assets* + *Market Value of Equity* -book value of equity (ceq).
Net Leverage	Short-term debt (dlc) + long-term debt (dltt) - cash (che), divided by *Total Assets*.
Net Debt Issuance (t+1)	Debt issuance (dltis) in year t+1 minus debt retirement (dltr) in year t+1, divided by *Total Assets* in year t.
Net Debt Issuance (t+1+,t+2)	Debt issuance (dltis) in year t+1 and t+2 minus debt retirement (dltr) in year t+1 and t+2, divided by *Total Assets* in year t.
Net Debt Issuance (t+1+,t+3)	Debt issuance (dltis) in year t+1 through t+3 minus debt retirement (dltr) in year t+1 through t+3, divided by *Total Assets* in year t.
Market Value of Equity	Shares outstanding(csho) × closing price at year-end (prcc)
MB	Total assets(at)+Market Value of Equity - Book value of equity(ceq) divided by Total Assets(at).
Firm Size	$\ln(\text{at})$
Op. CF	Operating income (oibdp), divided by total assets (at).
Cash	Cash and cash equivalents (che), divided by *Total Assets*.
AP	Accounts payables (ap), divided by *Total Assets*.
CAPX	Capital expenditure (capx), divided by *Total Assets*.
PP&E	Gross property, plant, and equipment (ppegt), divided by *Total Assets*.
Persistent CF	Long-run cash flow component from Hodrick and Prescott (1997) filter decomposition, divided by *Total Assets*.
Pers. CF Shock	The difference between current year and previous year's *Persistent CF*.
Temporary CF	Cyclical cash flow component from Hodrick and Prescott (1997) filter decomposition, divided by *Total Assets*.
Temp. CF Shock	The difference between current year and previous year's *Temporary CF*.
Persistent Volatility	Standard deviation of *Persistent CF* over preceding ten years.
Temporary Volatility	Standard deviation of *Temporary CF* over preceding ten years.
Persistent to Total CF Var.	The ratio of the square of *Persistent Volatility* to the variance of *Op. CF* over preceding ten years.
Persistent ACorrelation	First-order autocorrelation of *Persistent CF*
Temporary ACorrelation	First-order autocorrelation of *Temporary CF*

Appendix B Simulation Analysis of Filter Performance

We use the model from Decamps et. al. (2016) to simulate the cash flow process in continuous time. The firm's assets A_t are assumed to follow geometric Brownian motion:

$$\frac{dA_t}{A_t} = \mu dt + \sigma_A dW_t^P \tag{B.1}$$

where dW_t^P is the Brownian motion corresponding to permanent shock and σ_A is the volatility of the shock. Operating cash flows are assumed to follow the process proportional to A_t:

$$\frac{dX_t}{A_t} = \alpha dt + \sigma_X dW_t^X \tag{B.2}$$

where dW_t^X is another Brownian motion with volatility σ_X. The two Brownian motions may be correlated with the correlation coefficient ρ:

$$dW_t^X dW_t^P = \rho dt \tag{B.3}$$

The dynamics of cash flow can also be written as:

$$\frac{dX_t}{A_t} = \alpha dt + \sigma_X(\rho dW_t^P + \sqrt{1-\rho^2}dW_t^T) \tag{B.4}$$

where dW_t^T is a temporary shock *uncorrelated* with dW_t^P.

We use parameter values for baseline model from Table 1 (p. 25) in Decamps et. al. (2016) to parameterize these equations. To create a panel of heterogeneous firms we generate the cross section of random pairs (σ_P, σ_X) as described in the main text. We then simulate dW_t^P and dW_t^T as independent Brownian motions using discretization of one day and time unit of one year i.e. $dt = \frac{1}{365}$ with total time for simulation $T = 10$ years. For each firm, assets are initialized at one ($A_0 = 1$) and the simulations are repeated 30 times. We integrate cash flow dX_t over each year to compute annual cash flow. The filters are applied to annual cash flow observations (10 observations per each path) and then the trend and cycle components are normalized by the assets A_t at each year's end to mimic our empirical procedure. The volatility of the filtered temporary (cycle) cash flow-to-assets ratio is compared to its theoretical counterpart $\sqrt{1-\rho^2}\sigma_X$. To facilitate comparison with calibrated values of σ_X we rescale both the estimator and the theoretical value by $\frac{1}{\sqrt{1-\rho^2}}$ so that the reported average estimation errors, standard errors and quartile ranges for cross section of theoretical parameters are comparable. Another version of the model repeats this procedure using $dt = 1$ where we re-run simulations for $T = 10$.

