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*The Pecking Order, Debt Capacity and Information*

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# The Pecking Order, Debt Capacity, and Information Asymmetry

## Abstract

We examine the pecking order hypothesis using a new empirical model and testing strategy. After illustrating how our approach provides a more powerful test relative to earlier attempts, we show that approximately 36% of firms adhere to the pecking order's prediction that firms issue debt before equity. Further investigation reveals that violations of the pecking order do not appear to be a consequence of variation in information asymmetry or attempts by firms to issue less information-sensitive securities. Similarly, using a database of private loans, we show that equity issuers are strikingly similar to private debt issuers along many dimensions, suggesting that the propensity to issue equity in violation of the pecking order is not fully explained by debt capacity concerns. When we relax the assumption of a strict financing hierarchy by incorporating alternative considerations (e.g., tradeoff) into the model, its predictive accuracy more than doubles, correctly classifying the debt and equity issuance decisions of almost 80% of our sample. Thus, a perhaps more accurate characterization of issuance behavior is that firms select the least costly source of financing but the costs are not limited to those emphasized by the pecking order.

## 1. Introduction

The pecking order hypothesis, posited by Myers (1984) and Myers and Majluf (1984), predicts that information asymmetry between managers and investors creates a preference ranking over financing sources. Beginning with internal funds, followed by debt, and then equity, firms work their way up the pecking order to finance investment in an effort to minimize adverse selection costs. While often thought of as a consequence of adverse selection, pecking order behavior can also be generated by other economic forces including agency costs (Myers (2003)) and taxes (Stiglitz (1973) and Hennessy and Whited (2005)). Thus, two empirical questions concerning the pecking order naturally arise: First, to what extent do firms follow the pecking order in their decision making? And, second, is information asymmetry behind any pecking order behavior?

The first question has received a significant amount of attention but with little consensus. Several studies (e.g., Shyam-Sunder and Myers (1999), Autore and Kovacs (2005), Mayer and Sussman (2005)) have found evidence in support of pecking order behavior while others (e.g., Helwege and Liang (1996), Frank and Goyal (2003) Fama and French (2005)) have shown evidence to the contrary.<sup>1</sup> Further, issues have been raised concerning the statistical power of existing hypothesis tests (Chirinko and Singha (2000)) and the role of debt capacity in augmenting the pecking order (Lemmon and Zender (2004)) that have challenged the interpretation of these investigations. Thus, while the evidence in earlier studies have revealed important insights into financing behavior, the empirical relevance of the pecking order is still unclear. Additionally, the empirical link between information asymmetry and the pecking order has yet to be investigated, as suggested by the recent survey of Frank and Goyal (2005). If adverse selection costs are heterogeneous (Gomes and Phillips (2004)) and/or firms issue securities in a manner to avoid such costs (Fama and French (2005)), then this behavior has potential implications for tests of the pecking order.

The goal of this paper is to address each of these issues using a new empirical model and testing strategy that enables us to make several contributions to the existing literature. First, as we demonstrate, our approach addresses the statistical power concerns associated with previous tests of the pecking order. Second, it enables us to quantify

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<sup>1</sup>There have been a number of studies commenting on the pecking order in the context of broader studies of capital structure (e.g., Titman and Wessels (1988), Rajan and Zingales (1995), Fama and French (2002)), studies of equity returns to issuing firms (e.g., Asquith and Mullins (1986), Eckbo (1986)) and studies of information asymmetry (e.g., Gomes and Phillips (2004) and Chang, Dasgupta, and Hilary (2004)).

the degree to which firms follow the financing hierarchy. Third, it allows us to directly examine the extent to which heterogeneity in information asymmetry and debt capacity account for deviations from pecking order behavior. Finally, our approach enables us to investigate the conjecture by Myers (1984) and Fama and French (2005) that integrating pecking order and tradeoff models can yield an improvement in characterizing observed financing behavior relative to the pecking order by itself.

Our results show that approximately 36% of our sample firms adhere to the hierarchy in their decision between debt and equity. That is, more often than not, when firms issue equity, they do so before turning to the debt market or in lieu of issuing debt. Further, a significant fraction of the sample (36%) violate the first rung of the pecking order, often turning to external capital markets despite having sufficient internal resources to finance investment. As an unconditional theory of capital structure, the pecking order appears to struggle.

We then examine several explanations for these results beginning with variation in information asymmetry. If there are times when information asymmetry (and the attendant adverse selection cost) is low then deviating from the hierarchy may not be costly. Alternatively, firms may issue securities in a manner that simply avoids the adverse selection problems associated with information asymmetry, such as using private capital markets (Gomes and Phillips (2004)). Using several different proxies, we find little, if any, relation between the degree of information asymmetry and the propensity of firms to adhere to or violate the pecking order. Thus, while information asymmetry may be an important determinant of financing decisions, our results suggest that it does not manifest itself in a financing hierarchy, consistent with theoretical studies (e.g., Cooney and Kalay (1993), Fulghieri and Lukin (2001), Halov and Heider (2004)) and survey evidence (e.g., Graham and Harvey (2001)).

A second explanation for the frequent deviations from the financing hierarchy relies on the hypothesis of Lemmon and Zender (2004), who suggest that debt capacity concerns prevent equity issuers from issuing debt.<sup>2</sup> Our analysis of a large sample of corporate loans suggest that this concern does not appear to be the motivation for the majority of equity issuers, consistent with Korajczyk, Lucas, and McDonald (1990). While equity issuers, *on average*, tend to be smaller and have larger future investment opportunities than their debt issuing counterparts, consistent with Lemmon and Zender (2004), the *majority* of equity issuers are very similar to firms issuing private debt and often have a

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<sup>2</sup>This notion was first suggested by Myers (1984); however, Lemmon and Zender (2004) appear to be the first to formally examine this hypothesis in an empirical study of the pecking order.

stronger financial profile (i.e., lower leverage, higher current ratio, etc.). Further analysis reveals that most equity issuers would face borrowing rates similar to those faced by private borrowers, and those rates are only slightly higher than that found on investment grade public debt. Thus, while debt capacity concerns help explain some deviations from pecking order behavior, the motivation behind most equity issuances appears to come from other sources. However, the broader implication of Lemmon and Zender's (2004) study, namely, that the pecking order is incomplete because of its emphasis on adverse selection costs, is not without merit.

Our final piece of analysis investigates the implications of relaxing the strict financing hierarchy by incorporating empirical determinants associated with alternative theories (e.g., tradeoff). After doing so, the classificatory ability of the model improves dramatically. Specifically, the model accurately identifies the debt and equity decisions of approximately 77% of our sample, and the internal and external decisions of 74% of our sample. Therefore, a perhaps more accurate description of observed financing behavior is that firms select the least costly source of financing but this cost often varies with a number of factors, many of which fall outside the purview of the pecking order.

While some of our conclusions overlap with those found in previous studies, the contribution of our paper lies in the novelty of both our results, as well as our empirical approach. Statistical power has been a focal point of many recent capital structure studies - both theoretical and empirical - that identify power problems with existing empirical tests.<sup>3</sup> We explicitly confront this issue with a power study that simultaneously illustrates the low power of previous tests and how our approach solves the problem. This approach enables us to provide new evidence on what fraction of firms actually adhere to the pecking order, as well as when they adhere to it. Though similar in spirit to the recent paper by Fama and French (2005), our results offer even less support for the pecking order as a descriptor of firm financing decisions and address several empirical issues raised by their study. Further, our evidence concerning Lemmon and Zender's debt capacity argument and the link between the pecking order and information asymmetry is new and enlightening in that it directly comments on two recently proposed explanations for deviations from the pecking order. And, finally, our results show that a combination of pecking order and tradeoff considerations results in an accurate description of financing

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<sup>3</sup>Studies by Alti (2004), Chirinko and Singha (2001), Flannery and Rangan (2004), Hennessy and Whited (2005), Kayhan and Titman (2004) Leary and Roberts (2004), Shyam-Sunder and Myers (1999), and Strebulaev (2004) all touch on, directly and indirectly, power problems associated with existing empirical tests. Indeed, in his review article, Myers (2003) emphasizes the importance of statistical power in empirical testing when alternative theories are present.

behavior for the large majority of firms, consistent with the conjectures of Myers (1984) and Fama and French (2005).

The remainder of the paper is as follows. Section 2 reviews the pecking order hypothesis and related literature, providing further context and motivation for our study. Section 3 develops the empirical model, compares it to previous models, and presents the results of our power study. Section 4 outlines the data and sample selection. Section 5 presents the results of our analysis beginning with a description of how well the pecking order characterizes financing behavior. This is followed by an examination of the link between the pecking order and information asymmetry, an investigation into the debt capacity argument of Lemmon and Zender, and, finally, an extension of the model that incorporates alternative considerations in determining financing decisions. Section 6 concludes.

## **2. The Pecking Order**

### **2.1 Theory and Empirical Evidence**

The conventional view of the pecking order hypothesis (Myers (1984) and Myers and Majluf (1984)) is that firms have a preference ranking over securities because of information asymmetry between the firms' well-informed managers and their less-informed investors. Managers use their informational advantage to issue securities when they are overpriced, but investors, aware of management's incentive, discount the price that they are willing to pay for the securities. The result of this discounting is a potential underinvestment problem, as managers forgo profitable investment opportunities.

To avoid the underinvestment problem, firms prefer to use internal funds because they avoid informational problems entirely. When internal funds are insufficient to meet financing needs (i.e., financing deficit), firms turn first to risk-free debt, then risky debt, and finally equity, which is at the top of the pecking order.<sup>4</sup> Thus, the pecking order hypothesis implies the existence of a financing hierarchy: internal funds first, debt second, and equity last.<sup>5</sup>

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<sup>4</sup>Strictly speaking, the pecking order leaves no role for equity. However, for obvious practical reasons, we interpret the pecking order hypothesis as allowing for equity issuances but only after exhausting the ability to issue debt; an issue we discuss more fully below.

<sup>5</sup>Implicitly, the pecking order also implies that any internal funds in excess of financing needs (i.e., financing surplus) are used to repurchase debt, as opposed to equity, because of similar adverse selection problems. However, we choose to focus on issuance decisions, which are more closely related to the

Empirical evidence on the pecking order is diverse and large. As such, we refer the reader to the surveys of Harris and Raviv (1991) and Frank and Goyal (2005) for comprehensive discussions of previous work. Instead, we discuss more recent efforts focused specifically on testing the pecking order hypothesis. For example, Helwege and Liang (1996) examine a small sample of IPO firms and show that issuance decisions appear to be only weakly related to the size of the financing deficit, leading them to reject the pecking order hypothesis. Shyam-Sunder and Myers (1999) show that a significantly large fraction of firms' financing deficits are filled with debt. This leads them to conclude that the pecking order offers an "excellent first-order descriptor of corporate financing behavior, at least for our sample of mature corporations." (P. 242)

More recently, Frank and Goyal (2003) show that the Shyam-Sunder and Myers' results weaken significantly when one expands the sample to include smaller firms and more recent data. While bringing to light the importance of equity financing during the 1990s and among smaller firms, Frank and Goyal rely on, to a certain extent, the empirical test of Shyam-Sunder and Myers in drawing their inferences concerning the pecking order. However, Chirinko and Singha (2000) identify power problems with this testing approach that can result in both false positives and negatives. Additionally, Lemmon and Zender (2004) suggest that the increased equity activity found by Frank and Goyal is due to debt capacity concerns or, specifically, concerns that issuing debt today may result in either debt overhang problems (Myers (1977)) or large increases in the likelihood of financial distress. Fama and French (2005) attempt to address these two issues by looking at the characteristics of firms issuing and retiring equity. Their study, which is most closely related to ours, raises several questions that we hope to address in this study.

Table 1 shows that the majority of equity issuances are very small, amounting to less than 1% of the firm's assets. Indeed, Fama and French note that "the equity issuing process is lumpy, with smaller issues during most years but large issues during some years, the result of infrequent SEOs and mergers." (P. 14) This result is consistent with the notion that the use of equity to finance investment is relatively rare, a conjecture supported by two additional facts. First, Fama and French also show that the issuing of equity for stock option exercises and outright stock grants "play a big role in our results on the frequency of equity issues." Second, the investment literature has clearly established that the temporal behavior of investment is also best described as lumpy or episodic

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underlying theory provided by Myers and Majluf (1984). Additionally, this eases comparison with previous works which focus primarily on issuances and helps manage the length of our study.



(e.g., Caballero and Engel (1999), Caballero, Engel, and Haltiwanger (1995), Doms and Dunne (1989), and Whited (2004)). Thus, a significant fraction of the equity issuances that Fama and French capture are likely due to stock option exercise and outright grants to employees - issuances that effectively amount to payment-in-kind and have little effect on capital structure.

This distinction between financing motivations is important because the pecking order hypothesis from Myers (1984) and Myers and Majluf (1984) is based on a theory of investment financing.<sup>6</sup> Further, Fama and French's results appear to be sensitive to this distinction. Using all issuances and retirements, regardless of how small, Fama and French find that between 40% and 50% of equity decisions are consistent with the pecking order hypothesis. However, when they focus on issuances and retirements in excess of 1% of assets (i.e., equity more likely issued for investment purposes) they find that between 70% and 80% of equity decisions are consistent with the pecking order's prediction. This increase represents a near doubling in their accuracy rate and suggests that the large majority of firms appear to adhere to the pecking order, although no standard errors are provided for these estimates.

