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Tradeoff theory and leverage dynamics of high-frequency debt issuers*

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Abstract

We test whether high-frequency net-debt issuers (HFIs)—public industrial companies with relatively low issuance costs and high debt-financing benefits—manage leverage towards long-run targets. Our answer is they do not: (1) the leverage-profitability correlation is negative even in quarters with leverage rebalancings, (2) the speed-of-adjustment to target leverage deviations is no higher for HFIs than for low-frequency net-debt issuers, and (3) under-leveraged HFIs do not speed up rebalancing activity in significant investment periods. Thus, even in the subset of firms most likely to follow dynamic trade-off theory, the theory does not appear to hold.

JEL classification: G32

Keywords: High-frequency debt issuer, issue costs and benefits, dynamic rebalancing, leverage profitability relation, speed of adjustment, tradeoff theory

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1. Introduction

Do public industrial firms manage leverage towards a 'long-run target' as predicted by dynamic tradeoff theory (Fischer et al., 1989; Goldstein et al., 2001)? Or, do firms work to maintain 'debt capacity' to finance investments as in the dynamic pecking order (Myers and Majluf, 1984; Fama and French, 2002)? Or, are *both* leverage strategies part of observed leverage policies (DeAngelo, DeAngelo, and Whited, 2011)? Recent empirical tests highlight the difficulties in separating tradeoff and pecking order behavior in the data.[1] For example, when estimating thresholds for switching between external debt and equity financing, Leary and Roberts (2010) find support for the pecking order only after conditioning on variables that are typically attributed to tradeoff theory. Faulkender et al. (2012) condition their estimation of leverage-ratio mean-reversion on firms' financing deficits—a pecking-order concept—but conclude in favor of tradeoff theory. Denis and McKeon (2012) and DeAngelo, Goncalves, and Stulz (2018) study proactive leverage rebalancings following periods with extreme leverage and conclude against the existence of leverage targets. Danis, Rettl, and Whited (2014) and Eckbo and Kisser (2019) both estimate the relation between profitability and leverage in periods with active leverage rebalancings but reach opposite conclusions with respect to tradeoff theory.

We contribute to this important capital structure debate by revisiting core theoretical tradeoff predictions using a new and hitherto unexplored subset of US public industrial companies: persistent high-frequency net-debt issuers (henceforth HFIs). We show that these firms raised the bulk of all public and private debts (net of debt retirements) over the past three decades. By selection, the leverage time-series of HFIs contains an extraordinarily large number of security issuances and retirements, thus minimizing the confounding impact of passive changes in market leverage that may have frustrated earlier tests (Welch, 2004). Also by design, the HFI selection algorithm tends to exclude firm-quarters with extremely high leverage—periods in which survival is likely to be more important than the type of ordinary leverage targeting described by tradeoff theory.[2] Simply put, given their likely low fixed issuance costs and high debt-financing benefits, if HFIs do not manage leverage towards a target, then who does?

The first and arguably most important dynamic tradeoff-theoretic hypothesis (H1) that we test is based on the intuitive notion that firms issue debt to rebalance capital structure only in periods when the benefits of doing so exceed fixed debt issuance costs (Fischer, Heinkel, and Zechner, 1989; Goldstein, Ju, and Leland, 2001). In theory, a rebalancing event involves issuing debt and distributing the proceeds to shareholders (a cash dividend or share repurchase). While sufficiently

[1] See Eckbo et al. (2007), Graham (2008), Frank and Goyal (2008), Parsons and Titman (2008), and Graham and Leary (2011) for reviews of earlier evidence.

[2] The market leverage of HFIs averages 32%. An analogous direct sort on leverage yields an average leverage ratio of 52%.

large fixed debt-issuance costs may deter rebalancings for long periods of time, H1 holds that when firms *do* rebalance, they move to their target leverage ratios (Danis, Rettl, and Whited, 2014; Eckbo and Kisser, 2019). Since more profitable HFIs have higher leverage targets (they are in a better position to benefit from corporate tax shields and face lower expected bankruptcy costs), the theory predicts a positive leverage-profitability correlation conditional on rebalancing events. This cross-sectional prediction is as powerful a test of a core tradeoff prediction as it is simple: the econometrician need not estimate the target leverage ratio as it is directly identified by the firm's rebalancing decision. Importantly, the test results reported in Section 4 below strongly reject H1. That is, when rebalancing capital structure by issuing debt to finance a large net-equity payout, more profitable HFIs do *not* choose higher leverage. It is also worth pointing out that, because the type of rebalancing events used to test H1 do not occur under the pecking order theory, the latter theory does not confound inferences with respect to the empirical validity of tradeoff theory.

The above conclusion from testing H1 using HFIs complements the test results in Eckbo and Kisser (2019) based on the full universe of Compustat industrial firms. In this context, our use of HFIs adds test power for several reasons: First, since HFIs rebalance leverage much more frequently than the typical Compustat industrial company, they are also more likely to satisfy H1 if this core tradeoff prediction holds in the data. Second, we show that the rebalancing events undertaken by HFIs are economically significant events involving large net-debt issues and shareholder distributions—much larger than the size-thresholds used to identify the events themselves. Third, while Danis, Rettl, and Whited (2014) find evidence of a positive conditional leverage-profitability correlation when including internally-financed (not just debt-financed) rebalancing events, we show that H1 is rejected irrespective of how the HFIs finance the equity payout in the rebalancings. Paraphrasing DeMarzo (2019), the strong rejection of H1 based on our HFIs is "most problematic for the standard tradeoff model" (p.1590).

While the above test is largely cross-sectional in nature, our second tradeoff hypothesis (H2) primarily exploits the time-series variation in leverage ratios. Here, we follow a large literature addressing whether firms manage leverage towards a target through time-series estimation of the speed-of-adjustment (SOA) to putative target leverage deviations. However, we introduce a novel cross-sectional element also here. As we explain in Section 2, under H2, the relatively low fixed issue costs and/or high issue benefits of the HFIs imply relatively tight theoretical rebalancing boundaries. Therefore, HFIs are predicted to exhibit higher SOA estimates (shorter time to close target-leverage deviations) than *low-frequency* net-debt issuers (LFIs), which almost certainly have less tight rebalancing boundaries. The results of this cross-sectional comparison of SOAs are also interesting. Notwithstanding that HFIs on average issue net-debt twelve times as often as LFIs (while their equity issue frequencies are similar), the SOA estimates are statistically indistinguishable across HFIs and LFIs, which rejects H2. We also note that the surprisingly high SOA estimates of LFIs—firms that rarely issue net-debt—may also reflect passive equity growth (Welch, 2004) or some degree of the mechanical mean reversion driven by the leverage-ratio boundaries pointed out by Chang and Dasgupta (2009). These alternatives are much less likely drivers of the SOA estimates of the highly active HFIs.

In our third tradeoff hypothesis (H3), we attempt to integrate investment finance decisions into the leverage dynamics of HFIs, relying on the intuition of models such as DeAngelo, DeAngelo, and Whited (2011). Combining elements of tradeoff and pecking order arguments, this model shows that the choice of funding instrument (debt or equity) may either support or temporarily override the objective of managing leverage towards a long-run target. For example, if marginal leverage-adjustment costs are relatively low when the firm is already issuing debt to finance investment, SOA may increase in periods when low-leverage firms exhibit high investment. However, conditionally over-leveraged firms may also issue new debt to fund large investment shocks, for subsequently to repurchase the debt issue as investment funding needs abate. We summarize these types of predictions in our hypothesis H3.

We perform our analysis of H3 in two parts. In the first part, we double-condition the SOA estimates on high/low leverage and investment. Contrary to Faulkender et al. (2012), who document an increase in SOA in periods with high external financing of investment, there is no evidence that under-leveraged HFIs also increase leverage-adjustment speed in periods with high investment. As discussed further in Section 6, our rejection of this part of H3 reflects not only our use of HFIs as test assets but also that—unlike Faulkender et al. (2012)—our definition of high-investment periods do not involve the firm's financing deficit. Also, we find that SOA estimates do not increase for over-leveraged HFIs during periods of low investment. In sum, we find no evidence that the SOA of HFIs differs across periods with high and low marginal cost of leverage adjustment. In the second part, we focus on the leverage dynamics of highly leveraged HFIs. Our approach here is similar in spirit to that of Denis and McKeon (2012) and DeAngelo, Goncalves, and Stulz (2018), both of which end up concluding against tradeoff theory. We show that as much as one-fifth of the net-debt issues by HFIs occur when they are presumed to be over-leveraged. However, only a small fraction of these issues are repurchased over a subsequent three-year period. Finally, we document frequent debt retirements by under-leveraged and highly profitably HFIs, which directly contradicts tradeoff theory.

The rest of the paper is organized as follows. Section 2 lays out our three central tradeoff hypotheses and how our test approach differs from prior attempts to test these. Section 3 explains the issue-frequency sort and documents striking differences in firm characteristics and lifecycle funding policies of the HFIs and LFIs. Sections 4 through 6 present the test results for our three hypotheses, while Section 7 concludes the paper. Detailed information on the persistence of the

HFI/LFI classification is found in the Appendix.

2. Core Tradeoff Hypotheses

We focus our analysis on each of the following three predictions, all of which are empirical variations of the basic tradeoff hypotheses that firms manage leverage towards a (long-run) target:

H1: More profitable HFIs move to higher leverage when they actively rebalance capital structure.

H2: SOA coefficient estimates are higher for HFIs than for LFIs.

H3: The SOA of HFIs increases in periods with low marginal adjustment costs and high marginal adjustment benefits (investment high and firm under-leveraged, or investment low and firm over-leveraged). While debt issues by over-leveraged HFIs are possible, they are transitory (followed by retirements towards the leverage target).

As a guide to understanding H1–H2, it suffices to keep the discussion at an intuitive level.[3] Thus, as in the familiar concave firm-value function $V(L)$ in Figure 1, where L is the market leverage ratio, the tradeoff between marginal tax benefits and expected bankruptcy costs maximizes equity value at the (long-run) target leverage ratio L^*. In the following, we highlight the effect of a fixed debt-issue cost C on optimal leverage rebalancing activity (debt issues may also entail small variable costs, which by themselves cannot create rebalancing inertia). Moreover, we explain differences in the hypothesized rebalancings of HFIs and LFIs based on the assumption that $C_{HFI} < C_{LFI}$ and/or that the slopes of the value-functions are such that $V'(L)_{HFI} > V'(L)_{LFI}$ for $L < L^*$. In other words, our empirical test strategy is based on the assumption that the HFIs face lower fixed debt issuance costs and/or higher marginal debt-financing benefits than the LFIs in our sample.

While we are unable to directly test for $V'(L)_{HFI} > V'(L)_{LFI}$, the respective firm characteristics of these two categories of firms (shown in Section 3.3) provide indirect support for this assumption. Moreover, observed differences in issue frequencies (Section 3.2) and in estimated issue hazards (Section 5.1) provide more direct support for the assumption that $C_{HFI} < C_{LFI}$.

[3]The early dynamic tradeoff models of Fischer, Heinkel, and Zechner (1989) and Goldstein, Ju, and Leland (2001) provide a set of sufficient conditions for H1 and H2 to hold, while H3 is motivated by the intuition in DeAngelo, DeAngelo, and Whited (2011). Goldstein, Ju, and Leland (2001) use the following model setup: Investment is exogenous and the firm's operating profits follow a stochastic process in continuous time. There are no agency conflicts between managers and equity-holders, nor any informational asymmetries between firm managers and investors. The firm selects the optimal leverage ratio so as to maximize shareholder value subject to the tradeoff between a debt-related tax shield and expected deadweight costs of liquidation in bankruptcy. Positive after-tax profits are immediately and costlessly distributed to shareholders as dividends (firms do not hold cash). When operating profits are negative, shareholders either costlessly inject new equity or exercise the option to default on its debt obligation. Strebulaev and Whited (2012) and Sundaresan (2013) provide literature reviews.

2.1 H1: The Conditional Leverage-Profitability Relation

Focusing on the solid firm-value curve in Figure 1, the presence of fixed debt issuance costs C implies that firms are at or near L^* *only* in periods when they actively rebalance leverage. Over time, as firm profitability puts downward pressure on L, the firm remains dynamically inactive until L reaches the endogenously determined lower rebalancing boundary $\underline{L}^{HFI}$, which for illustrative simplicity is drawn at $V(L^*) - C$. At this lower boundary, it is optimal to rebalance capital structure as the value created by a debt issue designed to restore L^* also covers C. The proceeds from the debt issue are paid out to shareholders in the form of a cash dividend or share repurchase.

A key implication of the above is that, in periods when firms actively rebalance leverage, the cross-sectional relation between leverage and profitability is positive. In inactive periods, the leverage-profitability relation is negative as profitability shocks (the positive drift term in the exogenous stochastic process driving operating profits) mechanically drive down L on average:

H1 (leverage-profitability correlation):
Let Π_{t-1} denote firm profitability in period $t-1$, and let $a = 1$ denote the presence of a capital structure rebalancing event in period t:

(i) *In periods when HFIs rebalance capital structure by issuing debt and paying the proceeds to shareholders, more profitable firms move to higher leverage: $Cov_{HFI}(L_t, \Pi_{t-1}|\ a = 1) > 0$.*

(ii) In other periods ($a = 0$), higher profitability reduces leverage: $Cov_{HFI}(L_t, \Pi_{t-1}|\ a = 0) < 0$.

As pointed out in the introduction, testing H1 does not require an estimate of the unobserved target leverage ratio L^*. This is because, under the theory, the leverage adjustment observed in rebalancing periods brings the firm close to L^*. Since, in the cross-section of rebalancing events, more profitable firms must end up at a higher target, a positive conditional correlation between profitability and observed leverage, $Cov(L_t, \Pi_{t-1}|\ a = 1) > 0$, is both necessary and sufficient for the dynamic tradeoff theory to hold.

Extant empirical testing of H1—based on the full sample of Compustat industrial companies rather than on our HFIs—shows mixed results. Danis, Rettl, and Whited (2014) find evidence of a significantly positive conditional leverage-profitability correlation, while Eckbo and Kisser (2019) instead find that the conditional correlation is significantly negative. As explained in greater detail in Section 4, the difference in the results of these two prior studies stem from differences in their respective definitions of a capital structure rebalancing event. While both studies require a substantial cash distribution to shareholders, only Eckbo and Kisser (2019) also require that this distribution be financed by a debt issue (as dictated by the underlying tradeoff theory). In Danis, Rettl, and Whited (2014), the bulk of the distribution is instead financed internally by cash-balance draw-downs. In general, issuing debt incurs a greater fixed costs (C) than drawing down a cash balance. As paying C is what creates rebalancing inertia, the test below and in Eckbo and Kisser (2019) represent the stronger tests of whether the conditional leverage-profitability correlation is positive.

Testing H1 based on HFIs is of particular interest for several reasons. First, since our HFIs are *a priori* more likely than other Compustat industrial firms to manage leverage towards a target, it follows that the predicted positive conditional leverage-profitability correlation is more likely to be correctly identified in the data. Second, we show in Section 4.2 below that the rebalancing frequency of the HFIs is three times that of non-HFI sample firms, which further increases test power. Third, the HFIs tend to exclude zero and near-zero leverage firms, which tradeoff theory fails to rationalize (Strebulaev and Yang, 2013) and the inclusion of which would exacerbate the (mechanical) negative leverage-profitability relation in the data. Fourth, notwithstanding that HFIs likely face relatively low fixed debt-issuance costs C, we show that the two rebalancing components (net-debt issue and shareholder distribution) are much larger than the minimum size-thresholds used to identify rebalancings (both average 12% when the minimum threshold is 2.5% of total assets). Thus, the greater rebalancing frequency of HFIs does not come at a cost of economically less significant transactions.

A fifth motivation for testing H1 using HFIs comes from the simulations of the tradeoff model of Goldstein, Ju, and Leland (2001) performed by Danis, Rettl, and Whited (2014). The last panel of their Figure 1 shows that firms with lower fixed debt issuance cost exhibit higher sensitivity of leverage to profitability at rebalancing points and so exhibit greater power to test H1. This prompts Danis, Rettl, and Whited (2014) to raise concern that their failure to reject the tradeoff prediction (H1) may be specific to frequent debt issuers: “if frequent refinancers differ in terms of unobservables from the rest of the sample, and if these differences affect leverage decisions, then our results would apply only to these frequent refinancers” (p.434). Notwithstanding their efforts to address this concern empirically (they randomly sample at most one rebalancing observation per firm), their simulation further suggests that it should be more difficult to reject H1 when using our “frequent refinancers” (HFIs) as test assets rather than a randomly selected sample of industrial Compustat firms.

2.2 H2: Speed-of-Adjustment to Target Leverage Deviations

While H1 examines the leverage-profitability correlation at rebalancing points in a sample of HFIs only, H2 examines whether the leverage dynamics of HFIs relative to that of LFIs is driven by differences in the curvature of the firm value function net of C:

H2 (speed-of-adjustment):
Suppose $C_{HFI} < C_{LFI}$ and/or $V'_{LFI}(L) < V'_{HFI}(L)$ for $L < L^*$. The SOA of HFIs exceeds that of

the LFIs.

As the relation between rebalancing boundaries, issuance cost and benefits is complex and requires solving a dynamic optimization problem, H2 formally relies on the comparative statics in Fischer, Heinkel, and Zechner (1989) (their Table III). The economic intuition is simple: if issuance cost are zero and the value function is concave, then a firm would instantaneously react to a profitability shock and adjust leverage back up to its target L^*. Hence, SOA would equal one. If a firm faces prohibitively high fixed debt issuance costs, it would never adjust leverage and the SOA would be zero.

Figure 1 further illustrates H2 visualizing the role of fixed issuance cost C and marginal debt benefits. Notice first that lowering C in Figure 1 directly shortens the "dynamic inactivity" distance $L^* - \underline{L}^{HFI}$, where $\underline{L}^{HFI}$ is HFI's lower recapitalization boundary. For simplicity (without loss of generality), the figure is drawn assuming $L^*_{HFI} = L^*_{LFI}$, $C_{HFI} = C_{LFI}$, and $V'_{LFI}(L) < V'_{HFI}(L)$ for $L < L^*$. As shown, the distance $L^* - \underline{L}^{HFI} < L^* - \underline{L}^{LFI}$. Adding the (reasonable) assumption that $C_{HFI} < C_{LFI}$ only exacerbates this distance. Hence, H2 hypothesizes that the SOA for HFI exceeds the SOA for LFI.

As discussed in greater detail in Section 5 below, there is a substantial literature testing H2 using the full Compustat universe of industrial firms (Fama and French, 2002; Flannery and Rangan, 2006; Hovakimian and Li, 2012; Faulkender et al., 2012). This literature reports SOA coefficients ranging from the OLS-estimated seven-year leverage-deviation half-life in Fama and French (2002) to about one year for the GMM estimates in (Faulkender et al., 2012). Our contribution to this literature comes from the fact that comparing the GMM-estimates of the SOA of HFIs and LFIs provides a new cross-sectional test of the SOA that effectively sorts firms on their latent net-debt issue costs and benefits.

2.3 H3: Leverage Dynamics with Endogenous Investment Finance

While H1 and H2 are derived from tradeoff theory with exogenous investment, our third and final hypothesis addresses an empirical implication of models where financing and investment are both endogenous. Models accounting for the dynamic interaction between investment policy and capital structure range from the impact of leverage on real investment options (Sundaresan and Wang, 2007; Tserlukevich, 2008; Morellec and Schürhoff, 2010) to considering debt covenants, taxes/agency and cash holdings (Hennessy and Whited, 2005; Titman and Tsyplakov, 2007; Gamba and Triantis, 2008; DeAngelo, DeAngelo, and Whited, 2011).