For the model with persistent but not permanent shocks to asset growth we use the specification based on productivity growth process from Riddick and Whited (2009) with some modifications to introduce additional temporary shock in cash flow similar to the continuous time case. We model assets and cash flows as discrete time processes with time interval of one year. Let a_t be the log growth rate of assets and assume it follows an AR(1) process with long-term mean μ, autocorrelation θ and innovation volatility σ_A:

$$a_t = \mu(1 - \theta) + \theta a_{t-1} + \sigma_A \varepsilon_t^a \tag{B.5}$$

where $\varepsilon_t^a \sim N(0, 1)$ i.i.d. The log assets of the firm grow at the rate a_t:

$$\log\left(\frac{A_t}{A_{t-1}}\right) = a_t \tag{B.6}$$

As in the continuous time model, we assume that expected cash flow is a constant fraction α of assets. We also introduce additional cash flow shock with volatility σ_X which may potentially be correlated with asset growth rate:

$$\frac{X_t}{A_t} = \alpha + \sigma_X \varepsilon_t^x \tag{B.7}$$

where $\varepsilon_t^x \sim N(0, 1)$ serially uncorrelated but correlated with ε_t^a with correlation coefficient ρ. Then cash flow can written as:

$$\frac{X_t}{A_t} = \alpha + \sigma_X(\rho\varepsilon_t^a + \sqrt{1 - \rho^2}\varepsilon_t^\tau) \tag{B.8}$$

where $\varepsilon_t^\tau \sim N(0, 1)$ i.i.d. is a temporary shock *uncorrelated* with ε_t^a. To parameterize the process we use the same values as for the continuous time specification and consider the values of θ of 0.6 and 0.8 to bracket the range considered in the literature, although, for brevity, we report results only for $\theta = 0.8$. We follow the same steps as with continuous time version to simulate and filter cash flows and construct filter performance measures.

Internet Appendix for "The Long and Short of Cash Flow Shocks and Debt Financing"

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Internet Appendix A Additional results and robustness

Table IA.1: **Variations in trend and cyclical cash flows - Manufacturing vs. Non-manufacturing industry**

This table examines the sources of time-series variations in both unfiltered and filtered cash flows for different industries. Namely, we examine firms in the manufacturing industries, which are main sources for the Industrial Production Index (*IP Index*), and non-manufacturing industries separately. The main independent variable is the Industrial Production Index (*IP Index*) obtained from the Federal Reserve Economic Database (FRED) as a measure of business cycle fluctuations in the overall economy. We take the yearly asset-weighted industry average of firm's *Operating CF to Assets*, *Persistent CF To Assets*, and *Temporary CF to Assets* to tease out cross-sectional variations in cash flows. To examine how the effects of business cycle fluctuations vary for firms with different exposure to persistent and temporary shocks to cash flows within industry, we split firms into *High* and *Low Persistent to Total CF Variance* groups by the top and bottom terciles of *Persistent to Total CF Variance* for each respective industry. Panel A and B report the separate estimates for the top and bottom groups, respectively, in the manufacturing industries. Panel C and D repeats the results for non-manufacturing industries. In each panel, we regress the changes in cash flow components on the changes in IP Index (Columns (1)-(3)), and on the changes in persistent and temporary components of the *IP Index* (Columns (4)-(6)).

Panel A. High Persistent to Total CF Var. - Manufacturing Industry

	Changes in asset-weighted average			Changes in asset-weighted average		
	Op. CF/AT	Pers. CF/AT	Temp. CF/AT	Op. CF/AT	Pers. CF/AT	Temp. CF/AT
Changes in IP Index	0.002**	0.001	0.001***			
	(2.17)	(0.78)	(3.01)			
Changes in Trend IP Index				0.003	0.003	-0.001
				(1.06)	(1.19)	(-0.49)
Changes in Cyclical IP Index				0.002	0.000	0.002***
				(1.52)	(0.02)	(3.53)
Constant	-0.004	-0.003	-0.001	-0.005	-0.006	0.001
	(-1.27)	(-0.79)	(-0.96)	(-1.08)	(-1.25)	(0.56)
N	41	41	41	41	41	41
adj. R-sq	0.084	-0.010	0.168	0.062	-0.011	0.211