## **2.2 Information Asymmetry and Debt Capacity Concerns**

Interestingly, the link between the pecking order and information asymmetry is ambiguous. In fact, the pecking order is not a necessary implication of the Myers and Majluf (1984) model. As Bolton and Dewatripont (2005) note: "Perhaps a more important criticism [of the Myers and Majluf (1984) model] is that this pecking order suggested by Myers does not hold for all relevant parameter values." (P. 118) That is, in certain situations, managers can prefer equity over debt. Further, papers by Dybvig and Zender (1991), Fulghieri and Lukin (2001), and Halov and Heider (2004) illustrate that, more generally, information asymmetry need not result in a financing hierarchy. Alternatively, Stiglitz (1973), Myers (2003), and Hennessy and Whited (2005), show how mechanisms other than information asymmetry, such as taxes and agency costs, can also generate a pecking order of financing decisions. Thus, it is important to note that our study is an examination of the pecking order hypothesis, as opposed to the general relevance of information asymmetry for financing decisions. While we do investigate the link between

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<sup>6</sup>One might argue, therefore, that the pecking order is not a theory of capital structure since it does not encompass all financing decisions. Nonetheless, the theory may well provide a reasonable approximation for financing decisions that have a significant effect on capital structure or, alternatively, the theory may simply be true as a descriptor of investment financing.

the two, our inferences concerning information asymmetry are limited to whether or not this market imperfection manifests itself in a pecking order of financing decisions.

If the presence of information asymmetry implies a financing hierarchy, then variation in this factor should coincide with variation in the costs of deviating from the hierarchy: when information asymmetry is low the costs of deviating from the hierarchy are also low. Alternatively, firms may be able to issue securities in a manner that avoids the adverse selection costs associated with information asymmetry (e.g., private placements) so that any costs emanating from pecking order violations are, again, low. We examine these implications using proxies for the degree of information asymmetry facing the firm, as well as information on the market in which the security is issued (public or private). Thus, we can measure whether or not firms are more likely to adhere to the hierarchy when information asymmetry is high or when firms issue more informationally sensitive securities.

Another reason why firms may violate the financing hierarchy is because of debt capacity concerns, as suggested by Lemmon and Zender (2004). In essence, their argument suggests that equity issuers would have issued debt but were “prevented” from doing so because of concerns over financial distress or to preserve financial slack for future investment. This argument effectively introduces more traditional tradeoff considerations (e.g., bankruptcy costs, agency concerns) into a pecking order environment, much like that suggested in the conclusion of Myers (1984). As such, testing this hypothesis requires care since it is not clear whether evidence in support of debt capacity concerns is really evidence in favor of a pecking order story or simply evidence in favor of a tradeoff theory with specific costs and benefits associated with debt financing.

Lemmon and Zender modify the Shyam-Sunder and Myers (1999) regression framework and show that firms more likely to face debt capacity concerns (e.g., smaller and without credit ratings) tend to finance a larger portion of any financing deficit with equity, consistent with the importance of debt capacity. Fama and French (2005), however, argue that equity issuers do not appear to face debt capacity concerns based on pre-issuance leverage ratios. Though suggestive, both studies provide only indirect evidence on the ability of firms to issue debt at the time of equity issuance. Our approach is to directly compare equity issuers violating the pecking order with firms that issue private debt, the most feasible option for many equity issuers.<sup>7</sup>

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<sup>7</sup>Faulkender and Petersen (2004) show how public debt usage is limited primarily to a relatively small number of large firms.

While such qualifications (i.e., variation in information asymmetry and debt capacity concerns) question the interpretation of the pecking order as an unconditional or all-encompassing theory of capital structure, they are perfectly consistent with the notion of, perhaps, a more realistic, conditional theory (Myers (1984, 2003) and Frank and Goyal (2005)) that can explain financing behavior for certain firms or under certain circumstances.

### 3. The Empirical Model

Panel A of Figure 1 illustrates the intuition behind the pecking order’s financing hierarchy. A firm will finance investment with internal resources (cash and liquid assets) up to the cash threshold  $C^*$ , which represents the amount of internal funds available for investment. When the size of current investment exceeds  $C^*$ , the firm then turns to external finance to fill the financing deficit. Debt finance is applied first and used up to the point  $D^*$ , where  $(D^* - C^*)$  represents the amount of debt a firm can issue without producing excessive leverage (i.e., without becoming financially distressed). Investment needs beyond  $D^*$  require that the firm turn to equity financing. Thus, Panel A illustrates the traditional financing hierarchy and the dependence of that hierarchy on the thresholds  $C^*$  and  $D^*$ .<sup>8</sup>

We formalize this discussion into an empirical model as follows. The first decision that firm  $i$  makes in period  $t$  is between internal and external funds,  $External_{it}$ , and is determined by the relative magnitudes of investment ( $Inv_{it}$ ) and  $C_{it}^*$ . This decision corresponds to the first rung of the pecking order and is represented mathematically as

$$External_{it} = \begin{cases} 1 & Inv_{it} \geq C_{it}^* \\ 0 & \text{otherwise.} \end{cases} \quad (1)$$

In measuring investment, we follow previous empirical studies of the pecking order (Shyam-Sunder and Myers (1999) and Frank and Goyal (2003)) and define this variable

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<sup>8</sup>We note that if one allows for transaction costs, then the number of financing decisions may be affected, though the financing hierarchy and, consequently, the empirical implications, are not. As Stafford (2001) shows, cash balances tend to increase after large investments, consistent with firms substituting capital raising funds for internal funds. Thus, rather than exhausting internal resources before turning to external capital markets, firms may simply go directly to external capital markets to finance all of their investment demand with debt if investment is greater than  $C^*$  but less than  $D^*$ , or entirely with equity if investment is greater than  $D^*$ . Regardless, the empirical implications under this alternative structure are unaffected: firms avoid external capital when investment is less than  $C^*$  and avoid equity capital when investment is less than  $D^*$ .

as the sum of capital expenditures, increase in investments, acquisitions, and other uses of funds, less the sale of PPE (plant, property and equipment), and the sale of investment. However, in our robustness checks (Appendix A) we also examine alternative measures of investment that include research and development expenditures and advertising expenditures in an effort to account for a broader notion of investment.

The second decision facing the firm is whether to use debt or equity and is determined by the relative magnitudes of investment,  $C_{it}^*$ , and  $D_{it}^*$ . This decision corresponds to the second rung of the pecking order and is represented mathematically as

$$Equity_{it} = \begin{cases} 1 & Inv_{it} \geq D_{it}^* \\ 0 & C_{it}^* \leq Inv_{it} < D_{it}^*. \end{cases} \quad (2)$$

The remainder of this section discusses the specification of the thresholds and compares the model to those found in previous studies. We then perform a simulation experiment to highlight the ability of the model to distinguish between varying degrees of pecking order behavior observed in the data. This performance is then compared to that found with previous empirical tests of the pecking order (e.g., Shyam-Sunder and Myers (1999)). Our simulations also provide the null hypotheses for our empirical tests, as well as a useful benchmark by which the results may be judged.

### 3.1 The Available Cash Threshold ( $C^*$ )

The available cash threshold ( $C_{it}^*$ ) is defined as

$$C_{it}^* = CashBal_{it-1} + CashFlow_{it} - CashTarget_{it}^*, \quad (3)$$

where  $CashBal_{it-1}$  is the firm's stock of cash and marketable securities at the end of period  $t - 1$ ,  $CashFlow_{it}$  is the after-tax earnings, net of dividends, minus the change in working capital (excluding cash and short-term debt) of the firm during period  $t$ , and  $CashTarget_{it}^*$  is the firm's target level of cash and marketable securities at the end of period  $t$ .<sup>9</sup> In the context of the pecking order, there is no cash target, per se, and therefore this term is specified as:

$$CashTarget_{it}^* = \alpha_C + \varepsilon_{it}, \quad (4)$$

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<sup>9</sup>Since the relevant comparison is between investment and  $C^*$ , this treatment of working capital implies that an increase in working capital can be viewed either as an increase in investment or a decrease in cash flow. However, the predicted financing choice is unaltered if we view an increase in inventory as a strategic investment and add it to the investment measure, or as a use of cash and subtract it from  $C^*$ .

where  $\alpha_C$  is an unknown parameter and  $\varepsilon_{it}$  is a mean zero normal random variable assumed to be independent across firms but correlated within firm observations. Thus, this specification implies that firms use current cash flows and draw down existing cash balances to the point  $\alpha_C + \varepsilon_{it}$ , which relaxes the unrealistic assumption that firms exhaust all of their internal resources before turning to external capital markets. Additionally, the random error captures the fact that the econometrician does not perfectly observe the threshold  $C^*$ , an important point that we discuss more fully with the simulations below.

Equation (3) shows that a firm has available internal resources for investment if the sum of last period’s cash balance and the current period’s cash flow are greater than a baseline level of cash balances at the end of the period. Note, this specification does not assume that  $C^*$  is the same for all firm-year observations. On the contrary,  $C^*$  is firm-year specific, varying with cash balances, operating income, and random error. We only assume, as demanded by the pecking order hypothesis, that  $C^*$  does not covary with other observable factors such as those identified by the cash management literature (e.g., Kim, Mauer, and Sherman (1998), Opler et al. (1999), and Faulkender and Wang (2004)). As we shall see below, this is not an innocuous assumption and is, in part, why the pecking order struggles somewhat to describe the internal-external decision.

Despite this assumption, the specification is not as restrictive as it may seem since the difference  $Inv_{it} - C_{it}^*$  implicit in equation (1) is close to the “financing deficit” (Frank and Goyal (2003)) but for two important differences. First, we replace the change in cash balance by the difference between the beginning cash balance and its end-of-period target. This enables us to evaluate the first decision in the pecking order (internal vs. external finance) by breaking the link between external finance raised and external finance needed.<sup>10</sup> Second, we treat issuances of short-term debt as a financing activity and include it in our measure of debt issuance, though our results are unchanged if we focus our attention on long-term debt (see the robustness section in Appendix A).

In order to limit potential endogeneity issues, we require all determinants of the financing choice to be in the manager’s information set at the beginning of year  $t$ . Therefore,

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<sup>10</sup>For example, consider a firm with no current investment opportunity and a cash balance in excess of  $\alpha_C$ . If the firm issues debt, only to further pad its cash balance, its financing deficit will equal the amount of the debt issuance, apparently consistent with the pecking order in the context of the Shyam-Sunder and Myers (1999) framework. However, the lack of investment opportunity coupled with a relatively high cash balance suggests that  $Inv \not\geq C^*$  (assuming cash flow is not sufficiently negative) and, therefore, the model can identify this pecking order violation.

rather than use observed year  $t$  cash flows, we use year  $t - 1$  cash flows as a proxy for expected cash flow for each year.<sup>11</sup>

### 3.2 The Debt Threshold ( $D^*$ )

The debt threshold is an aggregate of the liquidity requirements of the firm ( $C^*$ ) and the firm's ability to issue debt without jeopardizing its financial stability ( $D_{it}^* - C_{it}^*$ ). We specify this second term as:

$$DC_{it}^* \equiv D_{it}^* - C_{it}^* = MaxDebt_{it}^* - Debt_{it-1}, \quad (5)$$

where  $Debt_{it-1}$  is the total debt of the firm outstanding at time  $t-1$  and  $MaxDebt_{it}^*$  is the maximum amount of debt the firm can issue before risking financial distress. Therefore, we model the debt threshold as

$$\begin{aligned} D_{it}^* &= C_{it}^* + DC_{it}^* \\ &= CashBal_{it-1} + CashFlow_{it} - CashTarget_{it}^* + MaxDebt_{it}^* - Debt_{it-1}. \end{aligned} \quad (6)$$

Relative to tradeoff theories of capital structure, the maximum amount of debt the firm can issue according to the pecking order,  $MaxDebt_{it}^*$ , is not a well defined concept. In fact, a literal interpretation of the pecking order suggests that this amount is infinite, as there is no role for equity. We take a more pragmatic approach, allowing for a finite amount of debt issuing ability and, consequently, equity issuances. Therefore,

$$MaxDebt_{it}^* = \alpha_M + \eta_{it}, \quad (7)$$

where  $\alpha_M$  is an unknown parameter and  $\eta_{it}$  is a mean zero normal random variable assumed to be independent across firms but correlated within firm observations and contemporaneously correlated with  $\varepsilon_{it}$ . The correlation between the errors in equations (4) and (7) is economically important as the cash and debt thresholds are likely related. The correlation is statistically important, as it requires equations (1) and (2) be estimated simultaneously to avoid biasing the parameter estimates. Thus, as with our cash target, equation (7) assumes that firms issue debt, in excess of their existing debt, up to a point  $\alpha_M + \eta_{it}$ , which relaxes the assumption that firms never issue equity while also incorporating the uncertainty associated with measuring the threshold  $D^*$ .

The specification in equation (7) is clearly restrictive, particularly in light of the existing empirical evidence identifying important determinants of debt financing (e.g.,

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<sup>11</sup>Using observed year  $t$  cash flows has no material effect on the results.

Titman and Wessels (1988), Frank and Goyal (2004), and many others). However, as with the cash target, we do not include empirical determinants corresponding to alternative considerations because this would only serve to cloud the interpretation of our results. As we show below, it is precisely this exclusion of alternative considerations and assumption of a rigid hierarchy that causes the pecking order to struggle in describing financing behavior. Additionally, this restriction enables us to investigate the alternative explanations outlined in the previous section (debt capacity and information asymmetry) in a manner that isolates different effects.