We focus on the intuition provided by the model of DeAngelo, DeAngelo, and Whited (2011) as it provides an immediate extension of H2. The model combines elements of tradeoff and pecking order arguments and shows that the choice of funding instrument (debt or equity) may either support or temporarily override the objective of managing leverage towards a long-run target. For example, because marginal leverage-adjustment costs are relatively low when the firm is issuing debt to finance investment, the SOA increases in periods when low-leverage firms exhibit high investments. Moreover, since debt may be the cheaper source of funds also for conditionally over-leveraged firms, such companies may issue new debt to fund large investment shocks. The new debt issue is then of a transitory nature as it optimally retired as soon as the demand for investment finance abates. Much as in a pecking order theory, this active leverage reduction reflects an attempt to restore debt capacity, and it provides shareholders with a direct marginal adjustment benefit.

H3 (Financing and investment):

Part (1): *Marginal leverage-adjustment costs are lower and/or benefits are higher in periods when (i) HFIs are under-leveraged ($L < L^*$) and investment is high, and (ii) when HFIs are over-leveraged ($L > L^*$) and investment is low. Both (i) and (ii) increase SOA.*

Part (2): *While over-leveraged HFIs may issue debt to finance investment shocks, such debt issues are transitory: they are retired soon after the investment activity abates.*

As discussed in more detail in Section 6, our empirical exploration of H3 resembles aspects of the analysis of Faulkender et al. (2012), Denis and McKeon (2012), and DeAngelo, Goncalves, and Stulz (2018). In the spirit of Faulkender et al. (2012), we condition the SOA analysis directly on the level of investments. They find that their SOA estimates increase in periods with high financing deficits, and conclude in favor of the existence of long-run leverage targets as predicted by tradeoff theory. Denis and McKeon (2012) sample debt issues that are large enough to raise the issuer's leverage to at least 10% above the estimated target leverage ratio, while DeAngelo, Goncalves, and Stulz (2018) select firms with historical peak leverage ratios. In both studies, firms' subsequent capital structure activity cause the authors to conclude that firms are unlikely to manage leverage towards a long-run target.

3. Who are the High-Frequency Net-Debt Issuers?

Since our tradeoff hypotheses H1–H3 are couched in terms of *active* leverage dynamics, performing tests based on a Compustat subsample of highly active debt issuers makes sense. The purpose of the tests, then, is to determine whether this active leverage policy is as predicted by tradeoff theory. Moreover, since two core but latent theoretical parameters underlying H1–H3 are fixed debt issuance costs and marginal debt issuance benefits, the objective of the sorting mechanism described below is to identify firms that are likely to score high on both these two dimensions.

We first describe the mechanism for sorting the Compustat industrial universe into HFIs and LFIs. We then describe their lifecycle firm characteristics. As shown, the HFIs and the LFIs turn out to be fundamentally different types of firms—not just in terms of debt issue activity and market leverage (their equity issue activities are similar) but more fundamentally along dimensions relating to asset structure and product market operations. Since the capital structure literature associates this difference with differences in the marginal benefits of debt financing, the simple issue-frequency sort described below appears to serve its purpose.

3.1 Data and Issue-Frequency Sorting Mechanism

We use the annual merged CRSP/Compustat (CCM) file to sample firms, and quarterly CCM data to construct the annual issue frequency count, 1984–2016. Table 1 details the sample selection, with Panel A for annual and Panel B for quarterly data. As is common in the capital structure literature, we exclude foreign firms, financial companies and regulated utilities, as well as firms with missing entries of key Compustat balance sheet and cash flow characteristics.[4]

In Panel C, we merge the quarterly and annual financial statement information and impose two additional sample restrictions. The most restrictive is to require the firm to go public during the sample period, which excludes 4,001 firms that went public prior to 1984. We condition the analysis below on public listing age in order to control for the effect of a firm's product market maturity on the debt issue frequency. That is, since older firms may have built collateralizable assets which may affect the propensity to issue debt, we structure the issue frequency analysis in event time since the year of going public. The final sample consists of 9,340 firms and an unbalanced panel of 66,056 firm-years and 240,028 firm-quarters.

We build the cumulative annual issue counts from the sample firms' quarterly Compustat cash flow statements. Definitions for annual variables are in Table 2, quarterly variables in Table 3. A quarterly net-debt issue (NDI) is defined as the difference between the sum of all forms of public and private debt issues and debt retirements. This definition ensures that we are not counting debt rollovers (which appear in the cash flow statement as an equal issue and retirement).

Turning to the issue-frequency sort, let N_{it} denote the cumulative number of positive quarterly net-debt issues (NDI^+) by firm i from the public listing year (event-year 0) through event-year t:

$$N_{it} = \sum_{\tau=0}^{t} \sum_{q=1}^{4} I_{iq\tau}. \tag{1}$$

$I_{iq\tau}$ is an index that takes a value of one if firm i issues positive net-debt of at least 2.5% of total assets in quarter q of event-year $\tau \leq t$, i.e., if $NDI^+_{iq\tau}/A_{iq\tau} \geq 2.5\%$. In a given event-year

[4]Exact details are provided in the footnotes of Table 1.

t, firm i is labelled high-frequency issuer (HFI) if N_{it} is in the upper quartile of the distribution of N_t. Conversely, firm i is labelled low-frequency issuer (LFI) if N_{it} is in the lower quartile of the distribution. A firm that is neither HFI not LFI is labelled medium-frequency issuer (MFI) in year t.

3.2 Issue Frequencies

Table 4 (using the 2.5% issue size threshold in Eq. 1) and Table 5 (using a 5% issue size threshold) list the average annual cumulative frequencies of net-debt issues (NDI^+), net-debt retirements (NDI^-), and equity issues (EI) by the HFIs and LFIs since public listing. The issue counts for NDI^- in Panel B and EI in Panel C are for the firms classified as HFI or LFI in Panel A. While the tabulation stops with event year 20 for expositional simplicity, the empirical analysis below uses all firm-years in the sample.

In the year of public listing, two thirds of the sample firms do not issue net-debt, while most of the remaining firms issue once only. Thus, (because the median debt issue frequency is zero) there are no MFIs in year 0. Moreover, as the median firm age since going public is five years (average seven), ten years into the public lifecycle the annual number of sample HFIs and LFIs shown in Table 4 drops off quickly. This drop-off, which will become evident as we tabulate the number of firms over their listing age, is of course equally present in any study sorting on calendar years.

The issue sort creates a dramatic difference in the number of issues between HFIs and LFIs. In Panel A of Table 4 and five years after public listing ($t = 5$), HFIs (LFIs) on average make 7.37 (0.41) quarterly net-debt issues. The large spread between HFIs and LFIs is evident throughout the public lifecycle and increases to 21.21 (HFIs) versus 2.70 (LFIs) twenty years following public listing. Moreover, the debt issues of HFIs are also large: HFIs undertake 61% of the total sample of 36,587 positive net-debt issues and receive 54% of the dollar value of total issue proceeds over the sample period. LFIs undertake only 4% of the issues and raise 7% of the issue proceeds.

As shown in Panel A of Table 5, raising the issue size threshold to 5% reduces the average number of net-debt issues but maintains the large spread between HFIs and LFIs. For example, the number of issues by HFIs (LFIs) is 4.82 (0.0) in year five, and 13.39 (1.62) in year twenty. Moreover, with the 5% threshold, HFIs raise 58% and LFIs 10% of the total issue proceeds over the sample period.[5]

Maintaining the HFI/LFI classifications from Panel A, panels B and C of Tables 4 and 5 show the annual spread in net-debt retirement (NDI^-) and for equity issues. The tabulated frequency

[5] While it is common in the security-issuance literature to use a 5% issue-size threshold (Leary and Roberts, 2005; Eckbo, Masulis, and Norli, 2007; Leary and Roberts, 2010), we focus primarily on the 2.5% threshold because it creates greater dispersion in the number of security issues per firm. However, the algorithm in Eq. (1) identifies much the same firms when using a 5% net-debt issue size threshold as with the 2.5% threshold.

of net-debt retirements is interesting since, in classical dynamic tradeoff models, it is never optimal to reduce leverage outside of default or strategic renegotiation (Admati et al., 2018). In fact, Table 4 shows a significant number of net-debt retirements. For example, the average number of net-debt retirements after five years of listing is 4.32 for HFIs and 1.19 for LFIs, and it is 17.18 and 3.73, respectively, after twenty years. Moreover, in year five, the percentage of total retirement volume is 48% for HFIs and 16% for LFIs (46% versus 6% after twenty years).

Also interesting, Panel C of Tables 4 and 5 show that HFIs and LFIs have similar equity issue frequencies. For example, with a 2.5% equity issue size threshold and after ten years of listing, HFIs and LFIs have on average made 3.78 and 4.87 equity issues, respectively. Increasing the debt-issue size threshold to 5% hardly changes the number of equity issues (3.49 versus 3.21, respectively for year ten). The total sample median is 3 equity issues after ten years (2 issues with a 5% threshold), which is similar to the frequency of seasoned equity offerings reported elsewhere in the literature (Fama and French, 2005; Eckbo, Masulis, and Norli, 2007; Leary and Roberts, 2010).

Last, but not least, we demonstrate in the Appendix that the above HFI/LFI sort successfully identifies firms that *persist* in their respective issue-frequency categories throughout their lifetimes as publicly traded companies. As such, the lifecycle net-debt issue-frequencies that we identify appear to be determined by firms' asset composition more than by listing age per se. Moreover, as shown next, these lifecycle differences in firm characteristics appear already when the firms go public, and they indicate that HFIs are more of a "brick and mortar" type of asset-rich companies while LFIs are less asset-rich and more R&D-intensive.

3.3 Firm Characteristics

Table 6 lists average firm characteristics of HFIs and LFIs sorted by year since public listing.[6] As expected, the table shows significant differences in firm characteristics that the capital structure literature often associates with differential issue costs and debt financing benefits. What is more surprising is that these differences emerge already shortly after public listing and then persist over the public lifecycle. HFIs have relatively high leverage ratios whether considering gross debt or debt net of cash balances. On average, the market leverage ratio (L in Column 1) is 32% for HFIs and 7% for LFIs. The annual fraction of the sample firms that are all-equity financed (AE in Column 2) averages 40% for LFIs and only 3% for HFIs. Moreover, the cash ratio C in Column

[6] In terms of the Fama-French FF12 industries, the sample representation of HFIs and LFIs is as follows: business equipment (HFIs 14%, LFIs 39%), shops (HFIs 21%, LFIs 8%), health care (HFIs 10%, LFIs 22%), consumer non-durables (HFIs 8%; LFIs 4%), consumer durables (HFIs 4%, LFIs 2%), manufacturing (HFIs 12%, LFIs 7%), energy (HFIs 8%, LFIs 2%), chemicals (HFIs 3%, LFIs 2%), and other (HFIs 21%, LFIs 14%).

(3) is much lower for HFIs than for LFIs: 11% versus 40%, respectively.[7]

As shown in columns (4)–(6), HFIs are larger than LFIs (total assets averaging $822 million versus $514 million), have greater asset tangibility (PPE/Assets of 0.32 versus 0.17), and are more profitable: $Prof(\Pi)$ averages 3% and -5% of total assets, respectively (40% of the LFIs have $\Pi < 0$ versus 24% for HFIs). The average profitability for LFIs turns positive only in year 13 after public listing, compared to year 2 for HFIs. The higher profitability of HFIs translates into a higher propensity to pay dividends (24% versus 15% for LFIs). In Column (7), the average ratio of dividends to book equity is 0.02 (0.01) for HFIs (LFIs). Adding share repurchases further reduces payout differences between HFIs and LFIs (leading to a payout yield of 4% for both categories of firms). Interestingly, the operating risk of HFIs and LFIs appears similar. Computing the annualized standard deviation of quarterly values of operating profitability ($Risk$), column (8) shows that $Risk$ is 0.07 for HFIs and 0.08 for LFIs.

Furthermore, columns (9)–(11) of Table 6 reveal interesting differences between the average investment rates of HFIs and LFIs. In Column (10), capital expenditures scaled by lagged book assets (I_{CX}) averages 10% versus 6% for LFIs. Column (11) is based on total cash investments and also includes cash outlays for patent purchases and acquisitions, increasing the scaled investments I_{CF} to 15% for HFIs and 9% for LFIs. Reflecting the larger rate of investments in fixed assets, Tobin's Q in Column (12) is on average substantially lower for HFIs than for LFIs (1.65 vs. 2.71). Relatedly, Column (13), documents a substantially higher rate of R&D expenditures for LFIs than for HFIs: 12% versus only 3%. R&D expenditures are designed to generate valuable future growth options, which likely translate into higher Tobin's Q to a greater extent than do investments in fixed assets (Fama and French, 1998; Carlson et al., 2004).

3.4 Lifecycle Funding Policies

We end our descriptive analysis by showing that the differences in debt-issuance activity translate into significant lifecycle funding differences between HFIs and LFIs. For this purpose, we compile the eight sources of funds identified by the firms' annual cash flow statements. Let $R_j \equiv S_j / \sum_i^8 S_i$

[7] While not tabulated, there is evidence that the high cash holdings of LFIs reflect basic operating policy. To see this, we first estimate the coefficients of a standard cash model accounting for firm and age fixed effects and using the full sample of firms, and then construct separate target cash balances for LFIs and HFIs using the coefficient estimates. Defining excess cash holding as the difference between the actual and estimated target cash holdings, the level of excess cash is similar across LFIs and HFIs: 0.5% and -.03%, respectively. In other words, the firm characteristics in the empirical target cash model go a long way in explaining the differential cash policies of LFIs and HFIs. It also suggests that much of the build-up of cash balances reported elsewhere (Bates, Kahle, and Stulz, 2009) is concentrated among LFIs.

denote the contribution of funding source S_j, where

$$\sum_{i=1}^{8} S_i \equiv CF^+ + EI + NDI^+ + \Delta C^- + S^- + I^- + \Delta W^- + O^+. \tag{2}$$

Here, CF^+ is the positive portion of operating cash flow, EI is proceeds from equity issues, NDI^+ is positive net-debt issues, ΔC^- is draw-down of cash balances, S^- is security sales, I^- is sale of investments, sale of property, plant and equipment (PPE) and cash flows from other investment activities, ΔW^- is reduction in net working capital, and O^+ is a small residual that maintains the cash flow identity.[8]

Figure 2 shows the annual funding pattern after combining the eight funding sources into four ratios, which by construction sum vertically to one: the *Net-Debt Issue* ratio $R_{NDI^+} \equiv NDI^+/\sum_i^8 S_i$, the *Equity Issue* ratio $R_{EI} \equiv EI/\sum_i^8 S_i$, the positive *Operating Cash Flow* ratio $R_{CF^+} \equiv (CF^+)/\sum_i^8 S_i$, and the *Asset Sales* ratio $R_{AS} \equiv (\Delta C^- + S^- + I^- \Delta W^- + O^+)/\sum_i^8 S_i$. A quick comparison of HFIs (Panel A) and LFIs (Panel B) suggests that HFIs generate most of their funding through a combination of operating cash and net-debt issues while LFIs, on the other hand, finance themselves by also relying heavily on asset sales and cash drawdowns.

Panel A of Table 7 contains detailed information on each of the eight sources of funds and shows that R_{NDI^+} averages 24% for HFIs but only 2% for LFIs (median values of 13% and 0%). In contrast, the importance of equity in the overall funding mix is more similar across HFIs and LFIs. The value of R_{EI} is 18% for HFIs and 30% for LFIs, with median values of 2% and 8%.[9] In sum, HFIs rely more on external finance than do LFIs (42% vs. 31%, respectively).

Notice also that, since the HFIs rely more on operating cash flows than LFIs (R_{CF^+} averages 34% vs. 29%), asset sales must be a particularly important funding source for LFIs. This is confirmed by our data: the lifecycle funding contribution of asset sales (R_{AS}) is substantial for both categories of firms, and larger for LFIs than for HFIs (40% versus 24%, respectively). Even when focusing only on illiquid asset sales (R_{I^-} in Table 7), the contribution is large for LFIs (11%). This is interesting in of itself, as it is not anticipated by the traditional financing pecking order (Arnold, Hackbarth, and Puhan, 2018; Edmans and Mann, 2019). For relatively high-R&D firms such as LFIs, raising cash through asset sales may be attractive as it avoids the strict disclosure requirements associated with public equity issuances and which risks disclosing valuable proprietary information produced by the R&D activity (Hall and Lerner, 2010; Brown, Martinsson,

[8]In 1988, Statement of Financial Accounting Standards (SFAS) instituted a new and uniform reporting system for working capital, including its component assets and liabilities. We work with net working capital over the entire sample period. Separate analysis on the post-1988 period shows that splitting net working capital into assets and liabilities does not affect our main conclusions below.

[9]Excluding the year of public listing substantially reduces the contribution from equity issues over the remaining life cycle as R_{EI} drops to 12% for HFIs and 17% for LFIs.

and Petersen, 2012; Bena and Li, 2014).

4. H1: Is the Leverage-Profitability Correlation Positive?

In this section, we test hypothesis H1 using the sample of HFIs.

4.1 Main Regression Specification

Let a_{it} denote a dummy variable which takes on a value of one if the HFI rebalances capital structure in quarter t, where

$$a = 1 \ \text{ if } \frac{\Delta D_t^e}{A_t} > s \text{ and } \frac{ER_t^e}{A_t} > s, \tag{3}$$

and $a = 0$ in other quarters. ΔD^e is quarterly long-term debt issues in excess of debt retirement. ΔD^e excludes short-term debt issuances, such as drawing down credit lines with remaining maturity of one year or less. ER^e is the sum of cash dividends and equity repurchases in excess of equity issues. The issue-size threshold s is in percent of total book assets A_t.

As Danis, Rettl, and Whited (2014) and Eckbo and Kisser (2019), we use the following linear regression form to test H1:

$$L_{it} = \alpha + \gamma_0 \Pi_{i,t-1} + \gamma_1 \Pi_{i,t-1} a_{it} + \gamma_2 a_{it} + \beta X_{i,t-1} + \epsilon_{it}, \tag{4}$$

where $L_{it} \equiv (\frac{D}{MV})_{it}$ is the market leverage ratio in quarter t (book value D of short- and long-term debt divided by D plus the market value of total equity), and $\Pi_{i,t-1}$ is firm i's profit lagged one period and standardized by the book value A of total assets. Π is measured as operating profits (EBITDA, earnings before interest taxes depreciation and amortization allowances). Finally, $X_{i,t-1}$ is a set of lagged control variables defined below.