Panel B. Low Persistent to Total CF Variance - Manufacturing Industry

	Changes in asset-weighted average			Changes in asset-weighted average		
	Op. CF/AT	Pers. CF/AT	Temp. CF/AT	Op. CF/AT	Pers. CF/AT	Temp. CF/AT
Changes in IP Index	0.004***	-0.001*	0.005***			
	(4.18)	(-1.71)	(5.57)			
Changes in Trend IP Index				-0.002	-0.001	-0.001
				(-0.88)	(-0.47)	(-0.60)
Changes in Cyclical IP Index				0.006***	-0.001	0.007***
				(5.27)	(-1.45)	(6.78)
Constant	-0.008**	0.000	-0.008**	0.001	0.000	0.001
	(-2.31)	(0.21)	(-2.59)	(0.20)	(0.02)	(0.20)
N	41	41	41	41	41	41
adj. R-sq	0.292	0.046	0.429	0.395	0.022	0.533

Panel C. High Persistent to Total CF Variance - Non-manufacturing

	Changes in asset-weighted average			Changes in asset-weighted average		
	Op. CF/AT	Pers. CF/AT	Temp. CF/AT	Op. CF/AT	Pers. CF/AT	Temp. CF/AT
Changes in IP Index	0.000	-0.001	0.001***			
	(0.61)	(-1.34)	(3.55)			
Changes in Trend IP Index				-0.001	-0.001	-0.000
				(-0.73)	(-0.56)	(-0.32)
Changes in Cyclical IP Index				0.001	-0.001	0.002***
				(1.12)	(-1.00)	(3.99)
Constant	-0.000	0.002	-0.002	0.002	0.002	0.000
	(-0.06)	(0.74)	(-1.46)	(0.69)	(0.57)	(0.23)
N	41	41	41	41	41	41
adj. R-sq	-0.016	0.019	0.225	-0.014	-0.006	0.267

Panel D. Low Persistent to Total CF Variance - Non-manufacturing

	Changes in asset-weighted average			Changes in asset-weighted average		
	Op. CF/AT	Pers. CF/AT	Temp. CF/AT	Op. CF/AT	Pers. CF/AT	Temp. CF/AT
Changes in IP Index	0.003***	0.000	0.003***			
	(2.94)	(0.37)	(3.77)			
Changes in Trend IP Index				-0.001	-0.001	-0.001
				(-0.50)	(-0.32)	(-0.32)
Changes in Cyclical IP Index				0.005***	0.001	0.004***
				(3.45)	(0.59)	(4.25)
Constant	-0.006	-0.002	-0.004	0.001	-0.000	0.001
	(-1.49)	(-0.61)	(-1.40)	(0.16)	(-0.08)	(0.33)
N	41	41	41	41	41	41
adj. R-sq	0.160	-0.022	0.249	0.202	-0.042	0.296

Table IA.2: **Leverage and CF Volatilities with BK Decomposition**

This table repeats main leverage regression with composition of cash flows estimated by Baxter and King (1999) filter. The dependent variable in Columns 1 - 6 is *Book Leverage*, defined as the book value of short-term debt plus long-term debt, divided by total book assets. The dependent variable in Columns 7-12 is *Market Leverage*, defined as the book value of short-term debt plus long-term debt, divided by the market value of firm, which is the total book value minus the book value of common equity, minus the market value of equity. The main independent variables are *CF Volatility* and *Persistent CF Volatility-BK*, which are the standard deviations of operating cash flow and persistent cash flows estimated on a ten-year rolling window basis, where the the persistent cash flows are estimated using Baxter and King (1999) filter. Columns 1, 4, 7, and 10 estimate the OLS regression with year fixed effects. Columns 2, 5, 8, and 11 estimate OLS with year and industry fixed effects. Columns 3, 6, 9, and 12 estimates OLS with year and firm fixed effects. Additional control variables are defined in Appendix A Table A.1. t-statistics based on firm-clustered standard errors are reported in the parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels, respectively.