For estimation purposes, it is easier to focus on the difference between *MaxDebt* and *CashTarget*, as opposed to treating *MaxDebt* separately.<sup>12</sup> Thus, we employ the following formulation in the estimation:

$$(\text{MaxDebt}_{it}^* - \text{CashTarget}_{it}^*) = \alpha_{M'} + \omega_{it}, \quad (8)$$

where  $\alpha_{M'}$  is an unknown parameter and  $\omega_{it}$  is a mean zero normal random variable assumed to be independent across firms but correlated within firm observations and contemporaneously correlated with  $\varepsilon_{it}$ .

### 3.3 Some Comments Concerning the Model

Substituting equations (3) and (4) into equation (1) reveals that the decision between internal and external funds is governed by

$$\text{External}_{it} = \begin{cases} 1 & y_{1it}^* \geq 0 \\ 0 & y_{1it}^* < 0, \end{cases} \quad (9)$$

where

$$y_{1it}^* = \text{Inv}_{it} - \text{CashBal}_{it-1} - \text{CashFlow}_{it} + \alpha_C + \varepsilon_{it}. \quad (10)$$

Substituting equations (6) and (8) into equation (2) reveals that the decision between debt and equity is governed by

$$\text{Equity}_{it} = \begin{cases} 1 & y_{2it}^* \geq 0 \\ 0 & y_{2it}^* < 0, \end{cases} \quad (11)$$

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<sup>12</sup>The difficulty arises from the fact that the scale term of discrete choice models is not identifiable. Thus, imposing cross-equation restrictions on slope coefficients requires that either the scale terms of the two equations be identical, or that the scale term of one of the equations be estimated. If the cross-equation restrictions or, more generally, the model, is inconsistent with the data, obtaining sensible parameter estimates or convergence of the optimization program is uncertain at best.

where

$$y_{2it}^* = Inv_{it} - CashBal_{it-1} - CashFlow_{it} + Debt_{it-1} - \alpha_{M'} - \omega_{it}. \quad (12)$$

For identification purposes, we assume that the variances of  $\varepsilon$  and  $\omega$  are unity, so that  $\alpha_C$  and  $\alpha'_{M'}$  are implicitly in  $\sigma_\varepsilon$  and  $\sigma_\omega$  units, respectively. This is a standard identifying restriction in discrete choice models and is innocuous as the observable data is governed only by the sign of the latent variables and not the magnitude. We also scale all variables by the book assets of the firm as of the end of the previous fiscal year to control for scale effects and mitigate heteroscedasticity. Appendix B derives the likelihood function.

The model specification in equations (10) and (12) imposes the restriction that the slope coefficients on *Inv*, *CashBal*, *CashFlow*, and *Debt* are each equal to one (or negative one). Imposing this restriction on the model, however, is infeasible because of the unidentifiability of the scale term associated with the errors. In the estimation, we require the coefficients on these terms to be equal in their respective equations, a less restrictive condition. Thus, the model contains five parameters: the two slope coefficients on  $(Inv - CashBal - CashFlow)$  and  $(Inv - CashBal - CashFlow + Debt)$ , the two intercepts ( $\alpha_C$  and  $\alpha_{M'}$ ), and the correlation between the two error terms ( $\rho$ ).

Before continuing, we make several comments concerning the model and its relation to previous studies. Equations (9) through (12) specify a partially observed (or censored) bivariate probit. The censoring is due to the unobservability of the decision between debt and equity if the firm chooses to use internal funds. Because *CashTarget\** and *MaxDebt\** are not observable, we do not directly estimate equations (4) and (7) (or equation (8)). Rather, the coefficients in these equations are obtained from the bivariate probit estimation. That is, given the pecking order's decision rule, and our specifications for *CashTarget\** and *MaxDebt\**, the estimation finds those parameter values that maximize the likelihood function.

Perhaps the most important aspect of the model is that it respects the ordering of financing decisions implied by the pecking order and does so in a manner consistent with the theory's decision rule relating investment to the availability of funds. This approach differs from previous discrete choice models, such as the multinomial logit specifications found in Helwege and Liang (1996) and Chen and Zhao (2003), which identify what types of firms tend to make certain financing decisions, as opposed to when and why those decisions are made - precisely the issues on which the pecking order speaks most clearly. Additionally, multinomial logit specifications require the independence of irrelevant alternatives property, which Gomes and Phillips (2004) and our results below



suggest does not hold.<sup>13</sup> Our approach is also related to an ordered probit (or logit) but offers a more flexible specification by incorporating two correlated sources of random error, as opposed to just one.<sup>14</sup> In doing so, we can allow the thresholds ( $C^*$  and  $D^*$ ) to respond differently to random shocks, a less restrictive specification.

### 3.4 Statistical Power

Recently, the empirical framework of Shyam-Sunder and Myers (1999) has become a popular tool for testing the pecking order (e.g., Frank and Goyal (2003), Lemmon and Zender (2004), Halov and Heider (2004), Brav (2004), Autore and Kovacs (2005), and Bharath, Pasquariello, and Wu (2005), among others). However, as noted earlier, Chirinko and Singha (2000) argue that the Shyam-Sunder and Myers test of the pecking order suffers from power problems. While Chirinko and Singha discuss the problem, they do not propose a solution. As such, we conduct a power study that explicitly illustrates the ability of the Shyam-Sunder and Myers (1999) framework and our empirical framework to detect pecking order behavior. The simulation also provides a benchmark with which to compare our results and measure the economic relevance of our findings. The remainder of this subsection discusses the simulation and presents the results of our power study. The technical details of the simulation are discussed in Appendix C.

The simulation is based on random draws of investment ( $Inv_{it}$ ), the cash threshold ( $C_{it}^*$ ) and the debt threshold ( $D_{it}^*$ ), corresponding to 100 years of data for 1,000 firms. Because there are components of each threshold that are not observable in the data ( $CashTarget^*$  in  $C^*$  and  $MaxDebt^*$  in  $D^*$ ), we use empirical proxies to aid in the construction of the thresholds. The generation of the simulated series is such that all first and second moments of the simulated data match those of their empirical counterparts. This matching ensures that the simulation is representative of the data generating process found in the data. Additionally, the simulations provide a laboratory in which there is no unmodelled heterogeneity to confound the results.

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<sup>13</sup>Some multinomial models place other, unnecessary restrictions on the data that are avoided in our bivariate framework. The multinomial logit requires that the data be firm specific (i.e., the same variables affecting the cash threshold also affect the debt threshold, and vice versa). This issue becomes particularly relevant in our expanded specification below. The conditional logit, instead, assumes that the data are choice specific but then requires that the marginal affect of each covariate is the same across alternatives.

<sup>14</sup>Yet another alternative would be to estimate a trivariate probit. However, such a specification would offer little, if any, benefit above ours and would impose the computational burden of evaluating a three-dimensional normal cumulative distribution function in the estimation procedure.

With these three series, two sets of financing decisions (*External* and *Equity*) are constructed. The first set (“Pecking Order”) is generated according to the pecking order decision rule: use internal funds if  $Inv < C^*$  ( $External = 0$ ), use debt finance if  $C^* \leq Inv < D^*$  ( $External = 1$  and  $Equity = 0$ ), and use equity finance if  $Inv \geq D^*$  ( $External = 1$  and  $Equity = 1$ ). In the process of generating the financing decisions, we parameterize the simulation to ensure that the ratios of internal-to-external and debt-to-equity decisions match those found in the data.<sup>15</sup> The second set (“Alternative”) of financing decisions is generated by a random decision rule, calibrated only to ensure that the ratio of internal to external and debt to equity decisions match those found in our sample.

As a brief aside, the Alternative decision rule is not without economic content, as it is loosely tied to alternative theories of capital structure. For example, consider the market timing hypothesis (Baker and Wurgler (2002)) which argues that firms issue securities in accordance with equity mispricing so that when equity prices are high, firms issue equity and to a lesser extent debt. That is, issuance behavior is largely removed from investment and, instead, dictated by equity returns (or the mispricing component of equity returns) under this alternative. Interpreting our random draws as coinciding with equity returns, we see that firms issue equity when a high return is drawn, debt when a low return is drawn, and nothing when a negative return is drawn.<sup>16</sup>

Alternatively, consider the dynamic tradeoff model of Fischer, Heinkel, and Zechner (1989) in which leverage evolves according to an (S,s)-rule because of random shocks to the firm’s assets and fixed costs of adjustment. Deviations from the optimum are corrected occasionally by debt issuances and retirements when leverage moves sufficiently far below or above, respectively, the optimum. Otherwise no external financing activity is undertaken. Again, financing behavior is largely removed from investment, dictated only by the relation between leverage and its optimum. Interpreting our random draws as coinciding with shocks to asset values and taking a little liberty with the original theoretical specification, we see that firms do nothing when a small shock is drawn, issue debt when a large positive shock is drawn, and issue equity when a large negative shock is drawn.<sup>17</sup> Of course, a more realistic representation might be accomplished with

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<sup>15</sup>See Table 3 for the sample ratios and Appendix C for a discussion of how this is accomplished.

<sup>16</sup>Implicit in this analogy is that issuances driven by mispricing are uncorrelated with one another and investment.

<sup>17</sup>Fischer, Heinkel, and Zechner (1989) focus only on debt financing, issuances and retirements, and assume geometric Brownian motion with drift for the asset driving process. Strictly speaking, for our argument to hold we would require that firms issue equity, instead of retiring debt, and that these is-

the construction of a structural model with endogenous investment, debt, and equity financing; however, such a task is beyond the scope of this paper. Instead, we restrict our attention to quantifying the degree of pecking order behavior observed in the data, reserving an examination of alternative explanations for our empirical analysis below.

Returning to the mechanics of our simulation, the two sets of financing decisions (Pecking Order and Alternative) correspond to two extreme situations: one in which all financing decisions are generated by the pecking order decision rule and the other in which all financing decisions are removed from the pecking order decision rule, absent chance error. In order to gauge intermediate results, we vary the fraction of firms (equivalently, observations) that adhere to the pecking order's decision rule by increments of 10%. This procedure gives us 11 sets of financing decisions varying in the degree to which the sample adheres to the financing hierarchy. For each of these 11 sets of financing decisions, we estimate the empirical model via maximum likelihood.

We then map the predicted probabilities from the estimated models into predicted financing decisions as follows. If  $\hat{Pr}(y_{1it}^* > 0) > 0.34$  then the firm's predicted financing decision is external, where 0.34 is the empirical likelihood of an external issuance (see Table 3). If  $\hat{Pr}(y_{1it}^* > 0) \leq 0.34$  then the firm's predicted financing decision is internal. Conditional on a predicted external financing, we define the model's prediction to be an equity issuance if  $\hat{Pr}(y_{2it}^* > 0 | y_{1it}^* > 0) > 0.27$ , where 0.27, is the empirical probability of an equity issuance (see Table 3). If  $\hat{Pr}(y_{2it}^* > 0 | y_{1it}^* > 0) \leq 0.27$  then the predicted financing decision is a debt issuance.

We choose the prediction thresholds, 0.34 and 0.27, for several reasons. First, the distributions of our choice variables, *External* and *Equity*, are skewed, which results in a tendency for the model to predict the more frequent choice very accurately at the expense of the less frequent choice if a 0.50 cutoff is used (see chapter 21 of Greene (2003)). Second, alternative thresholds that minimize type I and type II errors (e.g., Marsh (1982) and Jung, Kim, and Stulz (1996)) risk overstating the empirical accuracy of the pecking order in characterizing financing decisions since they are explicitly chosen to minimize prediction errors. Third, since the pecking order treats all financing decisions as equally important, we avoid choosing thresholds that give more or less weight to a particular type of error (i.e. type I or type II - see Boyes, Hoffman, and Low (1989)). Ultimately though, the exact choice of thresholds has little impact on our conclusions,

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suances face a fixed cost similar in magnitude to a debt issuance. Further, the cross-sectional distribution of asset value changes would have to be symmetrically distributed within the no-activity region.

which are based more on the theory's ability to characterize financing decisions as a whole, as opposed to its ability to identify one particular decision.

Panel A of Table 2 presents the simulation results. The classification accuracy of the model for various financing decisions is given in the rows denoted: internal funds, external funds, debt issuances, and equity issuances. For example, when 50% of the sample is assumed to follow the pecking order's decision rules, the model accurately identifies 63.9% of the internal financings, 67.2% of the external security issuances, 35.8% of the debt issuances, and 50.5% of the equity issuances. The model fit is summarized by the two "Average Correct" rows, which represent an equal-weighted average of the accuracy rates for internal and external decisions, and debt and equity decisions, respectively.<sup>18</sup>

The last row, "Improvement", corresponds to the prediction accuracy improvement of the pecking order model over that of a naive predictor, such as one that predicts the same outcome for every decision. This measure is crucial in assessing the empirical relevance of the model and highlights several aspects associated with testing the pecking order. First, it illustrates the importance of accounting for the ability of the pecking order to accurately identify the first decision between internal and external funds. The accuracy in this first decision is important because the fraction of external issuances accurately identified determines the upper bound for predicting debt and equity issuances. To see this, consider two extreme situations where in the first, the model does not correctly identify any external issuances and in the second, the model correctly identifies all external issuances. In the first case, the model cannot correctly identify any debt or equity issuances because all of the external issuances have been incorrectly identified as internal issuances. In the second case, all of the debt and equity decisions could potentially be accurately classified, whereas a naive predictor would correctly predict half of them, on average. Therefore, to appropriately measure the performance of the model, we compare the average prediction accuracy for debt and equity decisions to that of a naive predictor, given the percent of external decisions correctly predicted. For example, when 50% of the sample firms are adhering to the hierarchy, a naive predictor would get half of the accurately classified external issuances ( $67.2\%/2 = 33.6\%$ ) correct, on average. Since the model accurately classifies 43.1% of the debt-equity choices in this case, the improvement is thus,  $43.1\% - 33.6\% = 9.5\%$ .