Combining H1 and the above regression specification, we have that

$$Cov(l_t, \pi_{t-1}|\ a = 0) < 0 : \quad \frac{\partial L}{\partial \Pi}_{|a=0} = \gamma_0 < 0, \tag{5}$$

and

$$Cov(l_t, \pi_{t-1}|\ a = 1) > 0 : \quad \frac{\partial L}{\partial \Pi}_{|a=1} = \gamma_0 + \gamma_1 > 0, \tag{6}$$

which yields the following empirical hypothesis:

$$\text{H1}: \ \gamma_0 < 0 \text{ and } \gamma_0 + \gamma_1 > 0. \tag{7}$$

The intuition behind H1 is simple. In periods with rebalancing inactivity ($a = 0$), higher profits mechanically drive down leverage, so $\gamma_0 < 0$. When firms actively rebalance ($a = 1$), two conditions must be fulfilled: First, leverage and profitability must be positively correlated at the margin, so $\gamma_1 > 0$. Second, in the cross-section, more profitable firms must choose higher leverage: $\gamma_0+\gamma_1 > 0$. If $\gamma_1 < 0$, the theory is rejected outright. If $\gamma_1 > 0$ but $\gamma_0 + \gamma_1 < 0$, then the tradeoff hypothesis is also rejected because the positive γ_1 just means a less negative relation between leverage and profitability. In sum, for there to be evidence that more profitable firms move to higher leverage when they rebalance, *both* conditions must be satisfied.

4.2 Empirical Results

H1 is tested by conditioning the leverage-profitability relation on quarters with active leverage rebalancings. Our full sample consists of 240,028 firm-quarters (9,340 firms) as detailed in Panel C of Table 1. In general, the fraction of observed capital structure rebalancings ($a = 1$) is low and ranges between 0.5% (1,302 cases, when s equals 5%) to 1.1% (2,602 cases, when s equals 2.5%). Reflecting the higher debt issue activity of HFIs, they account for half of all rebalancings (720 and 1,383 cases, respectively).[10]

In the interest of test power, we first verify that the rebalancing indicator a isolates periods without potentially confounding cash flow events, and that financing components used to define a are large both in absolute magnitude and relative to all other empirical sources and uses of funds. The verification uses the firm's cash flow statement in the rebalancing quarter, as follows:

$$OCF - INV + OTH + \underbrace{(-CH + IVSTCH)}_{\text{Cash and cash equivalents}} = \underbrace{ER^e - NDI}_{\text{Debt-financed equity payout}} \tag{8}$$

where OCF is operating cash flow, INV is total net investment outlays, and OTH denotes (generally small) other financing cash flows. The contribution of cash and cash equivalents consists of two components: cash-balance draw-down ($-CH$) and net sale of short-term marketable securities ($IVSTCH$). On the right-hand side, ER^e is (again) the net equity retirement (dividends and share repurchases net of equity issues) and NDI is debt issues in excess of debt retirements. All variables are scaled by the book value of total assets (the exact variable definitions using Compustat mnemonics are given in Panel B and C of Table 3).

Table 8 displays the individual components of the cash flow identity for HFIs when using a 2.5% size threshold (Panel A) or a 5% threshold (Panel B). Within each panel, results are shown for all HFIs, mature HFIs (those with a minimum age of five years) or long-term HFIs (using the

[10]For HFI firms, the fraction of capital structure rebalancings ranges from 1.0% (720 cases, when s equals 5%) to 1.9% (1,383 cases, when s equals 2.5%). For non-HFI firms, the fraction of capital structure rebalancings ranges from 0.3% (582 cases, when s equals 5%) to 0.7% (1,219 cases, when s equals 2.5%).

classification of year ten since going public). The decomposition suggests that the magnitudes of the debt-financed rebalancing components dwarf all other items.

For example, Panel A shows that the average size of the net equity payout equals 12% for all HFIs which equals the net-debt issues in the same quarter. Increasing the issue size threshold to 5% (Panel B), net equity payouts increase to 18% and net-debt issues to 17%, respectively. Thus, the economic magnitude of the capital structure rebalancing event is significant. Moreover, the items on the left-hand side of Eq. (8) are all small. For example, Panel B shows that operating cash used for investments (INV) averages 3% and the remaining funds are generated through a combination of other financing flows (1%) and cash draw-downs (generating 2% of book assets). Focusing on the samples of mature or long-term HFIs yields similar results.

Figure 3 shows the dynamics of a firm's cash flow identity in event time relative to the quarter of the capital structure rebalancing (2.5% size threshold in Panel A, 5% in Panel B). Following each firm over a 33 quarter horizon (16 quarters before and after the rebalancing), it visualizes that the large debt issue and associated equity payout is a significant capital structure rebalancing event. Also important, operating cash flow and net investment outlays are stable throughout the entire event horizon. This rules out that the debt issues were designed to finance investment shocks, which also suggests that these events are not easily explained by pecking order financing arguments. On the other hand, since the events do fit the type of capital structure rebalancings that one might see if firms follow dynamic tradeoff theory and manage leverage towards a long-run target, the leverage-profitability correlation test performed next is particularly interesting.

Table 9 reports the conditional leverage-profitability correlation estimates γ_0 and γ_1. Results are shown when using an issue-size threshold of 2.5% (columns 1 to 3) or 5% (columns 4 to 6). Moreover, in addition to the total sample of HFIs, the table reports results for two more restrictive sets of HFIs. The first is *mature* HFIs, which are HFIs that have been publicly traded for a minimum of five years (median firm age is five years in our sample). The second subsample, *long-term* HFIs, are all HFIs existing in year ten after public listing (a balanced sample of HFIs held constant throughout the analysis). Across the three samples and two size thresholds, the total number of rebalancing events ranges between 977 (column 1) and 184 (column 6). The vector X_{it} of lagged control variables include the standard deviation of Π (labelled $Risk$), the market-to-book ratio Q, asset tangibility (Tan), and firm size ($Size$). Size is adjusted for inflation, the continuous variables ($Size$, Q, Π, $Risk$) are winsorized at the 1(99) percent level, and naturally bounded variables (L, Tan) are set to be within the unit interval.

In all of the columns of Table 9, all of the lagged regressors in X_{it} in Table 9 receive coefficient estimates that are statistically significant at the 1% level of better. Moreover, in periods without rebalancing activity, all of the leverage-profitability correlation estimates of γ_0 (in the first row of the table) are negative and significant at the 1% level, ranging from -0.64 in Column (1) to -0.91

in Column (5). Most important, while the estimate of γ_1 is positive for some samples, this increase in γ_1 is not sufficient to drive the sum $\gamma_0 + \gamma_1$ to become positive. Instead, in the last two rows of the table, the coefficient sum is negative, and significantly so in columns (1), (3) and (4). In none of the columns is the sum $\gamma_0 + \gamma_1$ positive, which rejects H1. In other words, Table 9 fails to show that profitable firms choose higher leverage in periods when they perform leverage-increasing rebalancings. This conclusion complements the Compustat-wide test results in Eckbo and Kisser (2019) who also define leverage rebalancing events in terms of gross leverage (Eq. 3 above).

The contribution of Table 9 is to show that H1 is rejected even after restricting the test sample to firms that likely face lower issuance costs and/or higher debt benefits than the average Compustat industrial firm. This rejection is also supported by the fact that HFIs account for half of all observed capital structure rebalancings and, as shown above in Table 8 and Figure 3, the economic magnitude of the debt issues is large. In other words, the missing positive relation between leverage and profitability is not driven by marginally small debt issues.

Finally, Danis, Rettl, and Whited (2014) test hypothesis H1 using the basic regression specification in Eq. (4) but with a *net* leverage event definition of both leverage (NL) and a', where

$$a' = 1 \text{ if } \frac{\Delta D_t^e - \Delta C_t}{A_t} > s \text{ and } \frac{ER_t^e}{A_t} > s. \tag{9}$$

Here, ΔC_t is the change in the firm's cash balance over quarter t (where cash balance includes cash holdings and short-term investments in marketable securities). Thus, with a', rebalancings may be financed with any combination of cash draw-downs and new debt issues. Using the full Compustat universe of industrial companies, Danis, Rettl, and Whited (2014) fail to reject H1 ($\gamma_0 + \gamma_1 > 0$). On the other hand, Eckbo and Kisser (2019) show that rebalancing events of type a' are predominantly cash distributions with no new debt issue. Since cash draw-downs incur small if any fixed issuance costs, they argue that tests of H1 using a' to identify issue-cost-driven capital structure inertia lack theoretical basis. Requiring rebalancing events to be financed externally (with debt)—using the event definition a in Eq. (4) above—they show that H1 is rejected on the full Compustat industrial-firm universe.

To address the debate over whether one should use the event indicator a or a' to test H1, Table 10 reports tests of H1 using net leverage (NL) as dependent variable and a' as the rebalancing threshold. Notwithstanding the increase in sample size when substituting a' for a, in all columns the result is $\gamma_0 + \gamma_1 \leq 0$. Combined with the evidence in Table 9, these results reject the hypothesis that more profitable HFIs move to a higher leverage ratio whether the rebalancing is financed externally (with new debt issues) or internally (with cash draw-downs). In other words, H1 is rejected whether based on a or a'.

5. H2: Does the SOA of HFIs Exceed that of LFIs?

While the tests in the previous section focus on HFIs only, in this section we exploit cross-sectional differences between HFIs and LFIs. In this cross-sectional analysis, firm-level differences between HFIs and LFIs that do not relate to the sorting-mechanims that we use to construct these two sets of firms are controlled for using firm characteristics (such as those in vector X in Section 4 above). Conditional upon these, and given the extremely low debt-issuance activity observed for LFIs, we expect SOA estimates to be higher for HFIs than for LFIs.

We begin this section by presenting additional empirical support for our conjecture that HFIs face lower fixed debt-issuance costs C than do LFIs. This support comes from estimating the type of dynamic issue-hazard function found also in Leary and Roberts (2005). While the HFIs by selection issue debt much more often then LFIs—and so can be expected to have lower debt issuance costs—the hazard estimation provides independent evidence that the dynamic issuance behavior of HFIs is consistent with relatively low fixed issuance costs C, which should lead to relatively high SOAs.

5.1 Debt Issue Hazards Suggesting $C_{HFI} < C_{LFI}$

Figure 4 shows estimated shapes of dynamic net-debt issue hazards for HFIs and LFIs, respectively. The shapes, which account for firm characteristics and unobservable firm-specific heterogeneity, are estimated by parameterizing the following hazard function h of the j'th net-debt issuance spell for firm i:

$$h_{i,j}(t|\alpha_i) = \alpha_i h_0(t)\exp(\beta x_{i,j}(t)), \tag{10}$$

where t is the length of the issue spell (years from the current to the next quarterly net-debt issue), $h_0(t)$ is the baseline hazard, and α_i captures unobserved heterogeneity analogous to a random effect in a panel data model (where multiple issues by firm i may be correlated). The shared frailty term α_i is assumed to be independent of the firm characteristics $x_{i,j}(t)$ and to have a zero-mean gamma distribution (Leary and Roberts, 2005; Whited, 2006).

The baseline hazard $h_0(t)$ measures the conditional issue probability when all covariates $x_{i,j}(t)$ equal zero. We follow Leary and Roberts (2005) and parametrize $h_0(t)$ as a cubic polynomial in the time since the last issue: $h_0(t) = \exp(c + \gamma_1 t + \gamma_2 t^2 + \gamma_3 t^3)$. The firm characteristics $x_{i,j}(t)$ are time-varying, lagged by one period and enter the estimation each year after subtracting the sample-wide median value. Panels A and B of Figure 4 plot the estimated hazard shapes for LFIs and HFIs, respectively. The horizontal axis is years since last issue (in year 0). For example, at year five, the dynamic hazard function gives the estimated probability of a debt issue in year six conditional on not having issued debt over the previous five years. The plots of the estimated hazard shapes have steps because time has been discretized to the annual frequency.

The hazard function for HFIs in Panel A has a high intercept and a negative slope, while the intercept is low and the slope positive for the LFIs in Panel B. For HFIs, the high intercept indicates relatively low total issuance costs and the slope of the hazard may reflect a combination (of fixed) with either proportional or quadratic issuance costs. For LFIs, on the other hand, the low intercept of LFIs is consistent with the presence of significant fixed issuance cost.

To see why, recall from Figure 1 that the presence of fixed cost C determines the optimal period of inactivity (the difference between the leverage target L^* and the lower rebalancing threshold $\underline{L}$). Higher C increases the period of optimal dynamic inactivity and therefore leads to a low baseline hazard (i.e., a low intercept). Furthermore, as shown by Leary and Roberts (2005), the presence of additional proportional or quadratic issuance cost can lead to a downward sloping hazard. The intuition is that those cost directly affect the optimal size of the capital structure rebalancing and, hence, lead to more frequent issues. Thus, while the hazard functions displayed in Figure 4 do not determine the overall split between fixed and proportional cost, they are consistent with our assumption that LFIs face higher fixed debt issuance costs than HFIs.

5.2 Speed-of-Adjustment Estimation

To test H2, we estimate the following dynamic panel regression

$$L_{i,t} - L_{i,t-1} = \alpha + \eta_i + \phi \left(L^*_{i,t}(\beta X_{i,t-1}) - L_{i,t-1} \right) + \epsilon_{i,t}, \tag{11}$$

where the dependent variable is the change in the market leverage ratio, $L^*_{i,t}$ is firm i's current-period leverage target, and η_i is a firm-fixed effect. The parameter ϕ is the SOA estimate and captures the fraction of the target deviation that is closed in a particular year. Finally, the lagged firm characteristics $X_{i,t-1}$, which form the estimate of L^* are size, profitability, Q, cash ratio, tangibility, depreciation, R&D expenses, capital expenditures, *Risk*, and the median industry leverage ratio. These characteristics follow closely the tradition in the extant literature estimating SOA coefficients (Fama and French, 2002; Flannery and Rangan, 2006; Hovakimian and Li, 2012; Faulkender, Flannery, Hankins, and Smith, 2012). Also, since the regressor $L^*_{i,t}$ is estimated, and since the lagged dependent variable $L_{i,t-1}$ also features as a regressor—Eq. (11) is equivalent to $L_{i,t} = \alpha + \eta_i + \phi L^*_{i,t}(\beta X_{i,t-1}) + (1-\phi) L_{i,t-1} + \epsilon_{i,t})$—we follow the literature and use GMM estimation (Blundell and Bond, 1998; Lemmon, Roberts, and Zender, 2008; Flannery and Hankins, 2013).

We present four alternative SOA coefficient estimations in Table 11. Panel A shows the baseline estimates using all firm-year observations, Panel B focuses on mature firms (minimum age of five years) and Panel C on long-term HFIs/LFIs (using the classification of year ten since public listing). The robustness check in Panel C implies that the number of firms is held constant for the first eleven years and thereby approaches a balanced dynamic panel. In Panel D, we return to the original HFI/LFI sort and instead investigate whether the equity issue and retirement activity reflects deviations from target leverage.

Turning to the coefficient estimates in Panel A, ϕ is 0.31 for HFIs and 0.27 for LFIs, both statistically significant at the 1% level. These estimates suggest that it takes on average 2.5-3.0 years to recover half of the target leverage deviation ($ln(0.5)/ln(1 + \phi)$). Interestingly, the third column suggests that the SOA coefficients for HFIs and LFIs are statistically indistinguishable from each other. Panel B shows that focusing on mature firms only does not change this conclusion. Similarly, using the balanced panel of firms in Panel C also fails to indicate a statistically different speed-of-adjustment behavior between long-term HFIs and LFIs.

The finding of statistically indistinguishable SOA coefficient estimates for HFIs and LFIs is surprising. After all, the debt-issue frequency is ten times higher for HFIs than for LFIs and the two exhibit similar equity issue propensities (Table 4). Also, Panel B of Table 7 shows that average issue size is similar for HFIs and LFIs. The result suggests that cross-sectionally lower net issuance costs do not map into cross-sectionally higher SOA estimates.

To further explore the surprisingly high SOA coefficient estimate for LFIs, we replace the dependent variable in Eq. (11) with scaled net equity issues in Panel D. This exercises produces a near-zero SOA estimate for both HFIs and LFIs, which rules out that LFIs actively manage target leverage using equity issues. In sum, it appears that the high SOA estimate for our subsample of LFIs is not driven by the underlying financing and payout decisions of these firms. Alternative explanations for the surprisingly high SOA estimates for the LFIs include the possibility that these are driven by passive equity growth as in Welch (2004). Moreover, the estimates may reflect some degree of mechanical mean reversion as in Chang and Dasgupta (2009). These alternatives are less likely to affect the SOA estimates of the HFIs, which are similar in magnitude to the average SOAs documented in the extant literature.

6. H3: Leverage Dynamics and Investment Finance

In this section, we integrate investment finance into the empirical analysis of the leverage dynamics of HFIs. Recall from Section 3.3 that HFIs typically exhibit a substantially higher level of investment than do LFIs.[11] We begin the analysis by re-estimating the SOA for HFIs using our baseline regression equation (11) augmented with dummy variables that condition on high/low leverage and investment. As stated in Part (1) of H3, in periods with relatively low leverage and high

[11] Column (10) of Table 6 above show that capital expenditures scaled by lagged book assets (I_{CX}) averages 10% for HFIs versus 6% for LFIs. Moreover, in Column (11), which also includes cash outlays for patent purchases and acquisitions, the scaled investments I_{CF} is 15% for HFIs and 9% for LFIs.

investment needs, firms are predicted to issue debt to finance investment and take advantage of the low marginal debt-issue costs to adjust leverage upward toward the long-run target—resulting in higher SOA. Moreover, as firms manage leverage towards a long-run target, SOA is predicted to increase in periods when highly leveraged (over-leveraged) firms face low demand for investment finance. We examine these two predictions in Section 6.1. Part (2) of H3, where the focus is on debt issues and retirements of conditionally over-leveraged HFIs, is examined in Section 6.2.

6.1 Part (1): SOA Estimation with Double-Conditioning

Halling, Yu, and Zechner (2016) test whether firms adjust leverage differently in periods of recessions or expansions. We use a similar regression specification to test whether the leverage adjustment process differs across periods of high/low investment and high/low leverage, as follows:

$$\begin{aligned} L_{i,t} - L_{i,t-1} \;\; &= \;\; \alpha + \eta_i + \phi L^*_{i,t}(\beta X_{i,t-1}) - \phi_1 L_{i,t-1}|_{(I=l,L=l)} - \phi_2 L_{i,t-1}|_{(I=l,L=h)} \\ &\quad -\phi_3 L_{i,t-1}|_{(I=h,L=l)} - \phi_4 L_{i,t-1}|_{(I=h,L=h)} + \epsilon_{i,t}, \end{aligned} \tag{12}$$

This regression estimates the leverage target L^* while separating out four SOA coefficients (ϕ_1 to ϕ_4) across periods of low and high investment (I) and leverage (L). We follow the literature and use median industry levels to define "high" and "low" in this context. Let $Ecapex_t$ (excess investment) denote the difference between firm i's capital expenditures ($I_{CX,t}$) and the median $I_{CX,t}$ in the firm's 3-digit SIC industry. Moreover, let $Elev_t$ (excess leverage) be the difference between the firm's lagged market leverage ($L_{i,t-1}$) and the lagged median 3-digit SIC industry leverage ratio. Periods with high investment and high leverage are periods where $Ecapex > 0$ and $Elev > 0$, respectively.

Table 12 shows the coefficient estimates based on the double-conditioning in regression Eq. (12). As in Table 11, we estimate the SOA for three different samples of HFIs: all HFI-year observations (Panel A), mature HFIs with a minimum age of five years (Panel B), and long-term HFIs using the classification in year ten following public listing (Panel C). The first row of each panel shows that the SOA in periods of low leverage ($Elev < 0$) and high investment ($Ecapx > 0$) is statistically indistinguishable from the SOA in periods with low leverage and low investment ($Ecapx < 0$). In other words, contrary to Part (1) of H3, HFIs do not speed up the leverage adjustment process in periods with high investment (when marginal leverage-adjustment costs are lower) even if they are under-leveraged. A similar conclusion emerges from the second row in each panel. That is, there is also no evidence that highly leveraged HFIs speed up the leverage adjustment process in periods with low investment financing needs.