	Book Leverage						Market Leverage					
	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE
CF Vol.	0.059	0.097**	0.231***				-0.039	-0.013	0.111**			
	(1.45)	(2.50)	(4.62)				(-0.98)	(-0.36)	(2.53)			
Persistent CF Vol.-BK				0.369***	0.298***	0.337***				0.228***	0.162***	0.199***
				(6.89)	(5.59)	(4.64)				(4.66)	(3.48)	(3.45)
Asset Vol	-0.036***	-0.031***	-0.016***	-0.046***	-0.038***	-0.016***	-0.036***	-0.028***	-0.017***	-0.046***	-0.034***	-0.017***
	(-9.75)	(-8.73)	(-3.42)	(-11.54)	(-9.62)	(-3.40)	(-10.65)	(-8.70)	(-4.11)	(-12.78)	(-10.02)	(-4.15)
MB	-0.018***	-0.016***	-0.008***	-0.018***	-0.016***	-0.009***	-0.057***	-0.053***	-0.040***	-0.058***	-0.054***	-0.040***
	(-9.13)	(-8.65)	(-4.88)	(-8.38)	(-7.97)	(-4.80)	(-18.04)	(-17.68)	(-14.99)	(-18.89)	(-18.75)	(-14.77)
Firm Size	0.009***	0.007***	0.035***	0.010***	0.008***	0.034***	0.003***	0.001	0.040***	0.004***	0.002**	0.039***
	(7.97)	(6.46)	(11.13)	(8.92)	(6.99)	(10.81)	(2.99)	(1.14)	(14.31)	(4.19)	(2.00)	(14.12)
Op. CF	-0.284***	-0.275***	-0.316***	-0.276***	-0.278***	-0.326***	-0.382***	-0.373***	-0.394***	-0.375***	-0.373***	-0.400***
	(-14.96)	(-14.84)	(-20.28)	(-13.74)	(-14.10)	(-20.69)	(-20.21)	(-20.43)	(-25.51)	(-19.42)	(-20.06)	(-25.38)
AP	-0.259***	-0.209***	-0.212***	-0.252***	-0.201***	-0.205***	-0.250***	-0.233***	-0.267***	-0.248***	-0.230***	-0.261***
	(-10.80)	(-8.08)	(-6.75)	(-10.26)	(-7.56)	(-6.52)	(-11.34)	(-9.96)	(-9.34)	(-10.98)	(-9.61)	(-9.03)
PP&E	0.032***	-0.008	0.011	0.032***	-0.007	0.012	0.041***	0.005	0.032***	0.039***	0.004	0.032***
	(5.66)	(-1.16)	(1.11)	(5.51)	(-1.06)	(1.22)	(7.87)	(0.80)	(3.72)	(7.55)	(0.68)	(3.74)
Constant	0.245***	0.280***	0.170***	0.237***	0.283***	0.171***	0.342***	0.376***	0.185***	0.333***	0.379***	0.184***
	(24.07)	(8.66)	(10.00)	(23.23)	(8.47)	(10.01)	(36.04)	(12.17)	(11.82)	(34.96)	(12.01)	(11.66)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	52477	52477	52477	51115	51115	51115	52477	52477	52477	51115	51115	51115
adj. R-sq	0.096	0.205	0.110	0.103	0.212	0.112	0.270	0.361	0.252	0.276	0.367	0.254

Table IA.3: **Net Debt Issuance and the Composition of Cash Flows with BK Decomposition**

This table repeats the main debt issuance regression with composition of cash flows estimated by Baxter and King (1999) filter. The dependent variable in Columns 1 - 6 is *Net Debt Issuance(t+1,t+2)*, defined as debt issuance in year t+1 to t+2 minus debt retirement in year t+1 and t+2, divided by total assets in year t. The dependent variable in Columns 7-12 is *Net Debt Issuance(t+1,t+2)*, defined as debt issuance in year t+1, t+2, and t+3, minus debt retirement in year t+1, t+2, and t+3, divided by total assets in year t. The main independent variables are *CF Shock(t)*, which is the year-to-year changes in the operating cash flows in year t, and *Temp. CF Shock(t)* and *Pers. CF Shock(t)*, which are the year-to-year changes in the temporary and persistent components of operating cash flows estimated using Baxter and King (1997) filter. Columns 1, 4, 7, and 10 estimate the OLS regression with year fixed effects. Columns 2, 5, 8, and 11 estimates OLS with year and industry fixed effects. Columns 3, 6, 9, and 12 estimate OLS with year and firm fixed effects. Additional control variables in year t are also included. The detailed definitions of each variable is contained in Appendix A Table A.1. t-statistics based on firm-clustered standard errors are reported in the parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels, respectively.