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<sup>18</sup>Note that taking an equal-weighted average of the accuracy rates implicitly puts greater importance on the less frequent choice, in our case external and equity issuances. For robustness, we also examine results using a weighted average of the accuracy rates, where the weights are the fraction of observations corresponding to each financing decision. The results are qualitatively similar and, as such, are not presented.

Second, while the Improvement measure enables us to identify the improvement of the model over a naive estimator, it is the combination of this measure with the simulation that enables us to translate the results into a more meaningful economic measure. In particular, though the improvement of 9.5% can be shown to be statistically significant (using bootstrap procedures that we discuss below), the economic significance is difficult to extract. However, by linking this improvement to the simulation results, we can see that the 9.5% corresponds to half of the sample adhering to the underlying theoretical model. Thus, by measuring the improvement of the pecking order over a naive predictor *and* comparing the improvement to our simulation results, we can better judge the economic significance of our results.

The results in Panel A of Table 2 lead to the following conclusions concerning the empirical model. First, the average predictive accuracy of the model increases monotonically with the fraction of firms following the pecking order, ranging from 50.2% to 83.0% for the internal-external decision and from 25.6% to 63.5% for the debt-equity decision. This pattern shows that the model is not only able to distinguish between pecking order and non-pecking order behavior but also the degree to which pecking order behavior is observed in the data.<sup>19</sup> Second, we note that even when every firm adheres to the pecking order (the 100% column), the model “only” gets 83.0% (63.5%) of the internal-external (debt-equity) decisions correct. This outcome is due to variation in the error terms,  $\varepsilon_{it}$  and  $\omega_{it}$ , which correspond to the econometrician’s inability to perfectly measure the thresholds  $C^*$  and  $D^*$ . To ensure the robustness of our results, we examine the impact of alternative values for these variances on the simulations by varying the parameter values over a three standard error range around the point estimates (discussed in more detail in Appendix C). None of the alternative values have a significant impact on the results.

We now contrast our model’s predictive results with the coefficient estimates and R-squares from the Shyam-Sunder and Myers (1999) model, which specifies:

$$\Delta Debt_{it} = \alpha + \beta FinDef_{it} + \varepsilon_{it}, \quad (13)$$

where  $FinDef_{it}$  is net financial need or the “financing deficit”, defined as<sup>20</sup>

$$FinDef_{it} = Dividends_{it} + Inv_{it} + \Delta WorkingCapital_{it} - CashFlow_{it}. \quad (14)$$

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<sup>19</sup>Each prediction accuracy rate falls outside of the adjacent 95% bootstrap confidence intervals. For presentation purposes, we do not report these intervals for the simulations but do so for the empirical results below.

<sup>20</sup>Shyam-Sunder and Myers (1999) also include the current portion of long-term debt, beyond its role in the change in working capital. Estimation of equation (13) is carried out after normalizing the change in debt and financing deficit by book assets.

Equation (13) is simply a rearrangement of the flow of funds identity, where the change in equity is treated as the residual ( $\varepsilon_{it}$ ). The pecking order hypothesis implies that  $\alpha = 0$  and  $\beta = 1$ , so that debt changes dollar-for-dollar with the financing deficit. In their analysis of 157 firms that traded continuously from 1971 to 1989, Shyam-Sunder and Myers find that the intercept is economically small (usually less than  $|0.01|$ ) and the slope, though statistically different from one, is economically close (approximately 0.7 in most of their results).

In order to estimate equation (13) using our simulated data, we compute the change in debt, change in equity and financing deficit implied by each sequence of simulated financing decisions. If the firm uses internal funds then  $\Delta Debt = \Delta Equity = 0$ . If the firm uses debt financing, then  $\Delta Debt = Inv$  and  $\Delta Equity = 0$ . If the firm uses equity financing, then  $\Delta Debt = 0$  and  $\Delta Equity = Inv$ .<sup>21</sup>

Panel B of Table 2 presents the estimation results, which are consistent with Shyam-Sunder and Myers' (1999) findings, as well as the discussion in Chirinko and Singha (2000). Specifically, the regression is unable to distinguish between data generated according to the pecking order and data generated by our Alternative decision rule. There is virtually no change in the estimated coefficients and R-squares as the fraction of firms adhering to the pecking order is increased from 0% to 100%.

Panel C presents the results of an extended specification that includes a squared term to incorporate potential nonlinearities in the relation between the change in debt and the financing deficit (e.g., Agca and Mazumder (2004)). As the results indicate, this modification has little effect on the results. This invariance shows that the empirical specification in equation (13) tells us more about the proportion of debt and equity issues in the data, rather than when and why firms are issuing these two securities. Thus, by modeling the actual decision making process, as opposed to the relative magnitude of debt issuances, our empirical model provides a more powerful means of identifying pecking order behavior.

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<sup>21</sup>We use this rule since dual issuances in the data are relatively rare and, as Stafford (2001) shows, cash balances tend to increase after large investments suggesting that capital raising activities substitute for internal fund usage. We also perform the simulation using the rule that firms may use multiple sources of capital to finance investment (e.g., internal funds and debt financing). The results are unaffected.

## 4. Data and Summary Statistics

### 4.1 Sample Selection

For consistency with previous studies and the broadest coverage, our data are drawn from firms on both the monthly CRSP and annual Compustat databases over the period 1971-2001. We exclude financial firms (SIC codes 6000-6999) and utilities (SIC codes 4900-4999) to avoid capital structures governed by regulation. In line with previous capital structure studies, we trim the upper and lower 1% of each variable used in the analysis to mitigate the impact of data errors and outliers. The final sample consists of 36,031 firm-year observations, with nonmissing data for all of the variables used in our analysis.

### 4.2 Identifying Financing Decisions

Our construction of  $External_{it}$  and  $Equity_{it}$  is motivated by other studies such as Chen and Zhao (2003), Hovakimian (2004), Hovakimian, Opler, and Titman (2001), Korajczyk and Levy (2003), and Leary and Roberts (2004), who identify financing decisions by the relative changes in debt and equity. Specifically, a debt issuance is defined as a net change in total debt from period  $t - 1$  to  $t$ , normalized by book assets in period  $t - 1$ , in excess of 5%. Total debt is defined as the sum of short-term and long-term debt.<sup>22</sup> While there may be instances of misclassification using this scheme, such as when convertible debt is called, the previous studies employing this scheme have shown that their analysis is unaffected by using the SDC database to classify issuances. More importantly, this scheme enables us to include private debt issuances, which represent the most important source of external funds for most firms (Houston and James (1996)).

While these previous studies define equity issuances using the statement of cash flows, namely, the sale of common and preferred stock, net of repurchases, during period  $t$  in excess of 5% of book assets in period  $t - 1$ , Fama and French (2005) note that this classification misses equity issuances through channels that do not generate cash flows (e.g., employee stock options, grants, and stock mergers). As an alternative, they suggest that net equity issuances be defined as the change in the market value of common equity, adjusted for capital gains.<sup>23</sup> Further, they focus their attention on results obtained without imposing a minimum cutoff. To address the issues raised earlier, while ensuring

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<sup>22</sup>We also estimate the model using net debt issuance from the statement of cash flows, as well as considering only long term debt issues, with no material change to the results (see Appendix A).

<sup>23</sup>They define net equity issued for year  $t$  as the product of (1) the split-adjusted growth in shares and

the robustness of our results, we examine both cash flow and market measures of equity issuance, using various cutoffs (1%, 3%, and 5%). For consistency with most of the previous work and to ease our discussion, we present only those results obtained with the cash flow measure using the 5% cutoff, postponing the results using the alternative definitions and cutoffs until the robustness section in Appendix A. However, our conclusions are largely unaffected by any of these changes.

If a firm issues neither debt nor equity, the firm is assumed to have used internal resources to fund investment, if any. Also, in the spirit of the pecking order, we classify the relatively few dual issuances as equity issuances since the pecking order rule dictates that a firm will not issue equity (regardless of whether it is accompanied by a debt issue) unless investment needs exceed its debt threshold,  $D^*$ .

Table 3 presents summary statistics for our data, which are consistent with the aggregate implications of the pecking order. The majority (66%) of financing decisions rely on internal funds, followed by debt (25%) and finally equity (9%, including dual issuances). Dual issuances represent a small minority (3%). Also presented are average firm characteristics associated with different financing events, which are broadly consistent with previous empirical findings in studies such as Titman and Wessels (1988), Rajan and Zingales (1995), and Lemmon and Zender (2004). Smaller firms, younger firms and firms with greater book leverage, more cash flow volatility, more growth opportunities and less asset tangibility rely more heavily on equity financing. Greater current and expected future investment results in a greater propensity to turn to external capital markets, both debt and equity. Overall, these results are reassuring in the sense that our sample selection and variable construction enable us to reproduce general results found in previous studies.

## 5. Results

In this section, we examine how closely actual financing decisions coincide with the pecking order's financing hierarchy, using the simulation results presented above as a benchmark. We then examine the link between information asymmetry and the pecking order, as well as the alternative hypothesis of Lemmon and Zender (2004) suggesting that equity issuers are motivated by debt capacity concerns. The section concludes by expanding the model specification to illustrate the effects of alternative theories on the model's ability to classify financing decisions.

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(2) the average of the split adjusted stock price at the beginning and end of the fiscal year, where both terms are obtained from Compustat data.



## 5.1 How Well Does the Pecking Order Characterize Financing Decisions?

Because of the restrictive nature of the model, it is difficult to attach an economic interpretation to the estimated coefficients and, thus, the estimates are not presented here. However, we do mention the following two points. First, a likelihood ratio test of the restrictions that the slope coefficients on *Inv*, *CashBal*, and *CashTarget* in equation (10) are equal and the slope coefficients on *Inv*, *CashBal*, *CashTarget*, and *Debt* in equation (12) are equal is rejected at all conventional significance levels.<sup>24</sup> Second, our estimate of the correlation between the error terms  $\varepsilon$  and  $\omega$  is 0.71, which is highly significant. This result is analogous to the result found by Gomes and Phillips (2004), who show that the independence of irrelevant alternatives (i.e., independence between error terms) is violated in their issuance data. Thus, multinomial specifications relying on this assumption may produce inconsistent estimates. We avoid this problem in our framework by modeling the dependence explicitly, whereas Gomes and Phillips use a nested logit framework.

After estimating the model, we construct predicted financing decisions from the estimated probabilities in the same manner as discussed earlier. Panel A of Table 4 presents the prediction accuracy results. The results first show that the pecking order model accurately identifies 71% of internal and external financing decisions. As previously discussed, this relatively high accuracy is not surprising given the close link between the decision rule and the flow of funds identity. However, based on our simulation benchmark, this accuracy rate corresponds to approximately 64% of the sample observations adhering to the first rung of the pecking order. This, and all subsequent, sample adherence figure is obtained from simulations (not presented) identical to those performed in Table 2 except that we vary the fraction of firms adhering to the hierarchy by 1%, as opposed to 10%, for greater resolution. Thus, while the model accurately identifies a majority of the internal-external financing decisions, in many instances this choice is not governed by the relation between investment and the availability of internal funds.

The numbers in brackets correspond to a 95% bootstrap confidence interval. We are forced to rely on bootstrap procedures for inferences regarding the predicted decisions because the mapping from the estimated probabilities to the decisions is not continuous. The bootstrapping procedure is accomplished by first sampling  $N$  observations with replacement, where  $N$  is the size of our original sample. We then re-estimate the model and compute the predicted financing decisions and corresponding accuracy rates. Repeating

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<sup>24</sup>Of course, this rejection also suggests that the more restrictive hypothesis assuming that all coefficients equal one would be rejected, as well.

this procedure 500 times generates a distribution of accuracy rates. We use the 2.5 and 97.5 percentiles of this bootstrap distribution to form the confidence interval.

For the debt-equity decision, the classificatory ability of the model breaks down relative to the first rung. The model accurately identifies 42% of the debt issuances and 45% of equity issuances for an average accuracy rate of 43.3%. Given the fraction of external issuances accurately identified in the first stage (74.6%), the lower bound on the prediction accuracy in the second stage is 37.3%. The improvement is thus  $43.3\% - 37.3\% \approx 6.0\%$ , which corresponds to 36% of the sample adhering to the pecking order. The table also shows that even for equity issuing firms, a significant fraction appear to have sufficient internal funds, as well as the capacity to issue debt.

These results suggest that, by itself, the pecking order's financing hierarchy offers a seemingly poor description of the choice between debt and equity. Firms issue equity in a manner inconsistent with the pecking order's financing hierarchy more than half the time. Additionally, the decision to turn to external capital markets in the first place often appears to be made independent of the relation between internal funds and investment demand. These inferences are consistent with those made by Fama and French (2005) but are based on different results. What is interesting though, is that focusing on larger equity issuances that are more likely for the purpose of investment, we find that the pecking order characterizes a small fraction of observed financing decisions. Thus, even as a descriptor of investment financing, the pecking order seems to struggle.