Faulkender et al. (2012) also present SOA estimates that condition on both the degree of leverage and funding needs. While we reject Part (1) of H3, they identify a significant increase in the SOA estimate in periods with high funding needs and conclude in favor of tradeoff theory. We reach a different conclusion based on Table 12 not only because we use a different sample of firms (the HFIs) but also because the earlier paper uses the so-called financing deficit to identify external funding needs (which they define as the difference between cash available from operating profits/losses and the industry average capital expenditure).[12]

The double conditioning underlying the SOA estimates in Table 12 does not involve the financing deficit. Instead, our SOA estimation allows leverage policy to reflect the full range of available investment funding options (internal as well as external funds). We prefer the SOA estimate to reflect such an unconstrained leverage policy optimization, i.e., the use of any internal and external investment funding mix that minimizes marginal leverage adjustment costs (which are already low for HFIs). Our finding that the SOA estimates are similar across the 2×2 coefficient-matrix in each of the three panels in Table 12 therefore suggests that managing leverage towards a target is, at best, of a second order importance for HFIs.

6.2 Part (2): Debt Issues and Retirements by Over-Leveraged HFIs

In this section, we shift our primary focus from the leverage dynamics of the total sample of HFIs in Table 12 to debt issues and retirements by *over-leveraged* HFIs. As directed by Part (2) of H3, we explore whether these firms issue transitory debt. Much as in Denis and McKeon (2012) and DeAngelo, Goncalves, and Stulz (2018) who also describe debt issuances and repurchases by highly leveraged firms, our investigation is exploratory in nature. That is, with endogenous investment, we are unable to distinguish debt repurchases that are designed to maintain future debt capacity (pecking order theory) from those that are designed to maintain a long-run leverage target (tradeoff theory). Notwithstanding this empirical equivalence, the extent of repurchase activity by HFIs reported below adds to the capital structure debate in of itself.

We begin by estimating the coefficients in the following logit regression:

$$Y^*_{i,t} = \alpha + \beta_1 D^*_{i,t-1} + \beta_2 I_{i,t} + \beta_3 D^*_{i,t-1} I_{i,t} + \epsilon_{i,t}. \tag{13}$$

In this regression, which includes industry fixed effects (FF12 industries), $Y^*_{i,t}$ is the latent variable for the probability of either a significant net debt issue by firm i in year t ($NDI^+_{i,t}/A_{i,t} > 2.5\%$) or of a significant net-debt retirement ($NDI^-_{i,t}/A_{i,t} > 2.5\%$). D^*_{t-1} is a dummy variable with a value of one if the firm is already over-leveraged going into period t. To define D^*_{t-1}, let $Dev_{i,t-1} \equiv L_{i,t-1} - L^*_{i,t-1}(X_{i,t-2})$, where $L^*_{i,t-1}(X_{i,t-2})$ is estimated each year on a rolling basis

[12] Since the financing deficit is a pecking order concept, the evidence in Faulkender et al. (2012) is also consistent with pecking-order behavior driving leverage policy.

using the explanatory variables in X in Table 11 lagged two periods. $D^*_{t-1} = 1$ if $Dev_{i,t-1} > 0$ and zero otherwise. At the annual frequency, HFIs make a total of 10,473 positive net-debt issues, of which 2,181 or 21% are over-leveraged according to this definition.

The investment variable $I_{i,t}$ is also measured in one of two ways: as *Ecapex*—defined above as the difference between the firm's I_{CX} and the median I_{CX} in the firm's 3-digit SIC industry—or as *Spikes*, which is modeled after DeAngelo, DeAngelo, and Whited (2011). *Spikes* is the difference between the firm's I_{CX} and the 2-digit SIC industry average I_{CX} divided by the standard deviation of the industry I_{CX} (using the entire data panel). *Spikes* is a more restrictive investment-shock measure: while as much as 55% of all over-leveraged net-debt issues by the HFIs occur during periods when $Ecapex_t > 0$, only 39% occur when $Spikes > 0$.

Table 13 presents the coefficient estimates for Eq. (13), with net-debt issues in columns (1)–(4) and net-debt retirements in columns (5)–(8). As before, for robustness, panels A–C present three sets of HFIs. When using *Ecapex* to measure investment, all three coefficient estimates (β_1, β_2, β_3) are highly statistically significant and of similar magnitudes across the three panels. With the exception of the estimate of β_1 in Column (2), this conclusion holds also for the alternative investment measure *Spikes*. Consistent with the SOA estimates for HFIs in Table 12 above, the two estimates of β_1 indicate that being highly leveraged slows down net-debt issues (negative β_1 in Column 2) and speeds up net-debt retirements (positive β_1 in Column (6). Moreover, as indicated by the positive (negative) estimates of β_2 in columns (3) and (7), respectively, the likelihood of a net-debt issue (net-debt retirement) is higher (lower) in periods with significant investment needs.

Our primary interest is in the statistically significant coefficient estimate of β_3, which multiplies the interaction variable $D^*_{i,t-1}I_{i,t}$. This coefficient is positive for net–debt issues in Column (4) and negative for net-debt retirements in Column (8). Thus, being simultaneously over-leveraged and in need of substantial investment funding further speeds up net-debt issue activity and slows down net-debt retirements. In terms of the prediction in Part (2) of H3, the negative estimate of β_3 is necessary—though not sufficient—to conclude that net-debt issues by over-leveraged HFIs and which finance investment are also transitory. We therefore next explore a multi-year, forward-looking check on whether the over-levered debt issues underlying the significant coefficient estimate of β_3 in Column (4) are followed by active net debt retirements.

In Figure 5, we track the leverage dynamics of initially over-leveraged HFIs for a three-year period following debt issues (in year 0) when $Ecapex > 0$. There are a total of 1,203 such over-leveraged net-debt issues financing large investments. The figure plots the subsequent 3-year evolution of the average values of three leverage-related statistics: *Deviation* is the degree of over-leverage defined above $[Dev_{i,t-1} \equiv L_{i,t-1} - L^*_{i,t-1}(X_{i,t-2})]$. *Cumulative NDI* is the cumulative net-debt issues over the event window, and *Cumulative NEI* is the cumulative net-equity issues (net of stock repurchases and dividends).

As shown, *Deviation* declines from 10% in year 0 to 3% in year +3, indicating that firms tend to lower (estimated) target-leverage deviations throughout the event period.[13] Moreover, since there is almost no decline in *Cumulative NDI* over the event period, Figure 5 also shows that the decline in *Deviation* primarily reflects an increase in net-equity issue activity. The combination of low net-debt repurchase activity and continuing equity issuances suggests that the HFIs are responding to additional investment financing needs over the event period. Indeed, while not shown in the figure, *Ecapex* is at a maximum of 9% in event year 0 but remains positive over the entire event period (4%, 3% and 2% in years 1 through 3).[14]

The experiment performed in Figure 5 is not unlike that of Denis and McKeon (2012) who also examine the evolution of leverage following large debt issues. They sample 2,314 debt issues by Compustat industrial firms (1971–2006) that raise the issuer's leverage ratio to at least 10% above an estimated target. While this leverage-criterion differs from ours (we first require $Dev_{i,t-1} = L_{i,t-1} - L^*_{i,t-1} > 0$ and then examine all $NDI_{i,t} > 0$), Denis and McKeon (2012) also report that a substantial fraction (nearly 70%) of their large debt issues are associated with investment funding needs. They do not, however, find a post-issue decline in their measure of excess leverage. Intrigued by this difference in results, we note that Denis and McKeon (2012) estimate L^* cross-sectionally (year-by-year, using Tobit regressions) without firm fixed effects. In contrast, Figure 5 is based on our time-series estimation of L^* (on a rolling basis) with firm-fixed effects. As it turns out, this difference in estimation methodology makes a difference in our sample: if we drop firm fixed effects in our estimation of L^*, we find that *Deviation* in Figure 5 nearly doubles in year 0, from 10% to 17%, for then to remain high over the subsequent three-year event period—much as reported by Denis and McKeon (2012). This raises the possibility that our inclusion of firm-fixed effects captures lower debt issuance-costs for HFIs, which in turn drive a higher leverage target.

6.3 Net-Debt Retirements by Under-Leveraged HFIs

We end our examination of net-debt repurchases with an interesting empirical observation on net-debt repurchases by *under-leveraged* HFIs. While a net-debt retirement by any firm (outside of bankruptcy or strategic debt renegotiation) is at odds with standard tradeoff theory (Fischer et al., 1989; Admati et al., 2018; DeMarzo, 2019), repurchases by under-leveraged firms are particularly difficult to explain within this theory. At the annual frequency, the HFIs in our sample undertake a total of 10,473 net-debt issues and 4,716 net-debt retirements. Of these retirements, 1,962 occur

[13] The degree of decline in *Deviation* in Figure 5 is consistent with the magnitude of the SOA coefficients estimates in tables 11 and 12 above.

[14] Unfortunately, further restricting the sample underlying Figure 5 to firms with $Ecapex \leq 0$ in years 1 through 3 lowers the sample from 1,203 to only 147. For this subsample, debt repurchases play a greater role relative to equity issuances in lowering *Deviation* over the event period (1,3). However, these firms nevertheless issue equity even though $Ecapex \leq 0$.

when HFIs are over-leveraged ($Dev_{i,t-1} > 0$) and as many as 1,384 when HFIs are under-leveraged ($Dev_{i,t-1} < 0$).[15]

In the subsample of net-debt retirements by under-leveraged HFIs, the beginning-of-year leverage ratio averages 25% which is 9 percentage points below the average leverage-target estimate. Moreover, these retirements typically occur during a year of high operating profitability: $Prof(\Pi)$ equals 10%, which jointly with the net-debt retirement reduces leverage to 20%. Thus, it is difficult to argue that this net-debt-retirement activity is somehow designed to restore a long-run target leverage ratio: if anything, they seem to move the HFIs further away from a putative long-run target.

On the other hand, it is quite possible that these net-debt retirements are designed to preserve debt capacity and financial flexibility for future investment finance. This evidence complements the earlier findings of DeAngelo, Goncalves, and Stulz (2018) that the leverage dynamics following historically high levels of leverage are more consistent with restoration of financial flexibility than of restoring a long-run leverage target. The fact that we observe an active net-debt repurchase program also for substantially *under*-leveraged HFIs further highlights the potentially significant role of financial flexibility considerations in the overall funding mix.

7. Conclusion

We identify and systematically analyze the leverage dynamics of HFIs—high-frequency net-debt issuers (debt issues net of retirements). HFIs are public industrial companies that raised the bulk of all private and public debts over the past three decades. These firms evidently view debt-financing as uniquely beneficial, and they face sufficiently low debt issue costs to issue frequently. The combination of high debt-financing benefits and low issuance costs makes the active leverage decisions of HFIs particularly interesting for examining capital structure theories in general and of dynamic tradeoff theory in particular.

We formulate and examine three core tradeoff predictions, all of which have received mixed empirical support in the prior literature. The first hypothesis (H1) holds that more profitable firms will move to a higher (target) leverage ratio when they actively rebalance leverage by issuing debt and distributing the proceeds to shareholders. Using the HFIs as test assets for this hypothesis is particularly interesting since their low issuance cost also contributes to higher rebalancing frequency (HFIs account for half of all observed capital structure recapitalizations). Notwithstanding this additional test power, our cross-sectional test firmly rejects H1.

The second hypothesis (H2) holds that the speed-of-adjustment (SOA) to putative target

[15] The remaining 1,370 net-debt retirements occur in years up until year -2 (recall that $Dev_{i,t-1}$ is only available as of year -3).

leverage deviations is greater for HFIs than for low-frequency net-debt issuers (LFIs). This cross-sectional test is also powerful since HFIs issues net-debt twelve times as often as LFIs and market leverage averages 32% for HFIs and only 7% for LFIs. Under dynamic tradeoff theory, greater issue benefits net of issue costs result in tighter rebalancing boundaries, which in turn drive higher debt-issuance frequencies. However, we find that SOA estimates are statistically indistinguishable across HFIs and LFIs. The fact that net-equity issuance activities are similar across our HFIs and LFIs, suggests that the surprisingly high SOA coefficient estimate for LFIs is driven by passive changes in equity values (the denominator of the leverage ratio) and perhaps even by the ratio's (0,1) boundaries.

Our third hypothesis (H3) attempts to integrate investment finance decisions into the leverage dynamics of HFIs. In Part (1) of H3, we test whether SOA increases in periods with low leverage and high investment—when marginal leverage adjustment costs are likely to be relatively low. However, we find no evidence that the SOA increases in such periods, even though debt-financing could have easily moved leverage towards a putative leverage target. Also, SOAs do not increase when the HFI is over-leveraged and investment is low. Part (2) of H3 holds that investment-driven debt issues by already over-leveraged firms are transitory—they should be repurchased when investment-financing needs abates. Interestingly, as much as one-fifth of all net-debt issues by HFIs do take place when these firms are estimated to be over-leveraged. However, we find little evidence that these debt-issues are followed by active net debt retirements in the three-year period following the year of the net-debt issue.

Last, but not least, we show that *under-leveraged* HFIs repurchase debt nearly as often as when they are over-leveraged. Moreover, retirements by under-leveraged HFIs typically occur during a year of high operating profitability. As tradeoff theory precludes active leverage reductions outside of bankruptcy or strategic debt renegotiation, this observation suggests that the objective is to preserve debt capacity and future financing flexibility rather than to manage leverage towards a target.

Data Availability Statement

The data underlying this article were provided by Compustat and CRSP through the Wharton Research Data Services database under licence. Data will be shared on request to the corresponding author if the user requesting the data can document a valid subscription to the Compustat and CRSP databases.

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Figure 1: **Debt-issuance costs and optimal recapitalization policy**

The figure plots firm value $V(L)$ as a concave function of the leverage ratio $L \equiv D/V$, where D is the market value of outstanding debt. L^* is the value-maximizing (target) leverage ratio, and C is a fixed debt issuance cost. The firm dynamically recapitalizes capital structure (issues debt and distributes the proceeds to shareholders) when L reaches the endogenous lower boundary $\underline{L}^j$, drawn here at $V(L^*) - C$ for illustrative simplicity. The superscript j denotes either HFIs or LFIs which differ with regards to the slope of the value function (solid line for HFIs, dashed line for LFIs). For ease of exposition, the figure draws HFIs and LFIs with identical debt-issue issue cost C and target leverage ratio L^*, while HFIs have higher marginal debt-financing benefits everywhere to the left of L^*. This results in recapitalization boundaries $\underline{L}$ such that $\underline{L}^{HFI} > \underline{L}^{LFI}$, which in turn causes HFIs to issue debt more often and in smaller amounts than LFIs. This prediction holds *a fortiori* if also $C_{HFI} < C_{LFI}$ as in Proposition 2. These comparative statics follow from the class of dynamic tradeoff models with exogenous investment (Fischer et al., 1989; Goldstein et al., 2001).

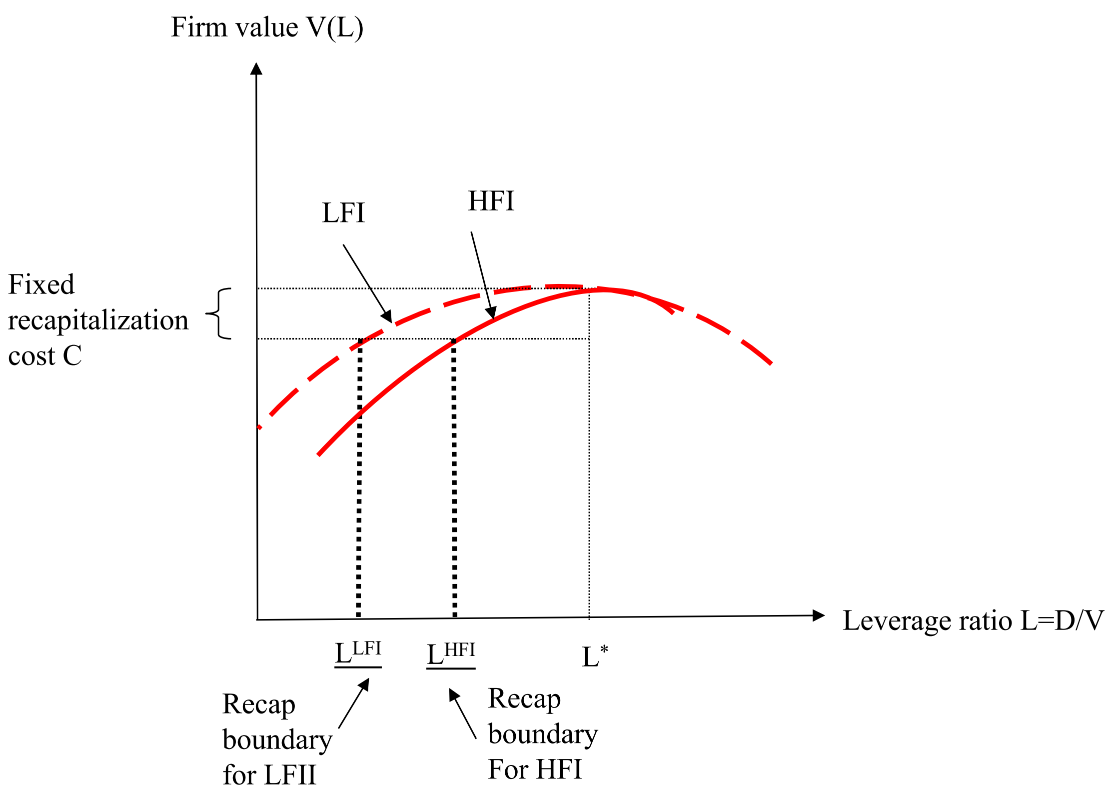
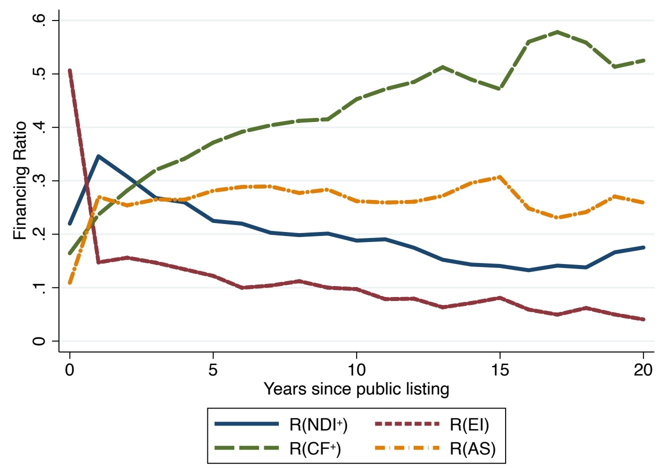


Figure 2: Lifecycle funding ratios for HFIs and LFIs

The classification of firms into high- and low-frequency net-debt issuers (HFIs and LFIs) is as detailed in Table 4 with the 2.5% issue size threshold. The figure plots four funding ratios $R_j \equiv S_j^+/\sum_i^8 S_i^+$, where $\sum_i^8 S_i^+$ is the firm's total cash contribution from each of its eight (non-negative) sources of funds: $\sum_i^8 S_i^+ = EI + NDI^+ + CF^+ + \Delta C^- + S^- + I^- + \Delta W^- + O^+$. EI is proceeds from equity issues, NDI^+ is positive net debt issues (net of debt retirements), CF^+ is positive operating cash flow, ΔC^- is cash drawdowns, S^- is security sales, I^- is sale of illiquid assets (sale of investments, PPE and other investments), ΔW^- is reduction in net working capital, and O^+ is "other" sources of funds (a small residual closing the cash flow identity). By construction, the following four ratios in the graph sum vertically to one: $R_{EI} = EI/\sum_i^8 S_i^+$, $R_{NDI^+} = NDI^+/\sum_i^8 S_i^+$, $R_{CF^+} = CF^+/\sum_i^8 S_i^+$, and $R_{AS} = (\Delta C^- + S^- + I^- + \Delta W^- + O^+)/\sum_i^8 S_i^+$. Year 0 is the year of public listing. Variable definitions are in Tables 2 and 3. Total sample of 9,340 U.S. public firms (66,056 firm-years), with an annual average of 1,616 HFIs (total of 19,424 firm-years) and 2,831 LFIs (total of 25,096 firm-years), 1984-2016.