	Net Debt Issuance(t+1,t+2)						Net Debt issuance(t+1,t+3)					
	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE	OLS	Ind FE	Firm FE
CF Shock(t)	0.091***	0.082***	0.027*				0.156***	0.139***	0.055***			
	(6.05)	(5.51)	(1.86)				(7.36)	(6.59)	(2.78)			
Temp. CF Shock(t)				0.036	0.027	-0.012				-0.063	-0.078**	-0.104***
				(1.36)	(1.03)	(-0.50)				(-1.64)	(-2.04)	(-3.16)
Pers. CF Shock(t)				0.133***	0.125***	0.058***				0.338***	0.320***	0.193***
				(5.68)	(5.41)	(2.86)				(9.17)	(8.84)	(6.55)
Book Leverage(t)	-0.044***	-0.103***	-0.439***	-0.043***	-0.103***	-0.438***	-0.034**	-0.125***	-0.586***	-0.032*	-0.123***	-0.583***
	(-4.28)	(-10.16)	(-25.88)	(-4.22)	(-10.09)	(-25.81)	(-2.03)	(-7.82)	(-23.60)	(-1.91)	(-7.67)	(-23.48)
Cash(t)	-0.047***	-0.066***	-0.090***	-0.047***	-0.066***	-0.089***	-0.040*	-0.073***	-0.129***	-0.040*	-0.073***	-0.126***
	(-3.37)	(-4.63)	(-4.32)	(-3.38)	(-4.62)	(-4.29)	(-1.79)	(-3.19)	(-4.16)	(-1.82)	(-3.21)	(-4.08)
Firm Size(t)	-0.004***	-0.007***	-0.038***	-0.004***	-0.006***	-0.037***	-0.008***	-0.013***	-0.077***	-0.008***	-0.013***	-0.075***
	(-5.75)	(-8.11)	(-8.86)	(-5.70)	(-8.06)	(-8.74)	(-7.47)	(-9.55)	(-10.55)	(-7.36)	(-9.45)	(-10.29)
MB(t)	0.028***	0.028***	0.029***	0.028***	0.028***	0.030***	0.042***	0.042***	0.038***	0.044***	0.044***	0.040***
	(12.37)	(12.52)	(10.29)	(12.40)	(12.56)	(10.31)	(12.24)	(12.37)	(9.41)	(12.35)	(12.50)	(9.64)
AP(t)	-0.019	-0.024	0.016	-0.018	-0.023	0.018	-0.015	-0.028	0.021	-0.012	-0.024	0.032
	(-1.21)	(-1.18)	(0.44)	(-1.16)	(-1.14)	(0.52)	(-0.57)	(-0.80)	(0.37)	(-0.46)	(-0.70)	(0.57)
PP&E(t)	0.018***	-0.019***	-0.012	0.018***	-0.020***	-0.013	0.036***	-0.016*	-0.005	0.035***	-0.018**	-0.008
	(4.57)	(-3.58)	(-1.26)	(4.50)	(-3.67)	(-1.34)	(5.44)	(-1.76)	(-0.28)	(5.28)	(-1.98)	(-0.48)
Constant	0.030***	0.088***	0.314***	0.029***	0.087***	0.311***	0.046***	0.137***	0.549***	0.040***	0.131***	0.535***
	(4.27)	(10.56)	(14.50)	(4.03)	(10.33)	(14.24)	(4.17)	(10.35)	(14.85)	(3.60)	(9.88)	(14.45)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	51,999	51,999	51,999	51,999	51,999	51,999	48,906	48,906	48,906	48,906	48,906	48,906
adj. R-sq	0.040	0.067	0.119	0.041	0.067	0.119	0.043	0.081	0.135	0.045	0.083	0.137

Table IA.4: **Correction for the Measurement Error in Tobin's "q"**

This table reports the robustness tests of our baseline regressions using Erickson, Jiang, and Whited's (2014) minimum distance estimator for correcting measurement error with respect to Tobin's q. We consider EJW estimator with 4, 5, and 6 higher order cumulants for robustness. Panels A and B report the EJW corrected estimates from the book and market leverage regressions, respectively, while Panel C reports the EJW-corrected estimates from the debt issuance regressions. All specifications include year and firm fixed-effects. Additional control variables are defined in Appendix A Table A.1. t-statistics based on firm-clustered standard errors are reported in the parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels, respectively.