We now turn to potential explanations for these results.

## 5.2 The Link Between Information Asymmetry and The Pecking Order

One potential explanation behind the poor performance of the pecking order centers on its link to information asymmetry. If information asymmetry varies over time and/or across firms, then there may be instances when the adverse selection costs associated with this asymmetry are small and, consequently, the costs of deviating from the hierarchy are small. Alternatively, firms may simply be able to avoid the adverse selection costs associated with information asymmetry through a judicious choice of issuance channel (Fama and French (2005)). These explanations imply that when information asymmetry is high (low), it is costly (not costly) for firms to deviate from the hierarchy, or when firms issue securities in a manner that avoids the information asymmetry problem (e.g., private markets) there is little reason to adhere to the hierarchy. In order to test these

hypotheses, we examine several measures of information asymmetry, as well as different types of security issuances.

Korajczyk, Lucas and McDonald (1990, 1991), Choe, Masulis and Nanda (1993), and Bayless and Chaplinsky (1996) identify the impact of time-variation in adverse selection costs on security issuance decisions. Choe, Masulis and Nanda document that the variation in adverse selection costs is associated, at least in part, with business cycle movements. Therefore, we split the years in our sample period into “hot” (high equity issuance), “cold” (low equity issuance), and neutral years, following Bayless and Chaplinsky (1996). We then estimate our model separately on the “hot” and “cold” subsamples. If our previous results are being driven by time-varying information asymmetry, we would expect the model to perform significantly better in the “cold” periods (high cost) than in the “hot” periods.

We define hot and cold years in three ways. First, we use the periods defined by Bayless and Chaplinsky, who use monthly data. If at least seven months of a sample year are designated a hot period by Bayless and Chaplinsky (and no months in that year designated cold), we define that year to be hot, and vice versa for cold years. Since their sample only extends through 1990, we define two alternative measures to utilize our entire sample period. We rank each year according to either the number of issuances scaled by the number of sample firms or the total net issuance volume scaled by the total market value of equity in the sample. (This last measure controls for market value fluctuations and most closely matches the measure reported by Bayless and Chaplinsky.) We then define hot years to be those years in the upper quartile (low information asymmetry) and cold years to be those years in the bottom quartile (high information asymmetry). As all measures yield similar results, we report only those based on the issuance volume rankings.

We also examine several firm-specific measures of information asymmetry including the ratio of intangible assets to total assets (Harris and Raviv (1991)), the dispersion in analyst forecasts (Gomes and Phillips (2004)), and analyst coverage of the firm (Chang, Dasgupta, and Hilary (2004)). For each of these measures, we stratify the sample into low and high information asymmetry according to the lower and upper third of the measures’ distributions. For analyst coverage, we identify firm-years for which there was either no analyst coverage (high information asymmetry) or at least one analyst covering the firm (low information asymmetry). We also examine alternative breakpoints for the analyst coverage proxy (e.g., low information asymmetry is less than or equal to one to two analysts covering the firm) but these changes have little effect on the results and are

therefore not presented.

As a final proxy for information asymmetry, we incorporate issuance data from SDC, Dealscan, and FISD to identify public and private debt issuances.<sup>25</sup> The motivation is that public and private issuances are exposed to more and less, respectively, information asymmetry between managers and investors. Alternatively, private issuances provide the firm with a means to avoid information asymmetry problems. For each of the three databases, we attach GVKEY and PERMNO identifiers in several ways using the historical header file in CRSP. For SDC, we use information on cusips and ticker symbols, in conjunction with company names. For Dealscan, we use ticker symbols and company names. Finally, for FISD, we rely on cusips and company names. For all matches with CRSP/Compustat, company names are checked, as are issuance dates to ensure that the information in the header file is contemporaneous with the issuance. While the issuance data spans the period 1970 to 2003, the coverage is significantly more complete beginning in the late 1980s. With this data, we are able to identify 38% of the security issuances defined using the 5% cutoff.<sup>26</sup>

Table 5 presents the results of the analysis by showing the average prediction accuracy for the debt-equity decision.<sup>27</sup> Contrary to what one would expect if information asymmetry drives firms to follow a pecking order of financing choices, we find little evidence of improvement in model fit as the degree of information asymmetry increases. In fact, we even find some evidence that firms are less likely to adhere to the hierarchy as information asymmetry increases. For firm age, tangible assets, analyst coverage, and analyst forecast dispersion, we see that the model accurately identifies fewer debt and equity issuances among the high information asymmetry group relative to the low group. For our hot/cold proxy and the comparison between private and public debt, we

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<sup>25</sup>The Dealscan database, which we discuss more fully below, contains information primarily on private loans. The FISD database contains information concerning primarily public debt issues. SDC contains information on both private and public debt and equity issuances. We also examined the distinction between public and private equity, as identified by the SDC database, but because of the relatively small sample of private equity issuances we do not present these results.

<sup>26</sup>There are many reasons for not finding a one-to-one correspondence. First, most financing decisions are private debt issuances for which we have the least amount of information. Further, even when a firm enters into a private debt agreement, most tranches (67%) are lines of credit that need not be drawn down at inception. Finally, the various datasets often do not overlap.

<sup>27</sup>In unreported analysis, we also examine the predictive accuracy across information asymmetry measures for the internal-external decision and find similar results. However, given the high correlation between  $(Inv_{it} - CashBal_{it-1} - CashFlow_{it})$  and our measure of external finance, these results are less informative.

do find some evidence consistent with information asymmetry coinciding with a greater propensity to adhere to the hierarchy. However, even for the high information asymmetry group, the majority of issuance decisions go against the predictions of the pecking order. Further, when we focus on firms that have the least amount of risk-free debt capacity (as identified by the lower third of Altman's Z-score distribution), the results (not presented) are unaffected.

In sum, we see little if any systematic variation in our results across various measures of information asymmetry. Thus, it appears as though variation in information asymmetry and the attendant adverse selection costs do not appear to be the motivation behind deviations from the pecking order's financing hierarchy. These results also question whether information asymmetry manifests itself in the form of a hierarchy of financing decisions, consistent with Cooney and Kalay (1993), Fulghieri and Lukin (2001), Halov and Heider (2004), and Bolton and Dewatripont (2005).

### **5.3 Are Equity Issuances Due to Debt Capacity Concerns?**

Another explanation for the poor performance of the pecking order is given by Lemmon and Zender (2004), who suggest that firms issue equity to preserve future investment options and avoid financial distress. To test this claim, we compare the equity issuing firms identified above as violating the financing hierarchy ("Equity Violators") with a large sample of borrowers in the private debt market. This comparison is particularly useful since equity issuers are, on average, relatively smaller and younger so that their primary source of financing outside of equity markets is private lenders, as opposed to public debt markets which are restricted to larger, more established firms (Denis and Mihov (2003)). Importantly, the large majority of our equity issuers have a strictly positive leverage, suggesting that they are not restricted from the debt markets because of transaction costs or other barriers to entry (Faulkender and Petersen (2004)). With this analysis, we can see whether equity issuers are significantly different from private borrowers along the dimensions that Lemmon and Zender suggest.

Our private lender data for this analysis is an August 2002 extract of the Dealscan database, marketed by Loan Pricing Corporation (LPC). The data consists of dollar denominated private loans made by bank (e.g., commercial and investment) and non-bank (e.g., insurance companies and pension funds) lenders to U.S. corporations during the period 1990-2001. According to Carey and Hrycray (1999), the database contains between 50% and 75% of the value of all commercial loans in the U.S. during the early

1990s. From 1995 onward, Dealscan contains the “large majority” of sizable commercial loans. According to LPC, approximately half of the loan data are from SEC filings (13Ds, 14Ds, 13Es, 10Ks, 10Qs, 8Ks, and registration statements). The other half is obtained from contacts within the credit industry and from borrowers and lenders. Borrower characteristics are obtained by merging Dealscan with the Compustat database using the historical header file and matching company names and dates. Our final sample consists of 22,166 unique, dollar denominated loans corresponding to 5,615 nonfinancial U.S. firms during the period 1987-2001.

Table 6 presents a comparison of the Equity Violators’ firm characteristics with those of our sample of private borrowers. Because our private borrower data is limited to the time period 1987-2001, we restrict our attention to the sample of Equity Violators over the same period. The first four columns present a synopsis of the distribution of each firm characteristic for the sample of private borrowers: the 25th percentile, median, 75th percentile and average. The fifth and sixth columns present the median and average values for the sample of Equity Violators. The last column presents t-statistics testing the difference in means between the two samples.<sup>28</sup>

Consistent with Lemmon and Zender’s argument, the equity issuers are, on average, smaller (Market Cap.), less profitable (EBITDA / Assets), and have a shorter term debt maturity structure (Long Term Debt / Total Debt), higher cash flow volatility, and lower Z-score. However, equity issuers also have much lower leverage, a higher current ratio (current assets / current liabilities), and similar asset tangibility. More important than these paired mean and median comparisons, though, is a comparison of the two samples’ distributions. In other words, the more relevant question is what is the overlap in the distributions of both samples? For example, the median financing deficit of the Equity Violators (0.05) is more than double that of the private borrowers (0.02) but far from the tail of the distribution or even the 75th percentile. Similarly, more than half of the Equity Violators have market-to-book ratios that fall below the 75th percentile of the borrowers. In many instances, the majority of equity issuers have firm characteristics that fall in the interquartile range of the borrower’s distribution, as opposed to the tail. Thus, while some equity issuers are clearly facing debt capacity concerns, as Lemmon and Zender suggest, the majority of equity issuers do not appear significantly different from their counterparts that turn to the private lending market.

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<sup>28</sup>We perform a two-sided test of the null hypothesis that the population means are equal, assuming the sampling distribution is asymptotically normal. The standard error is computed after adjusting for dependence at the firm level.

Though suggestive, the above analysis is unconditional. Our next analysis addresses this issue by estimating a model of loan yields, following the analysis of Bradley and Roberts (2003), in an effort to compute the (expected) promised yields that equity issuers would have faced had they turned to the private lending markets. The goal of this analysis is not a precise model of loan pricing but, rather, a method to address the conditional nature of the borrowing process. Because of obvious data constraints, we are restricted to including characteristics in our model that are observable for both groups of firms: bank borrowers and equity issuers. Thus, our model incorporates firm-specific characteristics and macroeconomic factors but does not incorporate information specific to the loan, as this is unobservable for the sample of equity issuers.

This omission raises the concern that the group of equity issuers might enter into loans different, in terms of contract structure, from our sample of private borrowers (i.e., are the samples different across unobservable characteristics?). We attempt to mitigate this problem by including both industry and year fixed effects to control for possible selection differences between the two groups based on their industry or timing of investment opportunities. Additionally, we note that the financial deficit facing the Equity Violators is not much different from that facing the private borrowers, as inferred from Table 6. As such, there is no reason to believe that the size of the loans would be vastly different for the equity issuers.

Panel A of Table 7 presents the coefficient estimates, excluding fixed effects, from the loan yield equation. We avoid discussing these results, noting only that they are broadly consistent with those found in Bradley and Roberts (2003). Instead we focus attention on Panel B, which presents a comparison of yield distributions across four groups of firms. The first group (Borrowers) corresponds to our sample of private borrowers. The second group (Equity Issuers) corresponds to all of the equity issuers in our sample. The third (Equity Non-Violators) and fourth (Equity Violators) groups are firms that issued equity in adherence to or violation of, respectively, the pecking order prediction from the empirical model of equations (1) and (2). These last three groups are restricted to observations during the period 1987-2001 to coincide with the lending data.

The yield distribution for the sample of bank borrowers has a median (mean) promised yield of 225 (219) basis points above the 6-month LIBOR. The median (mean) estimated spread for the Equity Violators is 26 (38) basis points higher than that of the borrowers, statistically significant but far from excessive differences. In addition, the median estimated yield for Equity Violators is well below the 75th percentile of the estimated yield distribution for private borrowers. In contrast, the median (mean) estimated spread for

the Equity Non-Violators is 73 (89) basis points higher than that of the borrowers. Thus, for a few of the equity issuers, debt capacity concerns may well be important. However, this argument applies to the minority of equity issuing firms. Indeed, the predicted yields for all equity issuers is only moderately shifted to the right, suggesting that most equity issuers are similar to their debt issuing counterparts even in a conditional analysis.

Another potential concern with this analysis is that our sample of loans might consist of risky securities, which face adverse selection costs similar in magnitude to equity. In this instance, the distinction between debt and equity is less clear according to the pecking order. To address this issue we compare the duration matched credit spreads of our loans to that of investment grade public debt. Specifically, we take each loan and subtract off the yield of the treasury security with the closest maturity. The average of these spreads is 2.0%, compared to an average spread between BAA 30-year bonds and 30-year T-bills of 1.7% for the same 1987-2000 period.<sup>29</sup> This 30 basis point spread is more likely to be a liquidity premium than a difference in default risk, suggesting that our sample of loans have a risk profile similar to that of a BAA bond. Coupled with higher recovery rates (Altman and Suggitt (2000)) and a greater propensity to be secured relative to public debt (Bradley and Roberts (2003)), these results suggest that our sample of loans are on the lower end of the risk spectrum for debt instruments.