A: Average funding ratios since public listing for HFIs



B: Average funding ratios since public listing for LFIs

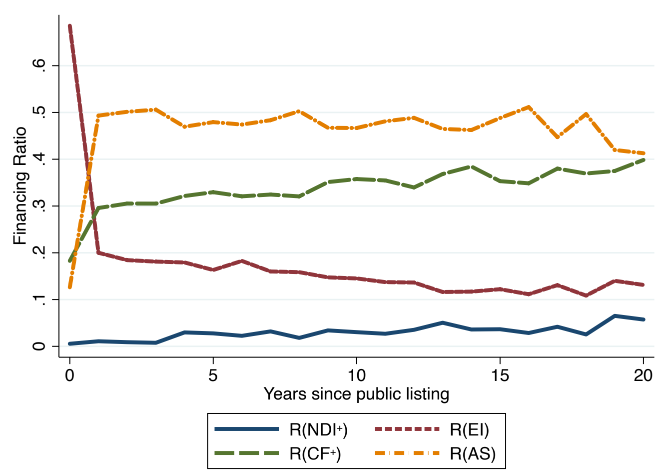


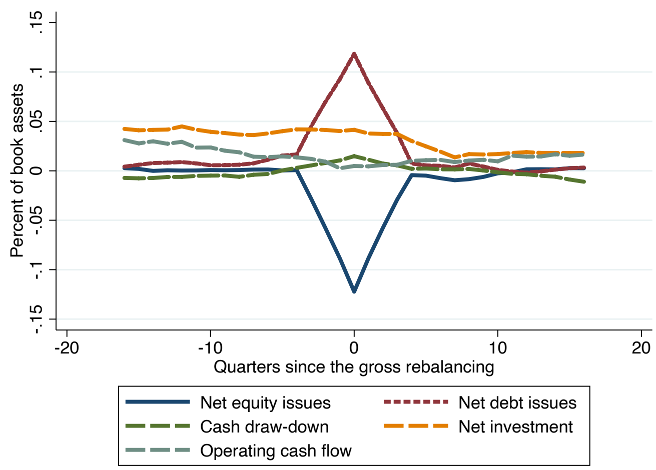
Figure 3: **Average cash flow statement dynamics for HFIs surrounding leverage rebalancing events**

The figure displays dynamics of major cash flow statement components surrounding leverage rebalancing events (occurring in event quarter 0). The leverage rebalancing is defined as follows

$$a_t = 1 \text{ if } \frac{\Delta D_t^e}{A_t} > s \text{ and } \frac{ER_t^e}{A_t} > s,$$

where ΔD^e is long-term debt issues in excess of debt retirements, ER^e is equity retirement in excess of equity issues, and A is book value of total assets. The figure shows the contribution of net equity issues ($-ER^e$), net debt issues (NDI), total cash drawdowns ($-CH + IVSTCH$), operating cash flow (OCF) and total net investment outlays (INV). All variables are scaled by the book value of assets. The size threshold s is set to 2.5% (Panel A; 1,383 rebalancings) or 5% of book assets (Panel B, 720 rebalancings). See Table 3 for the variable construction and Appendix Table 1 for an explanation of Compustat mnemonics. Sample period 1984-2016.

A: Rebalancing size threshold s equals 2.5%



B: Rebalancing size threshold s equals 5%

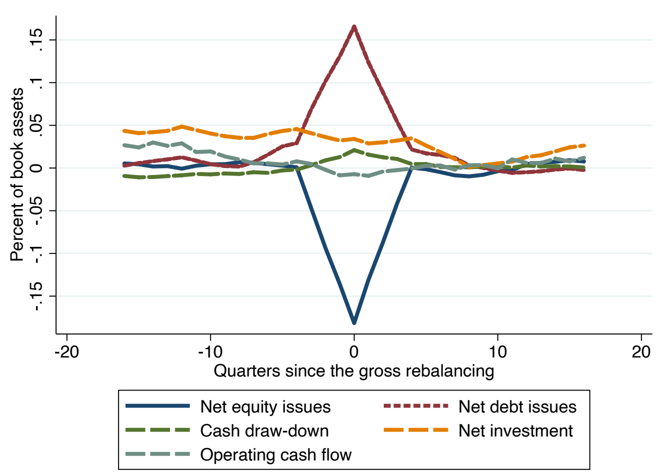


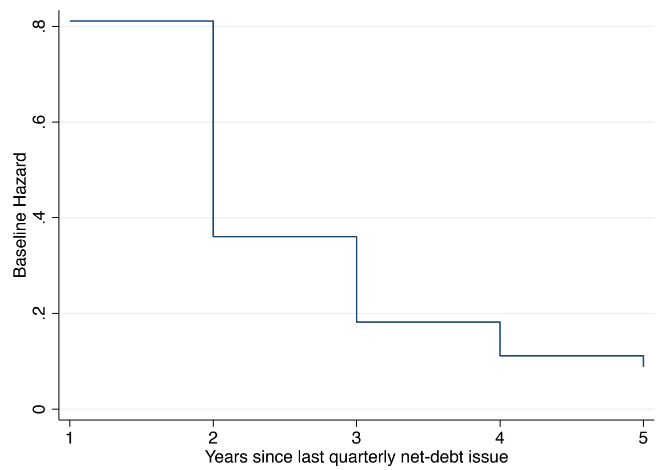
Figure 4: Estimated dynamic hazard curves for high- and low-frequency net-debt issuers

The classification of firms into high- and low-frequency net-debt issuers (HFIs and LFIs) is as detailed in Table 4 with the 2.5% issue size threshold. The figure plots the baseline hazard $h_0(t)$ that is obtained from estimating the following exponential shared frailty hazard model (indexed as the j'th issue by firm i):

$$h_{i,j}(t|\alpha_i) = \alpha_i h_0(t)\exp(\beta x_{i,j}(t)),$$

where t is the length of the issue spell (measured in years until the next quarterly net debt issue), $h_0(t)$ is the baseline hazard (parameterized as $h_0(t) = \exp(Constant + \gamma_1 t + \gamma_2 t^2 + \gamma_3 t^3)$) and α_i captures unobserved heterogeneity analogous to a random effect in panel data model - it is assumed to be independent of the firm characteristics $x_{i,j}(t)$ and to have a zero-mean gamma distribution. The covariates in x include investment ($Capex$), market leverage ratio (L), cash ratio (C), the logarithm of assets ($Size$), operating profitability ($Prof$), cash flow risk ($Risk$), tangibility (Tan), Tobin's Q (Q), and research and development expenditures ($R\&D$). These variables are lagged one period and are entered after subtracting their median values, thus the hazards are relative to the median sample firm. Total sample of 9,340 U.S. public firms (66,056 firm-years), with an annual average of 1,616 HFIs (total of 19,424 firm-years) and 2,831 LFIs (total of 25,096 firm-years), 1984-2016.

A: Estimated baseline hazard for high-frequency net-debt issuers (HFIs)



B: Estimated baseline hazard for low-frequency net-debt issuers (LFIs)

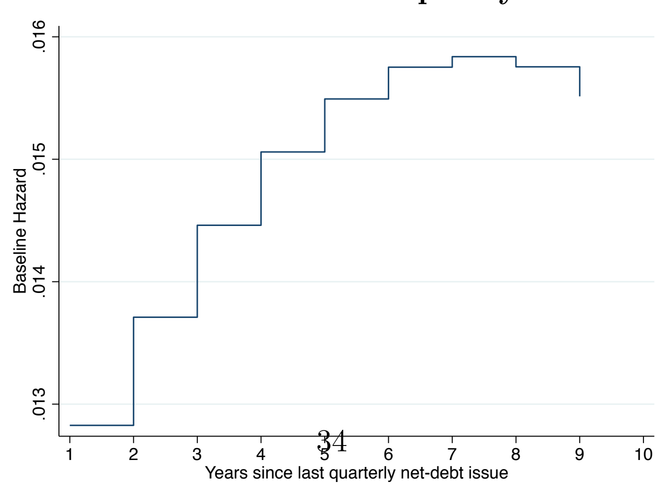


Figure 5: Cumulative net-debt and net-equity issues by over-levered HFIs following excess investment

The classification of firms as HFIs is as in Table 4 with the 2.5% issue size threshold. The event in year 0 is a joint net-debt issue (NDI/A >2.5% of total assets) and an investment spike ($Ecapex > 0$) by a firm that is over-levered going in to year 0 ($Dev_{t-1} = L_{t-1} - L^*_{t-1}(\beta X_{t-2}) > 0$, where L^* is estimated on a rolling basis using the firm characteristics X in Table 11). *Deviation* is the cumulative value of Dev_t, *Cumulative NDI* is the cumulative net-debt issues, and *Cumulative NEI* is cumulative net-equity issues (net of stock repurchases and dividends). Sample of 1,203 over-leveraged net debt issues financing investment, period 1984–2014.

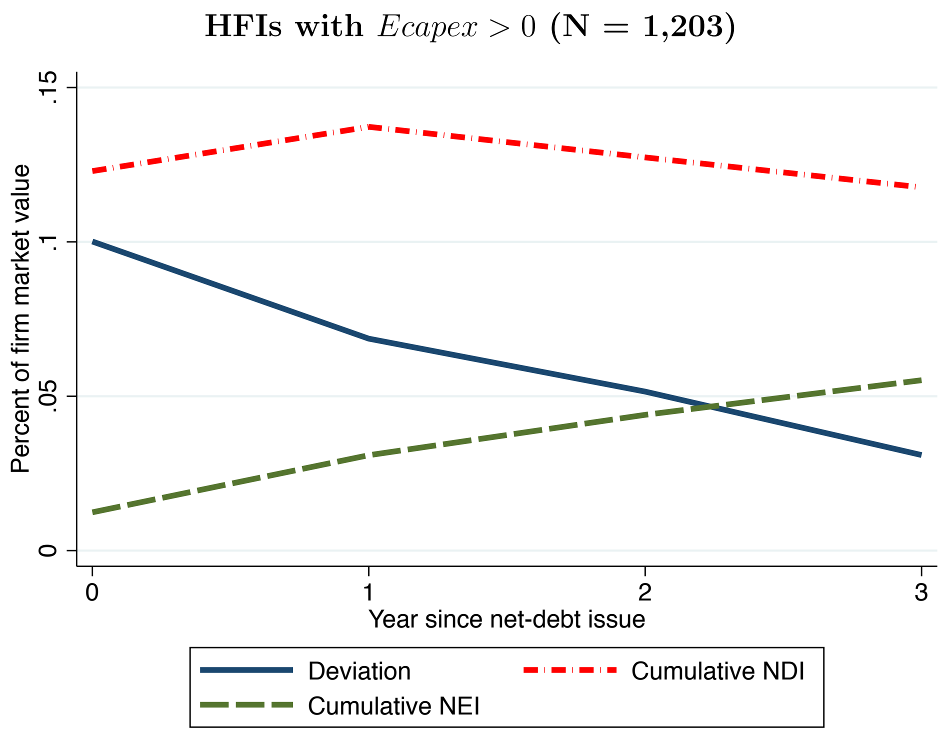


Table 1: Data sources and sample selection

Sample restriction	Observations	Firms
A: Annual CRSP/Compustat (CCM) sample, 1984-2016		
Initial CCM sample	217,674	21,915
U.S. domiciled firms only	-22,521	-2,385
Nongovernmental, industrial firms only[a]	-62,811	-5,662
No multiple annual observations	-1,865	0
No missing information on book value of assets	-266	-23
Firm age positive[b]	-174	-15
= Subsample	130,037	13,830
Consistent cash-flow statement data[c]	-568	-31
Consistent other financial statement data[d]	-2,559	-81
= Intermediate sample	126,910	13,718
B: Quarterly CRSP/Compustat (CCM) sample, 1984-2016		
Initial CCM Sample	877,248	22,448
U.S. domiciled firms only	-165,579	-3,515
Nongovernmental, industrial firms only[a]	-177,700	-4,640
No multiple quarterly observations	-7,126	0
No missing information on book value of assets	-1,638	-9
Consistent cash-flow statement data[c]	-24,236	-344
Consistent other financial statement data[e]	-27,432	-102
= Intermediate Sample	473,537	13,838
C: Merged CRSP/Compustat (CCM) sample, 1984-2016		
Merged Sample	445,046	13,384
Went public during sample period	-179,500	-4,044
Contiguous annual observations[f]	-25,518	0
Final quarterly CRSP/Compustat sample	240,028	9,340
Final annual CRSP/Compustat sample	66,056	9,340

[a] Eliminates utilities (SIC codes 4899-5000), financial firms (SIC codes 5999-7000), and government entities (SIC codes greater than 8999).

[b] Firm age is the difference between the reporting date of the annual financial statement and the date of the first month a company is reported in the CCM monthly stock price database, rounded to the next smaller integer.

[c] For cash-flow data consistency, we first set missing entries for items in the cash flow statement to zero and then drop observations in case total sources or uses of funds equal zero or deviate by more than 1% from each other. Total sources are the sum of gross equity issues, gross debt issues, cash balance drawdowns, asset sales, reduction of net working capital, positive operating cash flow and other financing inflows. Total uses of funds are dividends, share repurchases, debt retirement, build-up of cash balances, investment, increase in net working capital, negative operating cash flow and other financing outflows.

[d] For other annual financial statement data, we require non-missing data for the market value of the firm's equity (prcc_f × csho), Tobin's Q (dltt + dlc + prcc_f × csho)/at), total debt (dltt + dlc), cash holdings (che), property plant and equipment (ppent) and operating profits (oibdp). We further drop observations in case the book leverage ratio is outside the unit interval or cash holdings are negative.

[e] For other quarterly financial statement data, we first replace missing values of the number of shares outstanding (cshoq) and the stock price (prccq) with the previously reported value in case the current observation is missing. As in footnote (d), we require non-missing quarterly data for the market value of the firm's equity, Tobin's Q, total debt, cash holdings, property plant and equipment and operating profits. Whenever quarterly operating profits are missing, we use Compustat's own variable definitions as follows: Compustat defines earnings before interest and taxes (oiadpq) as the difference between operating profits and depreciation expenditures (dpq): oiadpq = oibdpq - dpq. Operating profits are further defined by Compustat as the difference between revenues (saleq) and operating costs (xoprq): oibdpq = saleq - xoprq. In case the entry for oibdpq is missing, we therefore set it to oibdpq = oiadpq + dpq or, if still missing, to saleq - xoprq. Finally, we drop observations in case the lagged stock split adjustment factor (ajexq) is zero.

[f] We eliminate observations once the underlying annual data become non-contiguous.

Table 2: **Construction of annual variables (Compustat mnemonics in Appendix Table 1)**

Variable	Description	Computation
A. Selected firm characteristics (All Financial Statements)		
L	Market leverage	(dlcc + dlt)/(prcc_f*csho + dlcc + dlt)
BL	Book leverage	(dlcc + dlt)/at
C	Cash ratio	che/at
$Size^{a}$	Size	log(at)
$Prof(\Pi)$	Profitability	oibdp/at
Tan	Tangibility	ppent/at
Q	Tobin's Q	(prcc_f*csho + dlcc + dlt)/at
$R\&D$	R&D expenses	xrd/at
Div	Dividend yield	dv/seq
$Capex$	Capital expenditures	capx/at
$Depr$	Depreciation	dp/at
$Risk$	Cash flow risk	Annualized value of quarterly $Risk$ estimate
I_{CX}	Investment into Capex	capx/lag(at)
I_{CF}	Total cash investment	(inv_total + ivstch)/lag(at)
$Ecapex$	Excess Capex	$I_{CX} - I_{CX}(ind3)^{b}$
$Spike$	Spike in Capex	$(I_{CX} - I_{CX}(ind2))/\sigma(I_{CX}(ind2))^{c}$
$Elev$	Excess leverage	$L - L(ind3)^{b}$
B. Sources of funds (Cash Flow Statement)		
EI	Equity issues	sstk
DI	Debt issues	dltis + max[dlcch,0]
CF^{+}	Positive operating cash flow	max[oancf + nwc_inv,0]
ΔC^{-}	Cash draw-down	max[chech*(-1),0]
S^{-}	Security sales	min[ivstch,0]
I^{-}	Illiquid asset sales	siv + min[ivaco,0] + sppe
ΔW^{-}	Decrease in net working capital	max[nwc_inv*(-1),0]
O^{+}	Other sources	max[fincf_oth,0]
C. Uses of funds (Cash Flow Statement)		
ER	Distributions to equity holders	dv + prstkc
DR	Debt retirements	dltr + min[dlcch,0]*(-1)
CF^{-}	Negative operating cash flow	max[(oancf + nwc_inv)*(-1),0]
ΔC^{+}	Build-up of cash balance	max[chech,0]
I^{+}	Investments	ivch + aqc + min[ivstch*(-1),0] + min[ivaco*(-1),0] + capx
ΔW^{+}	Increase int net working capital	max[nwc_inv,0]
O^{-}	Other uses	max[fincf_oth*(-1),0]
D. Composite Variables (Cash Flow Statement)		
NDI	Net debt issues	DI - DR
NDI^{+}	Positive portion of net debt issues	max[DI - DR,0]
NDI^{-}	Negative portion of net debt issues	max[DR - DI,0]
NEI	Net equity issues	EI - ER

[a] When computing size, we adjust the book value of assets by inflation using January 1984 as the base year.
[b] $I_{CX}(ind3)$ and $L(ind3)$ are computed using the industry median based on the 3-digit SIC code.
[c] $I_{CX}(ind2)$ is computed using the industry average based on the 2-digit SIC code.