Panel A. Book Leverage

	Book Leverage								
	deg4	deg5	deg6	deg4	deg5	deg6	deg4	deg5	deg6
CF Vol.	0.261***	0.268***	0.262***						
	(4.94)	(5.01)	(5.01)						
Persistent CF Vol.				0.256***	0.261***	0.255***			
				(5.05)	(5.05)	(5.11)			
Persistent to Total CF Var.							0.018***	0.019***	0.018***
							(3.48)	(3.64)	(3.51)
Asset Vol.	-0.056***	-0.064***	-0.057***	-0.059***	-0.067***	-0.056***	-0.057***	-0.066***	-0.055***
	(-4.79)	(-6.93)	(-9.01)	(-5.10)	(-7.31)	(-8.94)	(-5.12)	(-7.41)	(-8.79)
MB	0.008	0.012	0.009	0.009	0.013*	0.007	0.014*	0.019***	0.013**
	(1.03)	(1.64)	(1.41)	(1.10)	(1.69)	(1.22)	(1.88)	(2.63)	(2.27)
Firm Size	0.022***	0.021***	0.022***	0.021***	0.020***	0.021***	0.019***	0.019***	0.019***
	(8.96)	(8.83)	(9.52)	(8.37)	(8.25)	(9.09)	(7.77)	(7.62)	(8.48)
Op. CF	-0.197***	-0.175***	-0.194***	-0.190***	-0.170***	-0.197***	-0.204***	-0.181***	-0.209***
	(-5.93)	(-6.28)	(-8.91)	(-5.79)	(-6.21)	(-9.05)	(-6.47)	(-6.79)	(-9.80)
AP	-0.171***	-0.162***	-0.170***	-0.164***	-0.156***	-0.166***	-0.167***	-0.158***	-0.169***
	(-5.08)	(-4.82)	(-5.21)	(-4.89)	(-4.66)	(-5.14)	(-5.03)	(-4.76)	(-5.26)
PP&E	-0.007	-0.009	-0.007	-0.007	-0.008	-0.007	-0.008	-0.009	-0.008
	(-0.75)	(-0.92)	(-0.79)	(-0.73)	(-0.88)	(-0.70)	(-0.83)	(-1.01)	(-0.81)
Constant	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(-1.03)	(-1.06)	(-1.04)	(-1.07)	(-1.09)	(-1.06)	(-0.96)	(-0.99)	(-0.96)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	52,590	52,590	52,590	52,590	52,590	52,590	52,590	52,590	52,590
adj. R-sq	0.097	0.099	0.097	0.098	0.100	0.097	0.095	0.097	0.095

Panel B. Market Leverage

	Market Leverage								
	deg4	deg5	deg6	deg4	deg5	deg6	deg4	deg5	deg6
CF Vol.	0.069	0.072	0.076*						
	(1.45)	(1.56)	(1.69)						
Persistent CF Vol.				0.100**	0.102***	0.106***			
				(2.51)	(2.63)	(2.76)			
Persistent to Total CF Var.							0.002	0.003	0.003
							(0.50)	(0.59)	(0.71)
Asset Vol.	0.005	0.001	-0.005**	0.005	0.001	-0.005*	0.005	0.001	-0.005**
	(0.68)	(0.14)	(-2.10)	(0.80)	(0.15)	(-1.69)	(0.80)	(0.21)	(-2.38)
MB	-0.039***	-0.037***	-0.034***	-0.040***	-0.038***	-0.035***	-0.037***	-0.035***	-0.032***
	(-7.57)	(-7.63)	(-7.81)	(-7.80)	(-7.90)	(-7.74)	(-7.19)	(-7.30)	(-7.54)
Firm Size	0.032***	0.031***	0.031***	0.032***	0.031***	0.031***	0.031***	0.031***	0.030***
	(15.03)	(15.25)	(15.31)	(14.92)	(15.21)	(15.19)	(14.60)	(14.89)	(15.01)
Op. CF	-0.510***	-0.500***	-0.487***	-0.511***	-0.498***	-0.483***	-0.515***	-0.504***	-0.489***
	(-19.83)	(-24.02)	(-27.36)	(-20.17)	(-24.44)	(-25.96)	(-20.27)	(-24.05)	(-27.68)
AP	-0.314***	-0.310***	-0.305***	-0.313***	-0.309***	-0.303***	-0.314***	-0.310***	-0.304***
	(-10.94)	(-10.95)	(-10.81)	(-10.92)	(-10.92)	(-10.71)	(-10.97)	(-10.97)	(-10.82)
PP&E	0.029***	0.028***	0.027***	0.029***	0.028***	0.027***	0.029***	0.028***	0.027***
	(3.34)	(3.29)	(3.22)	(3.39)	(3.33)	(3.25)	(3.34)	(3.28)	(3.21)
Constant	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.79)	(0.78)	(0.77)	(0.78)	(0.77)	(0.75)	(0.82)	(0.81)	(0.80)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	52,590	52,590	52,590	52,590	52,590	52,590	52,590	52,590	52,590
adj. R-sq	0.153	0.158	0.164	0.152	0.158	0.165	0.152	0.157	0.164