While the majority of equity issuers do not appear to be motivated by debt capacity concerns, the argument of Lemmon and Zender (2004) can be interpreted more broadly as suggesting that firms weigh more than just adverse selection costs in their decision-making. Though Lemmon and Zender focus only on debt capacity, we now examine the implications of expanding this idea to encompass other considerations previously identified by the empirical literature as being important determinants of capital structure.

#### **5.4 Alternative Theories and Relaxing the Financing Hierarchy**

A final explanation for the poor performance of the pecking order is that it simply ignores alternative costs and benefits that are important for financing decisions. Indeed, Myers (1984) suggests that one start with a pecking order framework and expand it by adding elements of tradeoff theories having clear empirical support. Fama and French (2005) echo this idea by suggesting that future research “regard the two models [pecking order and tradeoff] as stable mates with each having elements of truth that help explain some aspects of financing decisions.” The empirical framework we developed above enables

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<sup>29</sup>The interest rate data come from the FRED database.



us to implement such a strategy and measure the degree to which the inclusion of costs and benefits associated with alternative theories of capital structure helps improve the predictive ability of the model. Additionally, this analysis can shed further light on why firms might be violating the financing hierarchy.

Returning to equations (4) and (8), we now specify the cash target and difference between maximum debt and the cash target as:

$$CashTarget_{it}^* = X_{it}\beta + \varepsilon_{it}, \quad (15)$$

$$(MaxDebt_{it}^* - CashTarget_{it}^*) = Z_{it}\gamma + \omega_{it}, \quad (16)$$

where  $X$  and  $Z$  are vectors of determinants identified by the cash management (e.g., Kim, Mauer, Sherman (1998) and Opler et al. (1998)) and capital structure (e.g., Titman and Wessels (1988) and Rajan and Zingales (1995)) literatures, respectively, as being empirically relevant for cash holdings and debt policy.

Our specification of the cash target includes the following variables. Firm size, as measured by the log of book assets, is used by Kim et al. to proxy for external financing costs and Opler et al. to capture economies of scale in cash management. The market-to-book ratio, defined as the ratio of total assets minus book equity plus market equity to total assets, proxies for growth opportunities. While we, like many previous studies (e.g., Titman and Wessels (1998), Kim et al. (1998), Opler et al. (1999) and others) use the market-to-book ratio to measure investment opportunities, it is a less than perfect proxy (see Erickson and Whited (2000)). As such, we include two additional measures of future investment opportunities: research and development expenditures and a forward looking measure of anticipated investment, which we measure with the average of actual investment over the next two years:  $t + 1$  and  $t + 2$ .<sup>30</sup> We similarly define a forward looking measure of anticipated cash flows to capture expected profitability. Assuming firms are rational, these forward looking averages should represent a reasonable approximation of anticipated investment needs and profitability, though their exclusion is of little consequence for the results.

We measure cash flow volatility by the historical standard deviation (using data during the previous 10 years, as available) of the ratio of EBITDA to total assets. Leverage is measured by the ratio of total debt (long term plus short term) to total assets. We

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<sup>30</sup>We assume that missing values for the research and development variable are zero, and include a dummy variable equal to 1 for firms with zero or no reported R&D, similar to other studies such as Fama and French (2002) and Kayhan and Titman (2003).

also examine a measure of market leverage whose denominator is the sum of total debt and market equity but this has no consequences for the results and is not presented. Unlevered Altman’s Z-score, defined as the sum of 3.3 times earnings before interest and taxes plus sales plus 1.4 times retained earnings plus 1.2 times working capital divided by book assets, is used to proxy for the likelihood of financial distress, as in previous studies by Mackie-Mason (1990) and Graham (1996). Given our broad definition of cash and marketable securities, net working capital represents primarily non-debt short-term liabilities and is defined as other current assets minus total current liabilities net of short term debt. We also include a binary indicator for whether or not the firm paid a dividend in year  $t - 1$ . This measure is intended to capture precautionary savings motives for the firm’s payout policy, as well as possible financial constraints (Korajczyk and Levy (2003)).

Drawing on the existing capital structure literature, our specification of the covariates for the maximum debt ratio overlap largely with those in the cash target model. Firm size, anticipated investment, anticipated cash flows, cash flow volatility, R&D expenditures, market-to-book, Altman’s Z-score and an indicator for dividend paying firms are all included in the vector  $Z_{it}$ . Additionally, we incorporate a measure of tangibility (the ratio of PPE to total assets) to capture the ability of firms to secure physical assets in order to reduce the cost of debt capital. We also include a proxy for the age of the firm, defined as in Lemmon and Zender (2003) as the amount of time that the firm has been listed on Compustat. Depreciation expense and operating loss carryforwards proxy for non-debt tax shields (Mackie-Mason (1990)). Selling expense is included as a measure of product uniqueness and, therefore, potential bankruptcy costs (Titman and Wessels (1988)). We also include the median leverage of firms in the same industry (Frank and Goyal (2004)). Last year’s stock return is included to capture investment opportunities, as well as potential changes in the cost of equity capital.

In both equations (15) and (16), we include year and industry (1-digit SIC level) binary variables to account for any longitudinal or industry fixed effects.<sup>31</sup>

Before discussing the results, we mention the implications of introducing these variables into the specification. Since the thresholds  $C^*$  and  $D^*$  are unconstrained, one can now get various permutations of the pecking order financing hierarchy that reflect the relative costs and benefits of different decisions. The intuition is illustrated in Panels B and C of Figure 1. Panel B shows a negative  $C^*$ , implying that the firm has less cash than it would like. Though the firm may still have cash on hand, it will issue debt first

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<sup>31</sup>Though Mackay and Phillips (2004) note that most variation in debt-equity ratios is firm-specific, there is still a significant amount of residual variation at the industry level.

to fund current investment and possibly replenish cash reserves. If current investment outstrips  $D^*$ , equity financing is required. Panel C illustrates a  $D^*$  that is less than  $C^*$ , implying that the firm is overlevered relative to its desired level. In this situation, the firm can use internal funds to pay down their debt or go straight to equity financing depending on the size of current investment. As we will shortly see, relaxing the ordering of decisions has a profound effect on predictive accuracy.

We also note that the sign and magnitude of our coefficient estimates help indicate why firms deviate from the Pecking Order’s financing hierarchy. Linking the included proxies to existing capital structure theories can then help in explaining the observed deviations. While a full exploration of alternative theories is beyond the scope of the current paper, we briefly examine the estimated parameters and their interpretation before discussing the change in predictive ability.

Table 8 presents the estimated parameters, which are largely consistent with expectations.<sup>32</sup> For the cash target, we see that larger firms maintain relatively lower cash targets, consistent with easier access to external capital markets (Faulkender and Petersen (2004)) and greater reliance on internal funds. Greater investment opportunities, as captured by *Future Investment*, *R&D / Sales*, and *Market-to-Book*, are associated with greater cash targets, as it should be if financial slack is important.<sup>33</sup> Analogously, larger anticipated cash flows result in lower cash targets. As expected, Net Working Capital, which can be viewed as a substitute for cash, is negatively associated with cash targets. Higher bankruptcy risk, as captured by *Cash Flow Volatility*, is positively related to cash targets, consistent with firms maintaining a buffer against incurring such costs, as in Opler et al. (1998). However, the coefficient on *Z-Score* is positive, which leads to the opposite implication of the coefficient on cash flow volatility.

As with the cash target, most estimated coefficients in the debt threshold have signs consistent with expectations. For example, our proxies for investment opportunities (*Future Investment*, *R&D / Sales*, *Market-to-Book*) all have a positive and significant coefficient, implying that as investment opportunities increase, firms are more likely to

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<sup>32</sup>To maintain focus on the included determinants, the parameter estimates on  $(Inv_{it} - CashBal_{it-1} - CashFlow_{it})$  and  $(Inv_{it} - CashBal_{it-1} - CashFlow_{it} + Debt_{it-1})$  in the internal-external and debt-equity, respectively, equations are not presented.

<sup>33</sup>We note that market-to-book has also been interpreted as a measure of mispricing (Baker and Wurgler (2002)) and exhibits measurement problems with respect to investment opportunities (Erickson and Whited (2000)). The question of what exactly market-to-book measures and how precisely it does so are questions beyond the scope of this study and, as such, we interpret this measure in a manner consistent with the majority of the capital structure and investment literatures.

turn to equity (Myers (1977)). *Cash Flow Volatility (Z-score)* has a positive (negative) coefficient, consistent with the effect of bankruptcy costs increasing the propensity to use equity. Older firms and those with greater asset tangibility are more able to rely on debt financing, consistent with these firms having more established lending relationships (Berger and Udell (1998)) and greater ease in securing their debt. We also find that firms with more non-debt tax shields (*Depreciation*) and more unique products (*Selling Expense*) are less likely to use debt financing, while higher industry leverage is associated with greater debt issuance. Finally, firms with higher leverage ratios are more likely to issue equity, consistent with prior empirical support for the tradeoff model (e.g. Hovakimian, Opler and Titman (2001)).

Panel B of Table 4 shows that the prediction accuracy of the model improves dramatically because of the inclusion of these additional factors. The model now describes the internal-external choice of 74% of the sample firms, a statistically significant improvement over the results found with the pecking order in Panel A. In the choice between debt and equity, we see an even more dramatic improvement. The model now accurately identifies the financing decisions of 77% of the sample firms, more than doubling the accuracy rate over the pecking order. Importantly, we note that the improvement is not a simple artifact of increasing the model degrees of freedom. Rather, it is the statistical (and economic) relevance of the additional variables that allows the model to more accurately distinguish between the observed financing decisions.

In sum, these results illustrate that it is largely the rigidity of the pecking order's financing hierarchy that lead to its inability to identify many financing decisions. Further, these results suggest that existing determinants and the theories motivating them result in an accurate description of a large majority of financing decisions. Thus, a perhaps more accurate characterization of issuance behavior is that firms select the least costly source of financing but the costs are not limited to those emphasized by the pecking order.

## 6. Concluding Remarks

We examined the empirical relevance of the pecking order and its relation to information asymmetry by developing a new empirical model and testing strategy. Our results show that firms often violate the hierarchy, both by issuing external securities when internal resources are sufficient and issuing equity in place of debt. These results paint an even dimmer picture of the pecking order's ability to characterize financing decisions relative to recent studies.

Further analysis reveals that variation in information asymmetry or attempts to avoid information sensitive securities do not appear to be behind the pecking order's poor performance. The likelihood of adhering to the pecking order shows little, if any, systematic variation across several measures of information asymmetry. Additionally, violations in the choice between debt and equity are not fully explained by debt capacity concerns, since most equity issuers are quite similar to their counterparts that turn to the private debt market, in terms of their characteristics and financial profiles. Thus, even as a conditional theory of capital structure, the pecking order appears to struggle.

We then illustrate how the pecking order's difficulty in describing financing decisions is due largely to its assumption of a rigid financing hierarchy and its exclusion of alternative considerations. After introducing empirical determinants associated with alternative capital structure theories (e.g., tradeoff), we find a dramatic improvement in the classificatory ability of the model to accurately identifying the internal-external and debt-equity decisions of 74% and 77% of our sample firms, respectively.

Our results open several questions for future research, a few of which we mention here. First, despite accurately identifying a large majority of financing decisions, a significant fraction remain unexplained. What are the factors behind these decisions? Second, if information asymmetry is important, as suggested by other studies, how does it manifest itself in financial policy if not through a pecking order? Finally, while we focus our attention on the pecking order in this study, our empirical approach can be translated to examine other theories or combinations of theories. In particular, perhaps an alternative and potentially more powerful test of capital structure theories can be found in examining their predictive ability, much like the focus of the asset pricing literature.

## Appendix A: Robustness Checks

Though we have briefly addressed various robustness concerns throughout the paper, we report the results of several specific tests in Table 9. The first column reproduces the prediction accuracy results of our base model from Table 4 for ease of reference. The second column shows the results when we expand our definition of investment to include both advertising and research and development expenditures. Many of the small, young firms issuing equity in the 1990s may have been focused on the development of intellectual property (e.g. high tech and pharmaceutical companies) or on establishing a brand image (e.g. internet start-ups). While R & D and advertising are often expensed in their accounting treatment, for such firms they may be significant strategic investments. However, the results indicate that this adjustment does not increase the model's ability to explain firms' financing choices. If anything the predictive accuracy is slightly worse for debt and equity issuers. Thus, while there may be important investments for some firms beyond that measured by capital expenditures, this does not seem to account for those security issuances that the pecking order fails to predict.

We also examine the robustness of our results to changes in the definition of a debt issuance. The third column displays the results when debt issuance is defined as the sum of net long term debt issuance and the change in short term debt from the statement of cash flows. Since the change in short term debt is often missing, especially prior to 1987, our sample size is significantly reduced. However, as can be seen, the results are largely unaffected. The fourth column uses only long term debt issuance to identify debt issues. This addresses the concern that since most of the assets in our original investment measure are likely long-lived assets, firms may not be actively financing these assets with short term debt. While this change has a slight effect on the model's ability to distinguish between internal financing and external financing choices, it has little impact on its ability to predict debt and equity issuances.

We then examine the effect of using alternative (1% and 3%) thresholds in our definition of debt and equity issuances. The results are shown in columns 5 and 6. Again, the results are not altered substantially; however, if anything, the model is less able to classify financing decisions as the threshold is lowered. This suggests that either the model is simply better able to identify relatively larger financing decisions, or those decisions are more likely related to investment financing, in so far as non-investment financing is more prevalent among smaller issuance sizes. Finally, columns (7) and (8) illustrate the results using Fama and French's definition of equity issuances based on the change in

shares outstanding. Importantly, this measure of equity issuance includes issuances for the purpose of stock based mergers. The results suggest that such activities are even less likely to adhere to the hierarchy, relative to SEOs. These results further reinforce our conclusions regarding the pecking order as a descriptor of financing decisions.