Table 3: Construction of quarterly variables (used for H1 and *Risk*)

Variable	Description	Computation
A. Selected firm characteristics (All Financial Statements)[a]		
D	Total debt	dlcq + dlttq
MV	Market value of firm	dlcq + dlttq + prccq*cshoq
C	Cash holdings	cheq
A	Total book assets	atq
L	Market leverage	(dlcq + dlttq) / (prccq*cshoq + dlcq + dlttq)
NL	Net Market leverage	(dlcq + dltq - cheq)/(prccq*cshoq + dlcq + dltq - cheq)
BL	Book leverage	(dlcq + dlttq) / atq
ΔC	Change in cash holdings	cheq - lag(cheq)
$Prof(\Pi)$	Profitability	oibdpq / atq
$Risk$	Cash flow risk	St. dev. of Π
$Size$	Firm size	log(atq)
Q	Tobin's Q	(prccq*cshoq + dlcq + dlttq) / (atq)
Tan	Tangibility	ppentq / atq
$Capex$	Capital expenditures	capxq / atq
B. Sources and uses of funds (Cash flow statement)		
EI	Equity Issues	sstkq
ER	Distributions to equity-holders	dvq + prstkcq
CH	Cash component of ΔC	chechq
$IVSTCH$	Short-term securities component of ΔC	ivstchq
OCF	Operating cash flow	oancfq + exreq
INV	Total investment	capxq + aqcq + ivchq - sivq - sppeq - ivacoq
OTH	Other	fiaoq + txbcofq
C. Composite variables		
NDI	Total net debt issues	dltisq + dlcchq - dltrq
NDI^{+}	Positive portion of net debt issues	max[NDI,0]
NDI^{-}	Negative portion of net debt issues	max[NDI × (-1),0]
ΔD^{e}	Long-term net debt issuance	dltisq - dltrq
ER^{e}	Equity distribution minus equity issue	ER - EI
a_t	Debt-financed rebalancing	=1 if $\frac{\Delta D_t^e}{A_t} > s$ and $\frac{ER_t^e}{A_t} > s$ (=0 otherwise)
a_t'	Mixed cash-and-debt-financed rebalancing	=1 if $\frac{\Delta D_t^e - \Delta C_t}{A_t} > s$ and $\frac{ER_t^e}{A_t} > s$ (=0 otherwise)

[a] Size is adjusted for inflation using the consumer price index provided by CRSP for September 1983 (the date of the first quarterly report in our sample) as a deflator. The continuous variables ($Size$, Q, Π, $Risk$, NL) are winsorized at the 1(99) percent level, and naturally bounded variables (L, Tan) are set to be within the unit interval.

[b] Risk is computed as the standard deviation of operating profitability (Π) using a rolling window estimation relative to the first available quarter in the year of public listing. The variable $Risk_t$ includes information up to quarter t (with the exception of $Risk_t$ in the first available quarter of the year of public listing which uses information on t and $t+1$).

Table 4: Issues and retirements with a 2.5% issue size threshold

Starting in the year of public listing ($t = 0$), firm i is classified as a high- or low frequency net-debt issuer (HFI or LFI) in year t as follows: First, calculate firm i's cumulative number of quarterly positive net-debt issues in year t, N_{it}, as follows: $N_{it} = \sum_{\tau=0}^{t} \sum_{q=1}^{4} I_{iq\tau}$, where $I_{iq\tau}$ takes a value of one if $NDI^{+}_{iq\tau}/A_{iq\tau} \geq 2.5\%$ in quarter q of event year $\tau \leq t$ and zero otherwise. NDI^{+} is the positive portion of total debt issue minus debt retirement as given by quarterly Compustat cash flow statements. Then, firm i is classified as a HFI (LFI) in year t if N_{it} is in the upper (lower) quartile of the frequency distribution of N_t. The cumulative quarterly number of issues for the HFIs and LFIs are within-group averages, while the mean and median are for the total sample of firms. The counts for the net-debt retirements (NDI^{-}) in Panel B, and cash equity issues (EI) in Panel C are for the firms classified as HFI or LFI in Panel A (thus Panel B lists information on the volume and frequency of retirements). Variable definitions are found in Tables 2 and 3. Total sample of 9,340 public US firms and 66,056 firm-years, 1984-2016.

	Total sample of firms			Fraction received of aggregate issue proceeds		Cumulative quarterly number of issues			
Event year	All	LFI	HFI	LFI	HFI	Average LFI	Sample Mean	Sample Median	Average HFI
A. Net-debt issues (NDI^{+})									
0	9,340	6,194	3,146	0.03	0.97	0.00	0.42	0	1.25
1	8,251	3,669	2,582	0.02	0.71	0.00	1.12	1	2.81
3	5,813	1,641	1,667	0.01	0.55	0.00	2.38	2	5.54
5	4,174	1,492	1,386	0.10	0.64	0.41	3.49	3	7.37
10	2,078	630	575	0.09	0.48	0.88	6.00	5	12.76
15	1,097	298	282	0.07	0.48	1.39	8.13	7	17.12
20	539	163	150	0.12	0.39	2.70	10.74	9	21.21
B. Net-debt retirements (NDI^{-}) by HFIs/LFIs in Panel A									
0	9,340	6,194	3,146	0.75	0.25	0.55	0.54	0	0.52
1	8,251	3,669	2,582	0.27	0.32	0.65	0.94	1	1.25
3	5,813	1,641	1,667	0.07	0.37	0.71	1.84	1	2.80
5	4,174	1,492	1,386	0.16	0.48	1.19	2.81	2	4.32
10	2,078	630	575	0.08	0.39	1.59	5.09	4	8.46
15	1,097	298	282	0.07	0.40	2.16	7.37	6	13.10
20	539	163	150	0.06	0.46	3.73	9.94	8	17.18
C. Cash equity issues (EI) by HFIs/LFIs in Panel A									
0	9,340	6,194	3,146	0.71	0.29	0.99	0.97	1	0.93
1	8,251	3,669	2,582	0.38	0.37	1.42	1.41	1	1.41
3	5,813	1,641	1,667	0.19	0.43	2.24	2.21	2	2.18
5	4,174	1,492	1,386	0.31	0.41	3.00	2.89	2	2.76
10	2,078	630	575	0.34	0.33	4.87	4.24	3	3.78
15	1,097	298	282	0.26	0.29	6.05	4.98	3	3.94
20	539	163	150	0.39	0.21	7.06	5.32	3	3.85

Table 5: Issues and retirements with a 5% issue size threshold

Starting in the year of public listing ($t = 0$), firm i is classified as a high- or low frequency net-debt issuer (HFI or LFI) in year t as follows: First, calculate firm i's cumulative number of quarterly positive net-debt issues in year t, N_{it}, as follows: $N_{it} = \sum_{\tau=0}^{t} \sum_{q=1}^{4} I_{iq\tau}$, where $I_{iq\tau}$ takes a value of one if $NDI^{+}_{iq\tau}/A_{iq\tau} \geq 5\%$ in quarter q of event year $\tau \leq t$ and zero otherwise. NDI^{+} is the positive portion of total debt issue minus debt retirement as given by quarterly Compustat cash flow statements. Then, firm i is classified as a HFI (LFI) in year t if N_{it} is in the upper (lower) quartile of the frequency distribution of N_t. The cumulative quarterly number of issues for the HFIs and LFIs are within-group averages, while the mean and median are for the total sample of firms. The counts for the net-debt retirements (NDI^{-}) in Panel B, and cash equity issues (EI) in Panel C are for the firms classified as HFI or LFI in Panel A (thus Panel B lists information on the volume and frequency of retirements). Variable definitions are found in Tables 2 and 3. Total sample of 9,340 public US firms and 66,056 firm-years, 1984-2016.

	Total sample of firms			Fraction received of aggregate issue proceeds		Cumulative quarterly number of issues			
Event year	All	LFI	HFI	LFI	HFI	Average LFI	Sample Mean	Sample Median	Average HFI
A. Net-debt issues (NDI^{+})									
0	9,340	6,844	2,496	0.08	0.92	0.00	0.31	0	1.18
1	8,251	4,430	3,821	0.08	0.92	0.00	0.79	0	1.70
3	5,813	2,163	1,453	0.05	0.50	0.00	1.58	1	4.18
5	4,174	1,231	1,490	0.03	0.71	0.00	2.22	2	4.82
10	2,078	671	659	0.08	0.57	0.42	3.64	3	7.73
15	1,097	370	299	0.14	0.46	0.94	4.79	4	10.30
20	539	182	140	0.22	0.48	1.62	6.30	5	13.39
B. Net-debt retirements (NDI^{-}) by HFIs/LFIs in Panel A									
0	9,340	6,844	2,496	0.82	0.18	0.41	0.41	0	0.40
1	8,251	4,430	3,821	0.39	0.61	0.43	0.63	0	0.85
3	5,813	2,163	1,453	0.21	0.31	0.50	1.11	1	1.89
5	4,174	1,231	1,490	0.10	0.48	0.56	1.62	1	2.67
10	2,078	671	659	0.10	0.44	0.86	2.71	2	4.75
15	1,097	370	299	0.17	0.42	1.22	3.74	3	7.21
20	539	182	140	0.07	0.50	1.87	5.01	4	9.96
C. Cash equity issues (EI) by HFIs/LFIs in Panel A									
0	9,340	6,844	2,496	0.77	0.23	0.94	0.92	1	0.86
1	8,251	4,430	3,821	0.44	0.56	1.29	1.29	1	1.30
3	5,813	2,163	1,453	0.24	0.40	1.87	1.92	1	2.09
5	4,174	1,231	1,490	0.23	0.46	2.39	2.45	2	2.61
10	2,078	671	659	0.30	0.38	3.21	3.37	2	3.49
15	1,097	370	299	0.30	0.29	3.80	3.84	2	3.64
20	539	182	140	0.49	0.20	4.12	4.06	2	3.65

Table 6: Lifecycle firm characteristics of HFIs and LFIs

The sort of firms into high- and low-frequency issuers (HFIs and LFIs) is as in Table 4 (using Eq. (1) and a 2.5% issue size threshold). The table lists, starting with the year of public listing (event year 0), average annual values of key firm characteristics, several of which are scaled by current book value of assets. The characteristics are market leverage ratio (L), fraction of the sample that are all-equity financed (AE), cash ratio (C), book asset value ($Assets$), asset tangibility (Tan, defined as $PPE/Assets$), operating profitability ($Prof(\Pi)$), the ratio of dividends to book equity (Div), the annualized standard deviation of quarterly operating profitability ($Risk$), capital expenditures ($Capex$), two measures of long-term investment (I, all scaled by the lagged book asset value: I_{CX} is investment into capital expenditures, and I_{CF} is total cash investment), Tobin's Q (Q) and $R\&D$ expenditures. All ratios are winsorized at the 1(99) percent level or must lie between zero and one (cash ratio and leverage). Variable definitions are found in Tables 2 and 3. Total sample of 9,340 U.S. public firms (66,056 firm-years), with an annual average of 1,616 HFIs (total of 19,424 firm-years) and 2,831 LFIs (total of 25,096 firm-years), 1984-2016.

Year	L (1)	AE (2)	C (3)	$Assets$ (4)	Tan (5)	$Prof(\Pi)$ (6)	Div (7)	$Risk$ (8)	$Capex$ (9)	I_{CX} (10)	I_{CF} (11)	Q (12)	$R\&D$ (13)
A: HFI characteristics													
0	0.21	0.04	0.22	406	0.28	-0.05	0.03	0.07	0.11	.	.	2.52	0.05
1	0.31	0.01	0.11	415	0.32	-0.04	0.01	0.08	0.11	0.15	0.23	1.90	0.04
2	0.35	0.02	0.09	505	0.33	0.01	0.01	0.08	0.09	0.12	0.18	1.63	0.03
3	0.36	0.02	0.08	517	0.34	0.04	0.01	0.08	0.08	0.10	0.16	1.54	0.03
4	0.38	0.01	0.07	617	0.33	0.04	0.01	0.07	0.08	0.10	0.15	1.43	0.03
5	0.37	0.02	0.08	631	0.34	0.05	0.01	0.07	0.07	0.09	0.13	1.37	0.03
10	0.34	0.03	0.08	1,103	0.34	0.08	0.01	0.07	0.07	0.08	0.12	1.33	0.02
15	0.32	0.08	0.09	1,796	0.30	0.09	0.02	0.06	0.06	0.07	0.09	1.26	0.02
20	0.25	0.07	0.08	2,654	0.29	0.11	0.03	0.06	0.06	0.06	0.12	1.31	0.01
Avg.	0.32	0.03	0.11	822	0.32	0.03	0.02	0.07	0.08	0.10	0.15	1.65	0.03
Median	0.28	0.00	0.04	118	0.24	0.10	0.00	0.05	0.05	0.05	0.07	1.14	0.00
B: LFI characteristics													
0	0.08	0.27	0.41	291	0.19	-0.04	0.02	0.06	0.07	.	.	3.30	0.08
1	0.07	0.36	0.41	287	0.17	-0.10	0.01	0.07	0.06	0.08	0.12	2.83	0.12
2	0.06	0.44	0.42	285	0.17	-0.10	0.01	0.08	0.05	0.06	0.10	2.62	0.14
3	0.04	0.49	0.43	267	0.16	-0.07	0.01	0.08	0.05	0.06	0.09	2.63	0.14
4	0.08	0.41	0.39	465	0.17	-0.06	0.01	0.09	0.05	0.06	0.09	2.57	0.13
5	0.07	0.43	0.39	500	0.17	-0.05	0.01	0.09	0.05	0.05	0.09	2.45	0.14
10	0.06	0.48	0.40	835	0.14	-0.01	0.01	0.09	0.04	0.04	0.07	2.25	0.12
15	0.05	0.53	0.39	945	0.13	0.01	0.02	0.09	0.03	0.03	0.07	2.19	0.12
20	0.06	0.45	0.35	1,648	0.15	0.01	0.03	0.09	0.03	0.03	0.07	2.14	0.11
Avg.	0.07	0.40	0.40	514	0.17	-0.05	0.01	0.08	0.05	0.06	0.09	2.71	0.12
Median	0.00	0.00	0.36	78	0.10	0.06	0.00	0.05	0.03	0.03	0.05	1.87	0.06

Table 7: Lifecycle funding ratios of HFIs and LFIs

The sort of firms into high- and low-frequency issuers (HFIs and LFIs) is as in Table 4 (using Eq. (1) and a 2.5% issue size threshold). In Panel A, the annual (non-negative) cash contribution of the i'th funding source is the ratio $R_j \equiv S_j / \sum_i^8 S_i$, where the denominator is the sum of the eight individual funding sources in the firm's total cash flow statement:

$$\sum_i^8 S_i = NDI^+ + EI + CF^+ + \Delta C^- + S^- + \Delta W^- + I^- + O^+$$

The eight columns are: R_{NDI^+} is the net debt issue ratio (NDI^+ in the numerator), R_{EI} is the equity issue ratio, R_{CF^+} is the operating cash flow contribution, $R_{\Delta C^-}$ is the contribution from cash draw-downs, R_{S^-} is the contribution from security sales, $R_{\Delta W^-}$ is contribution of reductions in net working capital and R_{I^-} is the fraction of funds provided by illiquid asset sales. Panel B displays R_j only for years with at least one positive quarterly net debt issues ($NDI^+ > 0$, using the 2.5% issue size threshold). Variable definitions are in Tables 2 and 3. Total sample of 9,340 U.S. public firms (66,056 firm-years), with an annual average of 1,616 HFIs (total of 19,424 firm-years) and 2,831 LFIs (total of 25,096 firm-years), 1984-2016.

	R_{NDI^+}		R_{EI}		R_{CF^+}		$R_{\Delta C^-}$		R_{S^-}		$R_{\Delta W^-}$		R_{I^-}		R_{O^+}	
Year	HFI	LFI	HFI	LFI	HFI	LFI	HFI	LFI	HFI	LFI	HFI	LFI	HFI	LFI	HFI	LFI
A: Funding ratios																
0	0.22	0.01	0.51	0.69	0.16	0.18	0.03	0.04	0.00	0.01	0.03	0.03	0.03	0.03	0.02	0.02
1	0.35	0.01	0.15	0.20	0.24	0.30	0.12	0.26	0.02	0.07	0.06	0.06	0.05	0.08	0.02	0.01
2	0.31	0.01	0.16	0.18	0.28	0.31	0.07	0.20	0.02	0.10	0.09	0.08	0.06	0.11	0.02	0.01
3	0.27	0.01	0.15	0.18	0.32	0.31	0.07	0.17	0.01	0.10	0.10	0.10	0.07	0.12	0.02	0.01
4	0.26	0.03	0.13	0.18	0.34	0.32	0.06	0.16	0.01	0.09	0.11	0.08	0.07	0.12	0.02	0.02
5	0.23	0.03	0.12	0.16	0.37	0.33	0.06	0.17	0.01	0.09	0.11	0.08	0.08	0.12	0.02	0.01
10	0.19	0.03	0.10	0.15	0.45	0.36	0.06	0.15	0.01	0.08	0.09	0.07	0.09	0.17	0.01	0.01
15	0.14	0.04	0.08	0.12	0.47	0.35	0.07	0.12	0.02	0.07	0.13	0.08	0.08	0.21	0.01	0.01
20	0.18	0.06	0.04	0.13	0.53	0.40	0.07	0.12	0.02	0.05	0.08	0.09	0.08	0.15	0.01	0.01
Average	0.24	0.02	0.18	0.30	0.34	0.29	0.07	0.14	0.01	0.06	0.09	0.07	0.07	0.11	0.02	0.02
Median	0.13	0.00	0.02	0.08	0.29	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B: Funding ratios during years with at least one positive quarterly net-debt issues																
Average	0.30	0.31	0.20	0.12	0.29	0.25	0.06	0.11	0.01	0.05	0.07	0.05	0.06	0.09	0.02	0.01
Median	0.25	0.26	0.02	0.03	0.24	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 8: Sources and uses of funds of HFIs undertaking capital structure rebalancings

The table displays components of a firm's cash flow identity conditional on the rebalancing event of type a_t, where

$$a_t = 1 \text{ if } \frac{\Delta D_t^e}{A_t} > s \text{ and } \frac{ER_t^e}{A_t} > s,$$

and where ΔD^e is the long-term debt issues in excess of debt retirements, ER^e is equity retirement in excess of equity issues, and A is book value of total assets. The table shows the following components of a firm's cash flow identity

$$OCF - INV + OTH + \underbrace{(-CH + IVSTCH)}_{\text{Cash and cash equivalents}} = \underbrace{ER^e - NDI}_{\text{Debt-financed equity payout}}$$

where OCF is operating cash flow, INV is total net investment outlays, and OTH denotes (generally small) other financing cash flows. The contribution of cash and cash equivalents can be broken down into the drawdown of cash balances ($-CH$) and the net sale of short-term marketable securities ($IVSTCH$). On the right-hand side, ER^e is (again) the net equity retirement (dividends and share repurchases net of equity issues) and NDI are total debt issues in excess of debt retirements. The size threshold s is set to 2.5% in Panel A and 5% in Panel B. In row 1 of each panel, the classification of firms into HFIs is based on the the original cumulative quarterly net debt issue frequency sort in Table 4. Row 2 focuses on mature HFIs by requiring a minimum of five years since listing for each HFI. Row 3 sorts firms into long-term HFIs using event-year ten relative to the year of going public and then holds this balanced sample constant. All variables are scaled by the book value of assets. See Table 3 for the variable construction and Compustat mnemonics. Sample period 1984-2016.