Panel C. Debt Issuance

	Net Debt Issuance(t+1,t+2)						Net Debt issuance(t+1,t+3)					
	deg4	deg5	deg6	deg4	deg5	deg6	deg4	deg5	deg6	deg4	deg5	deg6
CF Shock(t)	-0.198***	-0.129***	-0.142***				-0.346***	0.094***	0.096***			
	(-3.21)	(-3.74)	(-5.35)				(-3.56)	(3.82)	(3.89)			
Temp. CF Shock(t)				-0.388***	-0.268***	-0.282***				-0.752***	-0.028	-0.033
				(-4.31)	(-5.59)	(-7.82)				(-5.33)	(-0.85)	(-1.11)
Pers. CF Shock(t)				0.465***	0.387***	0.396***				1.113***	0.611***	0.614***
				(5.58)	(6.01)	(6.24)				(7.36)	(8.78)	(8.89)
Book Leverage(t)	0.271***	0.196***	0.209***	0.311***	0.216***	0.226***	0.470***	-0.005	-0.006	0.545***	-0.006	-0.002
	(4.43)	(6.08)	(9.14)	(4.62)	(6.29)	(9.05)	(4.72)	(-0.34)	(-0.44)	(5.19)	(-0.31)	(-0.16)
Cash(t)	-0.297***	-0.341***	-0.333***	-0.274***	-0.330***	-0.324***	-0.340***	-0.623***	-0.624***	-0.297***	-0.625***	-0.623***
	(-7.41)	(-13.72)	(-15.45)	(-6.28)	(-12.71)	(-14.32)	(-5.14)	(-24.01)	(-24.27)	(-4.28)	(-23.58)	(-24.49)
Firm Size(t)	-0.369***	-0.288***	-0.303***	-0.399***	-0.299***	-0.311***	-0.605***	-0.099***	-0.097***	-0.651***	-0.086**	-0.089***
	(-5.17)	(-6.62)	(-8.24)	(-5.22)	(-6.60)	(-8.13)	(-5.13)	(-2.99)	(-2.96)	(-5.28)	(-2.51)	(-2.77)
MB(t)	-0.011	-0.019***	-0.018***	0.003	-0.010	-0.008	-0.033**	-0.087***	-0.087***	-0.003	-0.080***	-0.079***
	(-1.36)	(-3.78)	(-3.90)	(0.33)	(-1.60)	(-1.57)	(-2.39)	(-14.08)	(-13.96)	(-0.15)	(-12.21)	(-12.43)
AP(t)	-0.101*	-0.065	-0.071*	-0.116**	-0.071*	-0.077*	-0.171*	0.030	0.031	-0.189**	0.036	0.035
	(-1.90)	(-1.60)	(-1.80)	(-2.05)	(-1.71)	(-1.88)	(-1.91)	(0.56)	(0.57)	(-1.99)	(0.67)	(0.65)
PP&E(t)	0.055**	0.030**	0.034***	0.052**	0.024	0.027**	0.121***	-0.034**	-0.034**	0.108***	-0.047***	-0.046***
	(2.32)	(1.97)	(2.69)	(2.19)	(1.62)	(2.11)	(3.03)	(-2.02)	(-2.04)	(2.77)	(-2.79)	(-2.78)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	62,226	62,226	62,226	62,226	62,226	62,226	55,013	55,013	55,013	55,013	55,013	55,013
adj. R-sq	0.185	0.157	0.162	0.203	0.167	0.171	0.227	0.105	0.104	0.261	0.109	0.110