## Appendix B: Likelihood Derivation

This appendix derives the likelihood function for the extended specification. The pecking order specification follows immediately from restrictions on the parameter vector.

We observe three possible outcomes (i.e., financing decisions) in the data. Beginning with the decision to use internal funds (i.e.,  $External_{it} = 0$ ), we do not observe the decision between debt and equity in this case and, thus, the likelihood of this outcome is simply:

$$\begin{aligned}
\Pr(External_{it} = 0) &= \Pr(y_{1it}^* \leq 0) \\
&= \Pr(Inv_{it} - CashBal_{it-1} - CashFlow_{it} + X_{it-1}\beta \\
&\quad + \varepsilon_{it} \leq 0) \\
&= \Phi(-Inv_{it} + CashBal_{it-1} + CashFlow_{it} - X_{it-1}\beta) \quad (17)
\end{aligned}$$

where  $\Phi(x)$  is the univariate standard normal cumulative distribution function.

The second scenario is when the firm chooses to go to the external capital markets and then decides to use debt financing. This outcome occurs with probability:

$$\begin{aligned}
&\Pr(External_{it} = 1 \cap Equity_{it} = 0) \\
&= \Pr(y_{1it}^* > 0 \cap y_{2it}^* \leq 0) \\
&= \Pr(\{\varepsilon_{it} > -Inv_{it} + CashBal_{it-1} + CashFlow_{it} - X_{it-1}\beta\} \\
&\quad \cap \{\omega_{it} \leq -Inv_{it} + CashBal_{it-1} + CashFlow_{it} + Z_{it}\gamma - Debt_{it-1}\}) \\
&= \Pr(\{\varepsilon_{it} \leq Inv_{it} - CashBal_{it-1} - CashFlow_{it} + X_{it-1}\beta\} \\
&\quad \cap \{\omega_{it} \leq -Inv_{it} + CashBal_{it-1} + CashFlow_{it} + Z_{it}\gamma - Debt_{it-1}\}) \\
&= \Phi_2(Inv_{it} - CashBal_{it-1} - CashFlow_{it} + X_{it-1}\beta, \\
&\quad -Inv_{it} + CashBal_{it-1} + CashFlow_{it} + Z_{it}\gamma - Debt_{it-1}, -\rho) \quad (18)
\end{aligned}$$

where  $\Phi_2$  is the bivariate standard normal cumulative distribution function with correlation coefficient  $\rho$ .

The third and final scenario occurs when firms choose to go to the external capital market and then decide to use equity financing. This outcome occurs with probability:

$$\begin{aligned}
& \Pr(External = 1 \cap Equity = 1) \\
&= \Pr(y_{1it}^* > 0 \cap y_{2it}^* > 0) \\
&= \Pr(\{\varepsilon_{it} > -Inv_{it} + CashBal_{it-1} + CashFlow_{it} - X_{it-1}\beta\} \\
&\quad \cap \{\omega_{it} > -Inv_{it} + CashBal_{it-1} + CashFlow_{it} + Z_{it}\gamma - Debt_{it-1}\}) \\
&= \Pr(\{\varepsilon_{it} \leq Inv_{it} - CashBal_{it-1} - CashFlow_{it} + X_{it-1}\beta\} \\
&\quad \cap \{\omega_{it} \leq Inv_{it} - CashBal_{it-1} - CashFlow_{it} - Z_{it}\gamma + Debt_{it-1}\}) \\
&= \Phi_2(Inv_{it} - CashBal_{it-1} - CashFlow_{it} + X_{it-1}\beta, \\
&\quad Inv_{it} - CashBal_{it-1} - CashFlow_{it} - Z_{it}\gamma + Debt_{it-1}, \rho) \tag{19}
\end{aligned}$$

Let  $\psi_{1it}$ ,  $\psi_{2it}$ , and  $\psi_{3it}$  denote the three terms in equations (17), (18), and (19), respectively. The log likelihood is thus:

$$\begin{aligned}
\log L_{it} = & \sum_{i=1}^N \sum_{t=1}^{T_i} (1 - External_{it}) \log(\psi_{1it}) + External_{it}(1 - Equity_{it}) \log(\psi_{2it}) \\
& + External_{it}(Equity_{it}) \log(\psi_{3it}) \tag{20}
\end{aligned}$$

Standard errors are adjusted for within-firm dependence by employing the generalized estimation equation approach of Liang and Zeger (1986)

## Appendix C: Simulations

This appendix details the simulations. We begin by discussing the mechanics of the simulations, followed by a discussion of its parametrization.

### C.1: Mechanics

Our simulation proceeds in two concurrent steps. First, we draw random triplets from a trivariate normal distribution with mean vector  $[\mu_{Inv}, \mu_C, \mu_D]$  and covariance matrix:

$$\begin{bmatrix} \sigma_{inv}^2 & \sigma_{C,inv} & \sigma_{D,inv} \\ \sigma_{inv,C} & \sigma_C^2 & \sigma_{D,C} \\ \sigma_{inv,D} & \sigma_{C,D} & \sigma_D^2 \end{bmatrix}$$

where  $C$  and  $D$  (note the lack of \*) correspond to:

$$C \rightarrow CashBal + CashFlow - \alpha_C \tag{21}$$

$$D \rightarrow CashBal + CashFlow - Debt + \alpha'_M \tag{22}$$



from equations (10) and (12) and each term is implicitly normalized by assets as of the previous period. Thus,  $C$  and  $D$  are simply  $C^*$  and  $D^*$  less the error terms,  $\varepsilon$  and  $\omega$ , respectively.

Second, we independently draw random pairs from a bivariate normal distribution with zero mean vector and covariance matrix:

$$\begin{bmatrix} \sigma_{\varepsilon}^2 & \sigma_{\omega,\varepsilon} \\ \sigma_{\varepsilon,\omega} & \sigma_{\omega}^2 \end{bmatrix}$$

These random draws correspond to the error terms  $\varepsilon$  and  $\omega$  in equations (10) and (12). The simulated error terms are then added to the simulated  $C$  and  $D$  above to obtain the  $C^*$  and  $D^*$  required for simulating the financing decisions. The normality assumption is made to coincide with our empirical model, a bivariate probit.

With a simulated triplet  $(Inv, C^*, D^*)$ , we construct financing decisions using two different decision rules. The first rule corresponds to the pecking order hypothesis and is defined by equations (9) and (11). That is, internal funds are used if  $Inv < C^*$ , otherwise, external funds are used. Conditional on using external funds, debt finance is used if  $Inv < D^*$ , otherwise, equity finance is used. The second decision rule randomly chooses the financing decision (internal, debt, or equity), independent of the simulated data, but with probabilities equal to that in our observed data. Thus, the probability of an external issuance is 33.8% and, conditional on an external issuance, the probability of a debt (equity) issuance is 72.8% (27.2%) (see Table 3).

These two sets of decisions correspond to 100% and 0% of the sample adhering to the hierarchy, respectively. To obtain intermediate realizations, we vary the fraction of the simulations that use the pecking order decision rule and the alternative decision rule by increments of 10%. This produces 11 sets of financing decisions, each of which is used in conjunction with the simulated data  $(Inv, C, D)$  to estimate the model by maximum likelihood. For each of the 11 sets of estimates, we map the predicted probabilities into predicted financing decisions using the following mapping. If the predicted probability of an external issuance exceeds 0.34, then the predicted decision is an external issuance. Otherwise, the predicted decision is an internal issuance. And, conditional on an external issuance, if the predicted probability of an equity issuance exceeds 0.27, then the predicted financing decision is an equity issuance. Otherwise, the predicted decision is a debt issuance. These thresholds, 0.34 and 0.27, are the empirical probabilities of using external funds and equity, respectively.

To reduce simulation error, this entire process is repeated 500 times and the resulting

predictions are averaged across the 500 simulations. The results are presented in Table 2.

## C.2: Parametrization

Before implementing the procedure described above, we must specify the means, variances and covariances in a manner consistent with the data. That is, the characteristics of the simulated data,  $(Inv, C, D)$  and  $(\varepsilon, \omega)$ , must match those of their counterparts in the data. For example, we specify the first two moments of investment,  $\mu_{Inv}$  and  $\sigma_{Inv}^2$ , as the sample mean and sample variance of capital expenditures divided by assets. Other elements of the simulation, however, have no directly observable counterpart in the data, and, as such, we require empirical proxies. In what follows, all variables are normalized by total assets as required by the empirical implementation.

We begin with  $C = CashBal + CashFlow - \alpha_C$ , for which we have data on  $CashBal$  and  $CashFlow$  as discussed in the paper. However, we need an estimate of  $\alpha_C$ , which we obtain from the following regression:

$$\frac{CashBal_{it}}{Assets_{it-1}} = \alpha_C + \varepsilon_{it}. \quad (23)$$

Thus, our estimate of the baseline cash holdings of firms,  $\alpha_C$ , is given by the mean cash balance observed in our sample. With the estimated coefficient from this regression, we construct our empirical proxy of  $C$ :

$$\hat{C}_{it} = CashBal_{it-1} + CashFlow_{it} - \hat{\alpha}_C,$$

where all variables are scaled by  $Assets_{it-1}$ . Using  $\hat{C}$ , we define  $\sigma_C$  as the sample variance of  $\hat{C}$  and  $\sigma_{Inv,C}$  as the covariance between capital expenditures divided by assets and  $\hat{C}$ . We use the variance of the estimated residuals from equation (23) to specify  $\sigma_\varepsilon^2$  since they represent our proxy for  $\varepsilon$ , the error term of the  $CashTarget^*$  (equation (4)).

We follow an analogous procedure in deriving empirical proxies for  $D = CashBal + CashFlow - Debt + \alpha'_M$  and  $\omega$ . We have data for the first three components of  $D$  but require an estimate of  $\alpha'_M$ , which we obtain from the following regression:

$$\frac{Debt_{it} - CashBal_{it}}{Assets_{it-1}} = \alpha_{M'} + \omega_{it} \quad (24)$$

We take the estimated coefficient from equation (24) to construct our empirical proxy of  $D$ :

$$\hat{D}_{it} = CashBal_{it-1} + CashFlow_{it} - Debt_{it-1} + \hat{\alpha}'_{M'},$$

where all variables are scaled by  $Assets_{it-1}$ . Using  $\hat{D}$ , we define  $\sigma_D^2$  as the sample variance of  $\hat{D}$ ,  $\sigma_{Inv,D}$  as the sample covariance between capital expenditures divided by assets and  $\hat{D}$ , and  $\sigma_{C,D}$  as the sample covariance between  $\hat{C}$  and  $\hat{D}$ . We use the variance of the estimated residuals from equation (24) to specify  $\sigma_\omega^2$  since they represent our proxy for  $\omega$ , the error term of difference in the maximum debt level and cash target (equation (8)). The covariance between  $\varepsilon$  and  $\omega$  is used to specify  $\sigma_{\varepsilon,\omega}$ .

The two parameters remaining to be specified,  $\mu_C$  and  $\mu_D$ , are chosen so that the proportion of internal to external issuances and debt to equity issuances match those found in the data (see Table 3). Note that adjusting these means in this way is not a departure from consistency with the data, since these variables are not observed and, therefore, their sample means cannot be measured. Rather, consistency with the data is ensured by matching the proportion of financing decisions in the simulated data with that found in the observed data.

### C.3: Shyam-Sunder and Myers (1999) Model

For the estimation of the Shyam-Sunder and Myers (1999) model (equation (13)), we require the change in debt, change in equity and total financing deficits implied by each sequence of financing decisions. The pecking order is ambiguous on how to make this translation, as it depends on the nature of adjustment costs. Consider the case where a firm's desired investment is \$150 and they have internal funds of \$100 and additional debt capacity of \$100. Under the pecking order, ignoring dynamic considerations and transactions costs, we would expect the firm to fund the first \$100 of investment with internal funds and the next \$50 with new debt. However, given a likely desire to minimize transactions costs, it may be more desirable to fund the entire \$150 with new debt. This latter case is consistent with the empirical evidence in Stafford (2001) that cash balances tend to increase when firms make large investments and with the fact that dual debt and equity issuances are rare in our sample relative to pure equity issuances.

We therefore calculate  $\Delta D$ ,  $\Delta E$  and  $FinDef$  in two manners. In both methods, if the financing decision is to use internal funds,  $\Delta D = \Delta E = 0$ . In the first approach, if the financing decision is a debt issuance then  $\Delta D$  equals the difference between the simulated investment and cash threshold ( $C^*$ ) and  $\Delta E = 0$ . If the financing decision is an equity issuance then  $\Delta E$  is equal to the difference between investment and the debt threshold ( $D^*$ ) and  $\Delta D$  is equal to  $(D^* - C^*)$ . In the second approach, which allows for the impact of transaction costs and valuable financial slack, if the financing decision is a debt issuance then  $\Delta D$  is set equal to investment and  $\Delta E = 0$ . If the financing decision is an equity issuance then  $\Delta E$  is set equal to investment and  $\Delta D = 0$ . In both

cases,  $FinDef = \Delta D + \Delta E$ , consistent with the accounting identity. Since both cases have little effect on the estimation results, we focus on those obtained using the second decision rule, which are presented in Table 2.