					Cash and cash equivalents		Debt Financed Rebalancing	
	N	OCF	INV	OTH	$-CH$	$IVSTCH$	ER^e	NDI
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
A: Rebalancing size threshold s equals 2.5%								
All	1,383	0.00	0.04	0.01	0.02	0.00	0.12	0.12
Mature	545	0.02	0.02	0.00	-0.01	0.00	0.10	0.09
Balanced	548	0.02	0.01	-0.01	0.00	0.00	0.16	0.15
B: Rebalancing size threshold s equals 5%								
All	720	-0.01	0.03	0.01	0.02	0.00	0.18	0.17
Mature	269	0.02	0.01	0.01	-0.01	0.00	0.15	0.13
Balanced	264	0.02	0.01	-0.01	0.00	0.00	0.16	0.15

Table 9: The leverage-profitability relation for HFIs

The table reports coefficient estimates from the following panel regression:

$$L_t = \alpha + \gamma_0 \Pi_{t-1} + \gamma_1 \Pi_{t-1} a_t + \gamma_2 a_t + \beta X_{t-1} + \epsilon_t$$

$$a_t = 1 \text{ if } \frac{\Delta D_t^e}{A_t} > s \text{ and } \frac{ER_t^e}{A_t} > s$$

where $L \equiv D/MV$ is the market leverage ratio, D is book value of total debt debt, MV is D plus the market value of total equity, ΔD^e is long-term debt issues in excess of debt retirement, ER^e is equity retirement in excess of equity issues, A is book value of total assets, Π is operating profitability scaled by A, and the constant issue-size threshold s is in percent of A. The vector X of control variables include $Risk$ (the standard deviation of Π), Q (the market to book ratio), Tan (the ratio of tangible assets to A), and $Size$ (the natural logarithm of A adjusted for inflation). The variables Q, Π and $Risk$ are winsorized at the 1(99) percent level, and naturally bounded variables (L, Tan) are set to be within the unit interval. Columns (1) and (4) use the full sample of HFIs, columns (2) and (5) the sample of mature HFIs (all rebalancing events for HFIs that have been publicly traded for a minimum of five years), and columns (3) and (6) show results for long-term HFIs (using all rebalancing events for a constant-composition set of HFIs selected in their tenth year following public listing). Superscript ** (*) indicates significance at the 1% (5%) level. See Table 3 for the variable construction and Appendix Table 1 for an explanation of Compustat mnemonics. Sample period 1984-2016.

Issue size threshold s:	$s = 2.5\%$			$s = 5\%$		
	All	Mature	Long-term	All	Mature	Long-term
	(1)	(2)	(3)	(4)	(5)	(6)
Firm profitability and rebalancing						
Π (γ_0)	-0.639**	-0.912**	-0.847**	-0.642**	-0.912**	-0.847**
	(0.01)	(0.03)	(0.03)	(0.01)	(0.03)	(0.03)
a	-0.037**	-0.036**	-0.033**	-0.012	-0.022	-0.011
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
$a \times \Pi$ (γ_1)	-0.112	0.517*	0.384	-0.178	0.856**	0.550*
	(0.10)	(0.25)	(0.22)	(0.11)	(0.27)	(0.27)
Firm controls						
$Risk$	-0.474**	-0.778**	-0.500**	-0.474**	-0.776**	-0.500**
	(0.03)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)
$Size$	0.021**	0.012**	0.019**	0.021**	0.012**	0.019**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Q	-0.062**	-0.092**	-0.069**	-0.062**	-0.092**	-0.069**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Tan	0.122**	0.147**	0.128**	0.122**	0.147**	0.128**
	(0.00)	(0.00)	(0.04)	(0.00)	(0.00)	(0.00)
Quarter FE	yes	yes	yes	yes	yes	yes
Adj. R^2	0.29	0.29	0.27	0.29	0.29	0.27
Rebalancings	977	458	442	416	184	184
Total obs.	66,431	32,002	36,601	66,431	32,002	36,601
Trade-off hypothesis H1: $\boldsymbol{\gamma_0 < 0}$ and $\boldsymbol{\gamma_0 + \gamma_1 > 0}$						
$\boldsymbol{\gamma_0 + \gamma_1}$	**-0.751****	**-0.395**	**-0.463***	**-0.82****	**-0.056**	**-0.297**
Wald test ($\gamma_0 + \gamma_1 = 0$)	0.000	0.117	0.035	0.000	0.833	0.272

Table 10: **The net leverage-profitability relation for HFIs**

The table reports coefficient estimates from the following panel regression:

$$NL_t = \alpha + \gamma_0 \Pi_{t-1} + \gamma_1 \Pi_{t-1} a_t + \gamma_2 a_t + \beta X_{t-1} + \epsilon_t$$

$$a_t = 1 \text{ if } \frac{\Delta D_t^e - \Delta C_t}{A_t} > s \text{ and } \frac{ER_t^e}{A_t} > s$$

where $NL \equiv (D - C)/(MV - C)$ is the net market leverage ratio, D is book value of total debt debt, C are cash holdings, MV is D plus the market value of total equity, ΔD^e is long-term debt issues in excess of debt retirement, ER^e is equity retirement in excess of equity issues, A is book value of total assets, Π is operating profitability scaled by A, and the constant issue-size threshold s is in percent of A. The vector X of control variables include $Risk$ (the standard deviation of Π), Q (the market to book ratio), Tan (the ratio of tangible assets to A), and $Size$ (the natural logarithm of A adjusted for inflation). The variables Q, Π and $Risk$ are winsorized at the 1(99) percent level, and naturally bounded variables (L, Tan) are set to be within the unit interval. Columns (1) and (4) use the full sample of HFIs, columns (2) and (5) the sample of mature HFIs (all rebalancing events for HFIs that have been publicly traded for a minimum of five years), and columns (3) and (6) show results for long-term HFIs (using all rebalancing events for a constant-composition set of HFIs selected in their tenth year following public listing). Superscript ** (*) indicates significance at the 1% (5%) level. See Table 3 for the variable construction and Appendix Table 1 for an explanation of Compustat mnemonics. Sample period 1984-2016.

Issue size threshold s:	$s = 2.5\%$			$s = 5\%$		
	All	Mature	Long-term	All	Mature	Long-term
	(1)	(2)	(3)	(4)	(5)	(6)
Firm profitability and rebalancing						
Π (γ_0)	-0.332**	-0.712**	-0.712**	-0.336**	-0.715**	-0.716**
	(0.03)	(0.05)	(0.05)	(0.03)	(0.05)	(0.04)
a	-0.084**	-0.079**	-0.082**	-0.077**	-0.079*	-0.077*
	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
$a \times \Pi$ (γ_1)	-0.024	0.441	0.471	-0.132	0.646	0.620
	(0.15)	(0.31)	(0.31)	(0.17)	(0.47)	(0.47)
Firm controls						
$Risk$	-0.404**	-1.220**	-0.826**	-0.405**	-1.219**	-0.829**
	(0.05)	(0.08)	(0.07)	(0.05)	(0.08)	(0.07)
$Size$	0.029**	0.018**	0.026**	0.029**	0.017**	0.026**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Q	-0.056**	-0.080**	-0.060**	-0.056**	-0.080**	-0.061**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Tan	0.204**	0.229**	0.198**	0.204**	0.229**	0.198**
	(0.00)	(0.01)	(0.07)	(0.00)	(0.01)	(0.01)
Quarter FE	yes	yes	yes	yes	yes	yes
Adj. R^2	0.15	0.16	0.14	0.15	0.16	0.14
Rebalancings	1,361	697	785	608	297	348
Total obs.	66,431	32,002	36,601	66,431	32,002	36,601
Trade-off hypothesis H1: $\gamma_0 < 0$ and $\gamma_0 + \gamma_1 > 0$						
$\gamma_0 + \gamma_1$	**-0.356****	**-0.271**	**-0.241**	**-0.468****	**-0.069**	**-0.096**
Wald test ($\gamma_0 + \gamma_1 = 0$)	0.016	0.372	0.435	0.007	0.883	0.836

Table 11: **Speed-of-adjustment estimation: HFIs versus LFIs**

The table reports estimates of the speed-of-adjustment coefficient ϕ in the regression:

$$Y_{i,t} = \alpha + \eta_i + \phi \left(L^*_{i,t}(\beta X_{i,t-1}) - L_{i,t-1} \right) + \epsilon_{i,t}.$$

where in Panels A to C the dependent variable $Y_{i,t}$ is firm i's change in market leverage ratio $(L_{i,t} - L_{i,t-1})$. Panel D replaces the dependent variable with net-equity issues (NEI) scaled by firm market value (MV). The term ϵ is the regression error, α is the constant, η_i is a firm fixed effect, $L^*_{i,t}(\beta X_{i,t-1})$ is the (estimated) target leverage ratio where the determinants $X_{i,t-1}$ are the lagged values of size, profitability, Q, cash ratio, tangibility, depreciation, R&D expenses, capital expenditures, $Risk$, the median industry leverage ratio, and year-fixed effects. In Panels A and D, the classification of firms into HFIs and LFIs is based on the the original cumulative quarterly net debt issue frequency sort in Table 4 (with the 2.5% issue size threshold). Panel B focuses on mature firms (minimum listing age of five years). Panel C first sorts firms into long-term HFIs and LFIs using event-year ten relative to the year of going public, and then hold this sample constant using all firm-years. All variables are winsorized at the 1(99) percent level or must lie between zero and one (cash ratio and leverage). Variable definitions are in Tables 2 and 3. Coefficient estimates are shown in the first row of each panel, with * and ** indicating significance at the 5% and 1% level, respectively. The second row contains either standard errors (in parentheses) or t-values. Total sample of 9,340 U.S. public firms (66,056 firm-years), with an annual average of 1,616 HFIs (total of 19,424 firm-years) and 2,831 LFIs (total of 25,096 firm-years), 1984-2016.

GMM estimates of SOA-coefficient ϕ			
Dependent variable $Y_{i,t}$	HFI (1)	LFI (2)	HFI - LFI (1)-(2)
A: All HFIs/LFIs			
$L_{i,t} - L_{i,t-1}$	0.313**	0.272**	0.041
	(0.018)	(0.029)	1.179
B: Mature HFIs/LFIs			
$L_{i,t} - L_{i,t-1}$	0.301**	0.304**	-0.003
	(0.023)	(0.037)	-0.067
C: Long-term HFIs/LFIs			
$L_{i,t} - L_{i,t-1}$	0.320**	0.304**	0.016
	(0.020)	(0.032)	0.413
D: All HFIs/LFIs			
$\frac{NEI_{i,t}}{MV_{i,t}}$	0.009	-0.014	0.022
	0.009	0.017	1.158

Table 12: **Speed-of-adjustment estimation with double-conditioning**

The table reports estimates of the speed-of-adjustment coefficient ϕ in the regression:

$$\begin{aligned} L_{i,t} - L_{i,t-1} &= \alpha + \eta_i + \phi L^*_{i,t}(\beta X_{i,t-1}) - \phi_1 L_{i,t-1}|_{(I=l,L=l)} - \phi_2 L_{i,t-1}|_{(I=l,L=h)} \\ &\quad -\phi_3 L_{i,t-1}|_{(I=h,L=l)} - \phi_4 L_{i,t-1}|_{(I=h,L=h)} + \epsilon_{i,t} \end{aligned}$$

where the dependent variable is the change in the market leverage ratio ($L_{i,t} - L_{i,t-1}$). The term ϵ is the regression error, α is the constant, η_i is a firm fixed effect, $L^*_{i,t}(\beta X_{i,t-1})$ is the (estimated) target leverage ratio where the determinants $X_{i,t-1}$ are the lagged values of size, profitability, Q, cash ratio, tangibility, depreciation, R&D expenses, capital expenditures, $Risk$, the median industry leverage ratio and year-fixed effects. The table distinguishes between high and low periods of investment (using $I = Ecapex$, computed either as the difference between the firm's I_{CX} and the median I_{CX} in the firm's 3-digit SIC industry) and high and low leverage ($L = Elev$, computed as the difference between the firm's lagged market leverage, $L_{i,t-1}$, and the lagged median 3-digit SIC industry leverage ratio). In Panels A, the classification of firms into HFIs is based on the the original cumulative quarterly net debt issue frequency sort in Table 4 (with the 2.5% issue size threshold). Panel B focuses on mature HFIs (minimum listing age of five years). Panel C first sorts firms into long-term HFIs using event-year ten relative to the year of going public, and then hold this sample constant using all firm-years. All variables are winsorized at the 1(99) percent level or must lie between zero and one (cash ratio and leverage). Variable definitions are in Tables 2 and 3. Coefficient estimates are shown in rows 1 and 3 of each panel, with * and ** indicating significance at the 5% and 1% level, respectively. Rows 2 and 4 contains either standard errors (in parentheses) or t-values. Total sample of 9,340 U.S. public firms (66,056 firm-years), with an annual average of 1,616 HFIs (total of 19,424 firm-years), 1984-2016.

GMM estimates of SOA-coefficients ϕ_1 to ϕ_4				
Dependent variable $Y_{i,t}$	Leverage	Investment low (1)	Investment high (2)	$I_l - I_h$
A: All HFIs				
$L_{i,t} - L_{i,t-1}$	low	0.338**	0.364**	-0.026
		(0.025)	(0.025)	-0.73
$L_{i,t} - L_{i,t-1}$	high	0.294**	0.327**	-0.033
		(0.017)	(0.021)	-1.23
B: Mature HFIs				
$L_{i,t} - L_{i,t-1}$	low	0.308**	0.325**	-0.018
		(0.030)	(0.034)	-0.39
$L_{i,t} - L_{i,t-1}$	high	0.296**	0.315**	-0.019
		(0.020)	(0.025)	-0.58
C: Long-term HFIs				
$L_{i,t} - L_{i,t-1}$	low	0.322**	0.311**	0.011
		(0.031)	(0.029)	0.25
$L_{i,t} - L_{i,t-1}$	high	0.314**	0.312**	0.002
		(0.019)	(0.022)	0.05

Table 13: **Link between debt issues and investment for over-leveraged HFIs**

The table presents coefficient estimates from the following logit regression:

$$Y_{i,t}^{*} = \alpha + \beta_1 D_{i,t-1}^{*} + \beta_2 I_{i,t} + \beta_3 D_{i,t-1}^{*} I_{i,t} + \epsilon_{i,t},$$

where $Y_{i,t}^{*}$ denotes the latent variable for the probability that firm i undertakes an annual (i) net debt issue in year t that exceeds 2.5% of total assets ($NDI_{i,t}/A_{i,t} \geq 2.5\%$; columns 1 to 4) or (ii) net debt retirement exceeding 2.5% of total assets ($NDI_{i,t}/A_{i,t} \leq -2.5\%$; columns 5 to 8). $D_{i,t-1}^{*}$ is a dummy variable indicating that the firm is over-levered at the end of year $t-1$, ($L_{i,t-1} - L_{i,t-1}^{*}(X_{i,t-2}) > 0$), where the control variables X are as in Table 11. $I_{i,t}$ is the size of the investment spike which is either *Ecapex* (computed either as the difference between the firm's I_{CX} and the median I_{CX} in the firm's 3-digit SIC industry) or *Spike* (the difference between the firm's I_{CX} and the 2-digit SIC industry average I_{CX} divided by the standard deviation of the industry I_{CX}). The estimation also includes industry dummies for eight of the 12 Fama-French (FF12) industries (excluding financial firms and regulated utilities). In Panel A, the classification of firms into HFIs is based on the the original cumulative quarterly net debt issue frequency sort in Table 4. Panel B focuses on mature HFIs by requiring a minimum of five years since listing for each HFI. Panel C sorts firms into long-term HFIs using event-year ten relative to the year of going public. Variable definitions are in Tables 2 and Appendix Table 3. *, ** indicate significance at the 5% and 1% level, respectively. Total sample of 9,340 U.S. public firms (66,056 firm-years), with an annual average of 1,616 HFIs (total of 19,424 firm-years), 1984-2016.

	Debt issues ($NDI_{i,t}/A_{i,t} \geq 2.5\%$)					Debt retirements ($NDI_{i,t}/A_{i,t} \leq -2.5\%$)				
Investment measure	N (1)	D_{t-1}^{*} (2)	I_t (3)	$D_{t-1}^{*} I_t$ (4)	Industry FE	N (5)	D_{t-1}^{*} (6)	I_t (7)	$D_{t-1}^{*} I_t$ (8)	Industry FE
A: All HFIs										
Ecapex	11,620	-0.20**	5.26**	2.61**	Yes	11,620	0.57**	-4.41**	-2.54**	Yes
Spikes	11,620	-0.12**	0.49**	0.32**	Yes	11,620	0.47**	-0.41**	-0.35**	Yes
B: Mature HFIs										
Ecapex	8,663	-0.17**	5.42**	3.12**	Yes	8,663	0.60**	-4.39**	-3.01**	Yes
Spikes	8,663	-0.07	0.51**	0.36**	Yes	8,663	0.48**	-0.41**	-0.41**	Yes
C: Long-term HFIs										
Ecapex	8,246	-0.13**	6.31**	1.54*	Yes	8,246	0.68**	-4.66**	-2.09*	Yes
Spikes	8,246	-0.08	0.58**	0.23**	Yes	8,246	0.58**	-0.46**	-0.34**	Yes

A. Issue-Frequency Persistence

Table 4 shows that the spread in *average* issue frequencies between LFIs and HFIs is high and persistent across the twenty-year event period. In this section, we also demonstrate firm-level persistence in the HFI and LFI classifications. We do so first by showing that the firms sorted into HFIs and LFIs using Eq. (1) overlap greatly with the firms sorted using different periods of cumulation. Moreover, we show that our HFI and LFI classifications have the power to predict future (out-of-sample) net-debt issue activity, as expected when firm-level issue activity is persistent.

(1) Effect of Shortening the Period of Cumulation

Appendix Table 2 examines whether a classification based on a three-year cumulative issue activity (columns 1-4), or a within-year classification (no cumulation, columns 5-8)), produces a similar set of firms in the HFI and LFI sorts as those based on Eq. (1). Alternatively, with a high degree of instability, where firms migrate from the HFI and LFI groups in event time, the degree of overlap will be small. Formally, the shorter time horizon modifies the cumulation period in Eq. (1) by adding the lag parameter $0 < s \leq t$:

$$N_{it}^{s} = \sum_{\tau=s}^{t} \sum_{q=1}^{4} I_{iq\tau}. \tag{14}$$

In the three-year cumulation, $s = t - 2$ (with $s = 0$ for the first two years after going public), while $s = t$ restricts the issue count to within-year (no cumulation).

First, as shown in Column (1), on average 85% of the firms originally classified as HFI in Table 4 are also classified as HFI with the three-year cumulation and a 2.5% issue size threshold (Panel A). With a 5% issue size threshold (Panel B), the overlap is 85%, and again with little variation across years since public listing. Moreover, as shown in Column (2), there is almost no migration from the HFI to the LFI categories: 1% of the LFIs would be classified as HFIs with the 2.5% threshold and the shorter period of cumulation (on average 3% with the 5% threshold). Similarly persistent, Column (4) shows that on average 91% of the LFIs remain LFIs also with the shorter three-year cumulation period (on average 96% when using the 5% threshold in Panel B).

Second, columns (5)-(8) show a high degree of overlap with the firms classified as HFI and LFI in Table 4 also when we use the within-year frequency classification. In column (5), 79% of the HFIs would be classified as HFIs also without cumulation (63% with the 5% threshold in Panel B)). Moreover, in Column (8), on average 96% of the firms classified as LFI using a within-year classification are also originally classified as LFI. Overall, Appendix Table 2 shows that the HFI classification emerging from the algorithm in Eq. (1) is strongly influenced by the recent three-year and within-year net debt issue activity, which is reassuring from an economic standpoint.

Third, to further indicate issuance persistence in event time, Appendix Table 3 computes the average issuance activity using *constant-composition* samples of HFIs and LFIs. For example, in Column 4 of Panel A, we report the average HFI issue frequency for each of the twenty event years using the sample of HFIs formed using Eq. (1) in year five. Five years later, in event year 10, the cumulative number of issues by these HFIs averages 11.44. This is close to the average of 12.76 in column (1) which is based on an annual rolling sort of firms into the HFI category. Overall, the table shows that, whether firms are classified as HFIs or LFI early or late following public listing, the cumulative net-debt issue frequencies in columns (2)-(9) remain very similar to that in Column (1).

(2) Firm-level Persistence and Issue Predictability

While Appendix Table 3 confirms persistence in terms of issue frequency, Appendix Table 4 also shows persistence in terms of the underlying firms classified as HFI and LFI. Panel A shows to what extent firms that are classified as HFI in a given year migrate to the medium-frequency (MFI) and LFI categories over the following year (columns 1-3) and over the next three years (columns 5-7). Panel B shows the corresponding migration for firms classified as LFI.

In Panel A, over the public lifecycle, on average 86% of the firms classified as HFIs in one year are also HFIs in the subsequent year. The remaining 14% migrate to become MFI (none migrate to become LFI). For the LFIs in Panel B, the corresponding lifecycle average is 82%, with the remaining 18% of the LFIs migrating to MFIs (14%) and HFIs (4%). Note also that the migration frequency of LFIs to HFIs occurs almost entirely in the year of public listing. A similar degree of firm-level stability in the sorts is also seen when using the three-year horizon in Columns (5)-(8): 78% of the HFIs and 71% of the LFIs remain classified as such three years later.

An important indicator of firm-level issue frequency persistence is that the HFI/LFI classifications predict future net-debt issues. Appendix Table 4 also shows that HFIs are more likely to issue net debt in the following year(s). To more formally drive home this point, we next estimate the future net-debt issue probability using the following logit model

$$Y^*_{i,t+v} = \alpha + \beta_1 HFI_{i,t} + \beta_2 LFI_{i,t} + \gamma X_{i,t} + \epsilon_{i,t+v}, \tag{15}$$

where $Y^*_{i,t+v}$ denotes the latent variable for the probability that firm i undertakes at least one (quarterly) net debt issue in year $t+v$ and $HFI_{i,t}$ and $LFI_{i,t}$ indicate whether firm i is HFI or LFI, respectively. Thus, this regression tests whether a firm's current classification as HFI or LFI predicts future net-debt issues by the same firm. The vector X of controls contains a standard choice of firm characteristics, which were introduced in Table 6.

In Table 5, the baseline sample consists of medium-frequency issuers (MFIs). An estimated odds ratio of 1.0 therefore indicates that the HFI/LFI classifications do not increase or reduce the likelihood of a future net-debt issue relative to that of MFIs. As shown in the first row, with a one-year forecast horizon HFI increases the probability of a net-debt issue in year $t+1$ by 103% (the difference 2.03-1.00), while LFI lowers the issue probability by 29% (the difference 1.00-0.71). The predictive power of HFI and LFI remains strong also with two- and three-year forecast periods, and for firms that have been publicly traded for nine years or more.

Finally, as our sample of HFIs/LFIs are identified in event time (relative to the year of going public), we check the time series evolution of these HFIs and LFIs in calendar time. The idea here is to check whether the HFIs/LFIs tend to occur in some calendar years and not in others. If so, the fraction of all firms that are classified as HFI/LFIs would be high in some years and low in others. There is little evidence of such calendar time-series variation. Across the 1984-2016 sample period, the annual average fraction of the sample firms classified as HFI (LFI) is 0.29 (0.38). This fraction averages 0.43 (0.36) in the 1980s, dropping to 0.34 (0.37) in the 1990s, and stabilizes at an annual average of 0.24 (0.39) since year 2000. We detect no obvious calendar time effects in these classifications but nevertheless include calendar-year fixed effects in the regressions below.[16]

[16] In untabulated results, we have also investigated the sample exit rates of HFIs and LFIs. We find no systematic difference in the rates of acquisitions and financial distress across the two groups. Confirming the above demonstrated issue frequency persistence, the yearly drop in the number of HFIs closely reflects firm exist (as opposed to migration to becoming a medium frequency issuer).

Appendix Table 1: Compustat mnemonics used for variable construction

Variable	Description
A. Compustat balance sheet items[a]	
che	Cash and cash equivalents
ppent	Property, plant and equipment (net of depreciation)
at	Total assets
dlc	Debt in current liabilities
dltt	Long-term debt
lt	Total liabilities
pstkl	Preferred stock liquidation value
txditc	Deferred taxes and investment tax credit
B. Compustat income statement items[a]	
sale	Revenues
xrd	Research and development expenditures
oibdp	Operating profits
dp	Depreciation expenses (Income statement)
C. Compustat cash flow statement items[b]	
ibc	Income Before Extraordinary Items
dpc	Depreciation and Amortization
ocf_oth[c]	Other Operating Cash Flow (= xidoc + txdc +esubc + sppiv + fopo + fsrco + exre)
nwc_inv[d]	Investment into Net Working Capital [= (recch + invch + apalch + txach + aoloch)*(-1)]
oancf	ibc + dpc + ocf_oth + nwc_inv
capx	Capital Expenditures
aqc	Acquisitions
ivch	Increase in Investments
siv	Sale of Investments
sppe	Sale of Property, Plant and Equipment
ivstch	Short-term Investments - Change
ivaco[e]	Investing Activities - Other
inv_total	capx + aqc + ivch - siv - sppe - ivstch - ivaco
sstk	Sale of Common and Preferred Stock
prstkc	Purchase of Common and Preferred Stock
dv	Cash Dividends
dltis	Long-Term Debt - Issuance
dltr	Long-Term Debt - Reduction
dlcch	Changes in Current Debt
fincf_oth[f]	Other Financing Cash Flow [= (txbcof + fiao)]
fin_total	sstk + prstkc + dv + dltis + dltr + dlcch + fincf_oth
chech	Change in cash and cash equivalents

[a] For quarterly balance sheet and income statement variables from Compustat, a "q" is added at the end to each Compustat mnemonic.

[b] For quarterly cash flow statement variables from Compustat, a "y" is added at the end to each Compustat mnemonic. Compustat records those variables in a year-to-date format (e.g. a second quarter cash flow statement item is the sum of cash flows in quarters one and two). We therefore compute quarterly changes in order to obtain the actual quarterly cash flow statement item (once done, we denote this variable by adding a q to the mnemonic).

[c] ocf_oth is the sum of extraordinary items and discontinued operations (xidoc), deferred taxes (txdc), equity in net loss (esubc), loss from sale of PPE and investments (sppiv), funds from operations–other (fopo), other sources of funds (fsrco) and exchange rate effects (exre). The item fsrco is 0 if the company reports according to format code 7 (scf=7), exre is zero in case of format codes scf=1, 2 or 3.

[d] nwc_inv is constructed as follows: For format code 7, it is the sum of (multiplied by minus 1) accounts receivable-decrease (recch), inventory-decrease (invch), accounts payable and accrued liabilities-increase (apalch), income taxes-accrued-increase (txach), assets and liabilities-other (aoloch). For format code 1, it is the variable wcapc. In case of format codes 2 and 3, it is $wcapc * (-1)$.

[e] ivaco is replaced by fuseo*(-1) in case of format codes 1, 2 or 3.

[f] fincf_oth is the sum of excess tax benefits of stock options (txbcof) and other financing activities (fiao).

Appendix Table 2: Overlap between net-debt-issue-frequency sorts with different periods of cumulation

In the original sort, firms are classified as HFI or LFI in event year t based on the cross-sectional distribution of quarterly net-debt issues cumulated from the year of public listing (year $t = 0$): $N_{it} = \sum_{\tau=0}^{t} \sum_{q=1}^{4} I_{iq\tau}$, where $I_{iq\tau}$ takes a value of one if $NDI^{+}_{iq\tau}/A_{iq\tau} \geq k$ in quarter q of event year $\tau \leq t$ and zero otherwise. This table shows the overlap between the firms in the original HFI and LFI sort and two alternative sorts: one based on a three-year trailing cumulation of quarterly net-debt issues, and the other based on zero cumulation (within-year quarterly issue count only). The table displays the fraction of the original HFIs and LFIs that would also be classified as HFI or LFI under the two alternative sorts. Total sample of 9,340 U.S. public firms (66,056 firm-years), with an annual average of 1,616 HFIs (total of 19,424 firm-years) and 2,831 LFIs (total of 25,096 firm-years), 1984-2016.

	Overlap with 3-year trailing cumulation $N^3_{it} = \sum_{\tau=t-2}^{t} \sum_{q=1}^{4} I_{iq\tau}$				Overlap with zero cumulation $N^0_{it} = \sum_{q=1}^{4} I_{iq\tau}$			
	Overlap between HFIs with 3-year cumulation and the original		Overlap between LFIs with 3-year cumulation and the original		Overlap between HFIs with zero cumulation and the original		Overlap between LFIs with zero cumulation and the original	
	HFI	LFI	HFI	LFI	HFI	LFI	HFI	LFI
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A Net-debt issue size threshold of $k = 2.5\%$								
0	1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00
1	1.00	0.00	0.00	1.00	0.95	0.00	0.05	1.00
2	1.00	0.00	0.00	1.00	0.86	0.00	0.14	1.00
3	0.96	0.00	0.00	1.00	0.81	0.00	0.19	1.00
4	0.87	0.00	0.01	0.77	0.77	0.08	0.23	0.92
5	0.74	0.00	0.02	0.81	0.71	0.07	0.29	0.93
10	0.79	0.04	0.08	0.79	0.65	0.09	0.35	0.91
15	0.69	0.05	0.11	0.78	0.55	0.10	0.45	0.90
20	0.61	0.09	0.15	0.69	0.55	0.14	0.45	0.86
Avg.	0.85	0.01	0.04	0.91	0.79	0.04	0.21	0.96
B Net-debt issue size threshold of $k = 5\%$								
0	1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00
1	1.00	0.00	0.00	1.00	0.74	0.00	0.26	1.00
2	1.00	0.00	0.00	1.00	0.73	0.00	0.27	1.00
3	0.97	0.00	0.00	1.00	0.69	0.00	0.31	1.00
4	0.81	0.00	0.04	1.00	0.58	0.00	0.42	1.00
5	0.70	0.00	0.10	1.00	0.53	0.00	0.47	1.00
10	0.78	0.12	0.22	0.88	0.45	0.03	0.55	0.97
15	0.73	0.18	0.27	0.82	0.36	0.08	0.64	0.92
20	0.70	0.20	0.30	0.80	0.36	0.11	0.64	0.89
Avg.	0.85	0.03	0.09	0.96	0.63	0.02	0.37	0.98

Appendix Table 3: Average annual number of net-debt issues with alternative constant-composition sorts

In the original sort (Table 4), firms are classified as HFI or LFI in event year t based on the cross-sectional distribution of quarterly net-debt issues cumulated from the year of public listing (year $t = 0$): $N_{it} = \sum_{\tau=0}^{t} \sum_{q=1}^{4} I_{iq\tau}$, where $I_{iq\tau}$ takes a value of one if $NDI^{+}_{iq\tau}/A_{iq\tau} \geq k$ in quarter q of event year $\tau \leq t$ and zero otherwise. With this annual rebalancing, firms may enter and leave the HFI and LFI classifications through time. This table shows the average annual number of net-debt issues if the composition of the HFI and LFI sorts are held constant over the entire sample period. In Column (2), the constant-composition sample of HFI and LFI is formed based on the distribution of N_{it} in event year $t = 3$. In Column (4), it is based on the distribution in year $t = 4$, etc., up to and including year $t = 10$ in Column (9). All sorts are based on the 2.5% net-debt issue size threshold. Total sample of 9,340 U.S. public firms and 66,056 firm-years, 1984-2016.

	Original	Constant composition sorts with N_{it} fixed in event-year t:							
Event	sort	t=3	t=4	t=5	t=6	t=7	t=8	t=9	t=10
year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A: High frequency net-debt issuers (HFIs)									
0	1.25	0.82	0.80	0.72	0.73	0.76	0.73	0.69	0.70
1	2.81	2.51	2.44	2.18	2.18	2.21	2.20	2.07	2.08
2	4.24	4.11	4.03	3.59	3.63	3.67	3.66	3.43	3.47
3	5.54	5.54	5.52	4.93	4.98	5.02	5.04	4.66	4.72
4	6.89	6.61	6.89	6.19	6.27	6.30	6.34	5.87	5.93
5	7.37	7.58	7.90	7.37	7.54	7.61	7.66	7.14	7.18
10	12.76	11.49	11.98	11.44	11.99	12.51	12.99	12.47	12.76
15	17.12	14.45	15.08	14.58	15.12	15.78	16.34	15.86	16.44
20	21.21	17.76	18.59	17.69	18.08	19.05	19.71	19.18	20.04
B: Low frequency net-debt issuers (LFIs)									
0	0.00	0.09	0.09	0.09	0.08	0.08	0.07	0.10	0.09
1	0.00	0.16	0.16	0.16	0.14	0.12	0.11	0.20	0.20
2	0.00	0.24	0.24	0.22	0.19	0.16	0.14	0.28	0.28
3	0.00	0.31	0.31	0.28	0.25	0.21	0.18	0.35	0.34
4	0.39	0.39	0.39	0.34	0.30	0.26	0.23	0.45	0.43
5	0.41	0.62	0.62	0.41	0.35	0.31	0.27	0.52	0.49
10	0.88	2.02	2.02	1.68	1.32	1.01	0.77	1.05	0.88
15	1.39	3.39	3.39	2.99	2.50	2.06	1.58	2.06	1.82
20	2.70	5.04	5.04	4.48	3.71	3.02	2.58	3.27	2.83

Appendix Table 4: Classification persistence and future issue frequency

The classification of firms into HFIs (LFIs) is based on the the cumulative quarterly net debt issue frequency classification as detailed in Table 4, using the 2.5% issue size threshold. Columns (1) to (3) display next period's issue frequency classification of the currently defined HFIs (Panel A) or LFIs (Panel B). Column (4) shows the fraction of next period's net debt issues for the two groups. Columns (5) to (8) display the corresponding characteristics three years into the future. Total sample of 9,340 U.S. public firms (66,056 firm-years), with an annual average of 1,616 HFIs (total of 19,424 firm-years) and 2,831 LFIs (total of 25,096 firm-years), 1984-2016.

	Next year				In three years			
	Classified as			Issue	Classified as			Issue
Age	HFI	MFI	LFI	Freq.	HFI	MFI	LFI	Freq.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A: High frequency net-debt issuers (HFIs)								
0	0.68	0.32	0.00	0.63	0.55	0.45	0.00	0.55
1	0.82	0.18	0.00	0.68	0.67	0.33	0.00	0.56
2	0.86	0.14	0.00	0.67	0.84	0.16	0.00	0.58
3	0.85	0.15	0.00	0.64	0.82	0.18	0.00	0.58
4	1.00	0.00	0.00	0.63	0.83	0.17	0.00	0.55
5	0.86	0.14	0.00	0.61	0.72	0.28	0.00	0.54
10	0.92	0.08	0.00	0.58	0.88	0.12	0.00	0.50
15	1.00	0.00	0.00	0.52	0.88	0.12	0.00	0.46
20	0.92	0.08	0.00	0.49	0.81	0.19	0.00	0.44
Avg.	0.86	0.14	0.00	0.61	0.78	0.22	0.00	0.54
B: Low frequency net-debt issuers (LFIs)								
0	0.14	0.20	0.66	0.34	0.17	0.42	0.41	0.36
1	0.02	0.22	0.77	0.23	0.04	0.24	0.72	0.27
2	0.00	0.19	0.81	0.19	0.03	0.18	0.79	0.21
3	0.00	0.04	0.96	0.16	0.01	0.17	0.82	0.19
4	0.00	0.11	0.88	0.18	0.01	0.30	0.70	0.24
5	0.00	0.13	0.87	0.18	0.00	0.30	0.70	0.22
10	0.00	0.07	0.93	0.14	0.00	0.07	0.93	0.16
15	0.00	0.08	0.92	0.16	0.00	0.08	0.92	0.16
20	0.00	0.06	0.94	0.20	0.00	0.03	0.97	0.19
Avg.	0.04	0.14	0.82	0.22	0.05	0.24	0.71	0.25

Appendix Table 5: Predicting net-debt issue activity using HFIs and LFIs

Firms are classified as HFI or LFI in event year t based on the cross-sectional distribution of quarterly net-debt issues cumulated from the year of public listing (year $t=0$): $N_{it} = \sum_{\tau=0}^{t} \sum_{q=1}^{4} I_{iq\tau}$, where $I_{iq\tau}$ takes a value of one if $NDI^{+}_{iq\tau}/A_{iq\tau} \geq 2.5\%$ in quarter q of event year $\tau \leq t$ and zero otherwise. The table presents odds ratios of a logit model determining the probability of a net debt issue in year $t+v$, conditional on the current issue frequency classification and a vector X of covariates:

$$Y^*_{i,t+v} = \alpha + \beta_1 HFI_{i,t} + \beta_2 LFI_{i,t} + \gamma X_{i,t} + \epsilon_{i,t+v}$$

where $Y^*_{i,t+v}$ denotes the latent variable for the probability that firm i performs at least one (quarterly) net debt issue in year $t+v$. In this regression, $HFI_{i,t}$ ($LFI_{i,t}$) is a dummy variables that takes on a value of one if firm i is classified as a high-frequency (low-frequency) net-debt issuer in period t, and zero otherwise. Thus, the baseline sample is medium-frequency issuers (MFIs, all firms that are neither HFI or LFI). The covariates in $X_{i,t}$ are: investment ($Capex$), R&D expenditures ($R\&D$), market leverage ratio (L), cash ratio (C), logarithm of assets ($Size$), operating profitability ($Prof(\Pi)$), tangibility (Tan), Tobin's Q (Q) and depreciation expenditures ($Depr$). All covariates are winsorized at the 1(99) percent level or must lie between zero and one (cash ratio and leverage). Variable definitions are in Table 2 and Table 3 in the paper. *, ** indicate significance at the 5% and 1% level, respectively. Total sample of 9,340 U.S. public firms (66,056 firm-years), with an annual average of 1,616 HFIs (total of 19,424 firm-years) and 2,831 LFIs (total of 25,096 firm-years), 1984-2016.

				Firm-specific explanatory variables (X)								
	N	HFI	LFI	$Capex$	$R\&D$	L	C	$Size$	$Prof(\Pi)$	Tan	Q	$Depr$
Net debt issue in year t+1:												
All	56,716	2.03**	0.71**	60.68**	0.78*	0.80**	0.04**	0.93**	0.49**	0.72**	1.02**	0.01**
Age > 4	26,621	1.94**	0.61**	53.51**	1.47*	0.82*	0.02**	0.98*	0.44**	0.58**	1.06**	0.07**
Age > 9	12,692	1.90**	0.69**	38.46**	1.41	0.89	0.02**	1.02	0.39**	0.54**	1.09**	0.16*
Net debt issue in year t+2:												
All	48,465	1.76**	0.80**	7.48**	0.38**	1.00	0.10**	0.92**	0.55**	0.96	1.01	0.03**
Age > 4	23,043	1.80**	0.67**	4.72**	0.69	0.99	0.06**	0.98*	0.49**	0.85	1.05**	0.31*
Age > 9	10,902	1.85**	0.76**	3.29*	0.70	1.17	0.06**	1.02	0.43**	0.77	1.07**	0.98
Net debt issue in year t+3:												
All	41,507	1.66**	0.85**	2.92**	0.25**	1.21**	0.14**	0.92**	0.54**	1.08	1.00	0.09**
Age > 4	19,929	1.69**	0.72**	2.25*	0.44**	1.29**	0.11**	0.98*	0.51**	0.99	1.03**	0.46
Age > 9	9,336	1.78**	0.75**	0.95	0.48*	1.43*	0.12**	1.02	0.48**	0.90	1.03	2.11