For the issuance decisions generated from the alternative model, we note that there is no relation between the financing choice and the size of investment relative to available cash and debt capacity. This results in cases where, for example, investment is less than available cash, but the firm issues debt. Therefore, we cannot use the first approach for calculating  $\Delta D$  and  $\Delta E$  for the alternative model simulation and rely only on the second approach. When the Shyam-Sunder and Myers regression is estimated using the data generated according to the pecking order; however, we obtain similar results from each approach for calculating  $\Delta D$  and  $\Delta E$ . Therefore, we do not believe that this assumption is a serious limitation.

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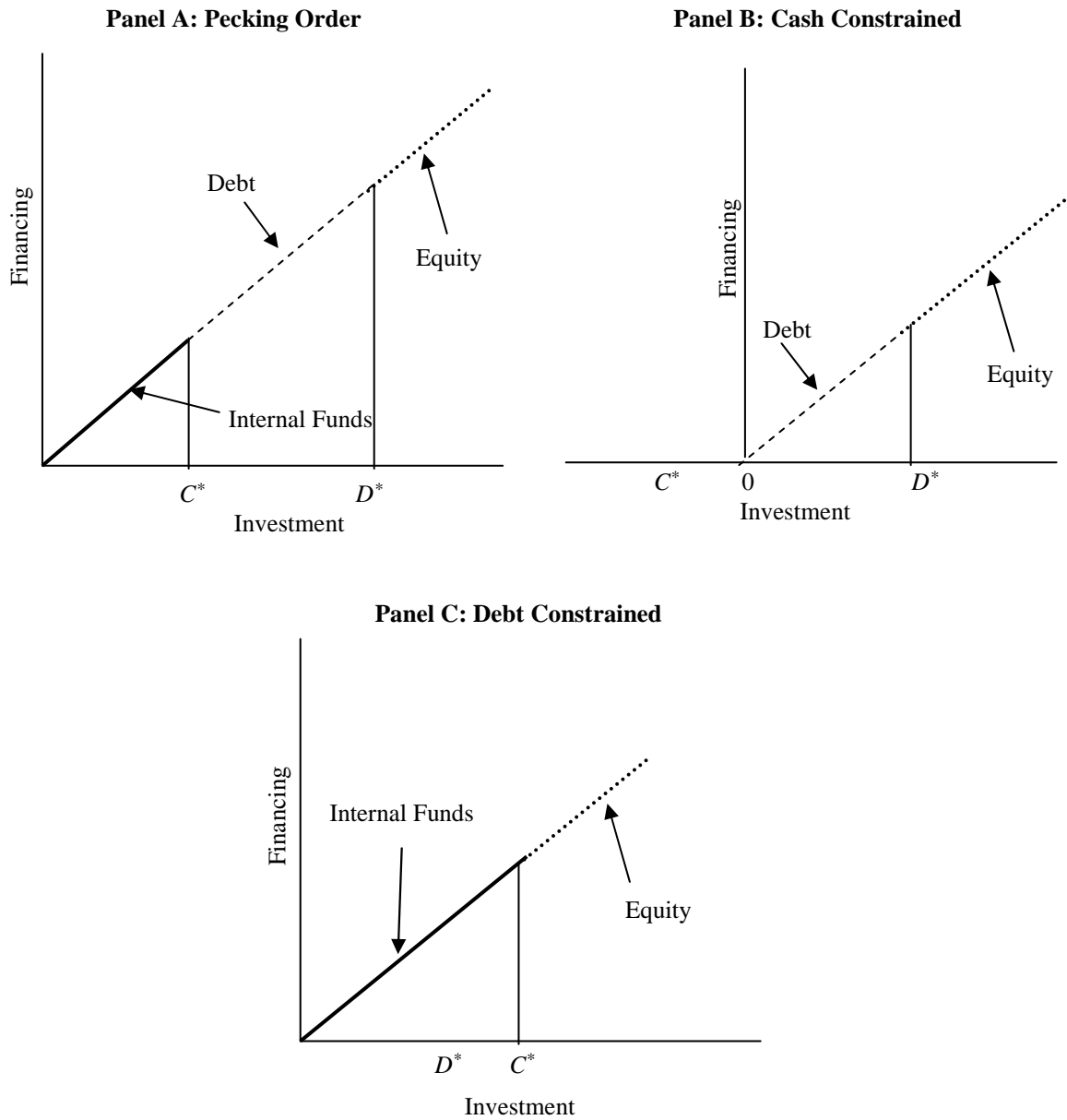
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**Figure 1**

**The Financing Hierarchy of the Pecking Order and Extended Specification**



**Table 1**  
**Distribution of the Magnitude of Equity Issuances**

The sample comes from the annual Compustat files during the period 1971-2001. Equity (SCF) is defined using the statement of cash flows as the issuance of common and preferred stock, net of repurchases, during period  $t$ , divided by total assets in year  $t - 1$ . Equity (SO) is defined for year  $t$  as the product of (1) the split-adjusted growth in shares and (2) the average of the split adjusted stock price at the beginning and end of the fiscal year, where both terms are obtained from Compustat data, divided by assets in year  $t - 1$ . The table presents the density and distribution of issuances.

Issuance Size	Equity (SCF)	Cumulative	
		Equity (SCF)	Equity (SO)
[0, 0.01)	61.1%	61.1%	49.6%
[0.01, 0.02)	11.0%	72.1%	12.1%
[0.02, 0.03)	4.8%	77.0%	6.0%
[0.03, 0.04)	2.8%	79.7%	4.0%
[0.04, 0.05)	2.2%	81.9%	2.8%
[0.05, 0.07)	2.9%	84.7%	4.0%
[0.07, 0.10)	2.9%	87.6%	4.0%
[.10, $\infty$ )	12.4%	100.0%	17.4%

**Table 2**

**Model Simulation Results**

The table presents the prediction accuracy of the empirical pecking order model for eleven sets of simulated financing decisions that vary in the degree to which they adhere to the pecking order’s financing hierarchy. For example, the column marked 50% corresponds to a simulated series of financing decisions in which half are generated according to the pecking order decision rule and half are generated according to an alternative decision rule. The pecking order decision rule dictates that internal funds are used if investment is less than internal resources and external funds are used otherwise. If external funds are used then debt is used first, followed by equity if investment is sufficiently large. The alternative decision rule randomly allocates internal-external and debt-equity decisions such that the ratios of these two sets of decisions match those found in the data. (The details of the simulation experiment are described in Appendix C.) Thus, when half of the firms are adhering to the pecking order, 63.9% (67.2%) of simulated internal (external) financing decisions and 35.8% (50.5%) of the simulated debt (equity) decisions are accurately predicted by the model. The “Average Correct” row presents an equal weighted average of the corresponding two financing decisions. The “Improvement” row presents the increased prediction accuracy of the model over a naive predictor (e.g., predict debt for every observation). Thus, for the 50% column, 67.2% of the external issuances are accurately classified, suggesting that a naive classification rule would accurately classify half (33.6%) of the debt and equity issuances correct by chance error alone. Since the model correctly identifies 43.1% , this corresponds to an improvement of approximately 9.5%. Panel B presents coefficient estimates and R-squares for the Shyam-Sunder and Myers (1999) regression, using the same sets of simulated data (See Appendix C.3 for details). The model regresses the change in debt normalized by start of period assets on the financing deficit, defined as dividends plus investment plus the change in working capital minus cash flow. Panel C presents estimates from the same model after including a squared term.

Panel A: Prediction Accuracy

Simulated Decision	Percent of Firms Following Pecking Order										
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Internal Finance	50.0%	53.2%	55.6%	58.3%	61.4%	63.9%	67.2%	70.5%	73.9%	77.4%	81.5%
External Issuance	50.5%	53.6%	57.2%	60.5%	64.4%	67.2%	71.3%	75.6%	78.5%	82.3%	84.6%
Average Correct	50.2%	53.4%	56.4%	59.4%	62.9%	65.5%	69.2%	73.1%	76.2%	79.9%	83.0%
Debt Issuance	39.7%	16.8%	23.3%	28.4%	31.1%	35.8%	39.6%	44.3%	47.8%	53.0%	57.2%
Equity Issuance	11.5%	38.4%	40.8%	41.2%	46.9%	50.5%	54.4%	59.9%	64.4%	67.2%	69.8%
Average Correct	25.6%	27.6%	32.0%	34.8%	39.0%	43.1%	47.0%	52.1%	56.1%	60.1%	63.5%
Improvement	0.3%	0.8%	3.4%	4.5%	6.8%	9.5%	11.4%	14.3%	16.9%	19.0%	21.2%

Panel B: Shyam-Sunder and Myers Regression Coefficient Estimates:

$$\Delta Debt_t = \alpha + \beta \text{Financing Deficit}_t + \varepsilon_t$$

	Percent of Firms Following Pecking Order										
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
$\hat{\beta}$	0.72	0.70	0.73	0.73	0.73	0.73	0.72	0.72	0.73	0.72	0.71
$R^2$	0.69	0.67	0.70	0.70	0.69	0.69	0.68	0.67	0.67	0.67	0.66

Panel C: Shyam-Sunder and Myers Regression Coefficient Estimates (Expanded Specification):

$$\Delta Debt_t = \alpha + \beta \text{Financing Deficit}_t + \gamma (\text{Financing Deficit}_t)^2 + \varepsilon_t$$

	Percent of Firms Following Pecking Order										
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
$\hat{\beta}$	0.72	0.72	0.74	0.73	0.73	0.73	0.74	0.74	0.77	0.76	0.76
$\hat{\gamma}$	0.00	-0.08	-0.02	-0.01	-0.02	-0.01	-0.09	-0.09	-0.16	-0.15	-0.15
$R^2$	0.69	0.67	0.70	0.70	0.69	0.69	0.68	0.67	0.68	0.67	0.66

**Table 3**  
**Financing Decisions and Firm Characteristics**

The sample comes from the annual Compustat files during the period 1971-2001. Debt issuances are defined as a change in total debt (long term plus short term) from year  $t - 1$  to  $t$  divided by total assets in year  $t - 1$  in excess of 5%. Equity issuances are defined for year  $t$  as sale of common and preferred stock net of purchase of common and preferred stock in excess of 5% of total assets at the end of the previous fiscal year. Internal financing is assumed if no issuance is made. All variables, except for size and age, are scaled by book assets. *Current Inv.* is defined as the sum of capital expenditures, increase in investments, acquisitions, and other use of funds, less sale of PPE and sale of investment; *Cash Balance* is defined as cash and marketable securities; *Current Cash Flow* for year  $t$  is defined as cash flow after interest and taxes net of dividends in year  $t-1$ ; *Market-to-Book* is defined as the ratio of total assets minus book equity plus market equity to total assets; *Book Leverage* is defined as the sum of short term and long term debt divided by the book value of assets; *Firm Size* is the natural logarithm of book assets; *Anticipated Investment* and *Anticipated Cash Flow* for year  $t$  are the sum of the realized values for years  $t+1$  and  $t+2$  of Investment (capital expenditures) and Cash Flow (defined as cash flow after interest and taxes net of dividends), respectively; *Tangible Assets* is defined as net property, plant and equipment; *Cash Flow Volatility* is defined as the standard deviation of earnings before interest and taxes, and is based on (up to) the previous 10 years of data for a given firm-year observation; *Firm Age* is defined as the number of years since a given firm first appeared on Compustat.

Financing Decision	% of Obs.	Current Inv.	Cash Balance	Current Cash Flow	Market-to-Book	Book Leverage	Firm Size	Anticipated Inv.	Anticipated Cash Flow	Tangible Assets	Cash Flow Volatility	Firm Age
Internal	66.20%	0.06	0.06	0.09	1.09	0.22	5.17	0.16	0.2	0.28	0.06	15
Debt	24.60%	0.14	0.04	0.11	1.2	0.23	5.14	0.2	0.22	0.3	0.06	14
Equity	6.10%	0.1	0.06	0.09	1.52	0.27	4.33	0.27	0.21	0.26	0.09	10
Dual	3.10%	0.27	0.05	0.11	1.52	0.26	4.66	0.37	0.27	0.3	0.08	9

**Table 4**  
**Model Prediction Accuracy Using Observed Financing Decisions**

The sample comes from the annual Compustat files during the period 1971-2001. Panel A presents the prediction accuracy results of our empirical model in equations (9) through (12). For example, the results suggest that the pecking order correctly classifies 67.47% (74.62%) of the observed internal (external) financing decisions and 41.82% (44.75%) of the debt (equity) decisions. However, the pecking order incorrectly classifies 24.99% (26.43%) of the debt (equity) issuances as internal funds. The “Average Correct” row presents an equal weighted average of the correct classifications. The “Sample Adherence” row presents the fraction of firms in the sample adhering to the particular model (pecking order, expanded), as suggested by the simulation results. The “Improvement” row in the debt-equity decision shows the model’s improvement in prediction accuracy relative to a naive estimator that would, on average, get half of the accurately identified external issuances correct. For example, 74.6% of external issuances are correctly classified, implying that 37.3% of debt-equity decisions will be correctly classified by a naive estimator. Since the model accurately identified 43.3% of the debt-equity issuances, this is an improvement of 6.0% which, according to our simulation results, corresponds to approximately 36% of the sample exhibiting pecking order financing behavior. The two numbers in brackets correspond to a 95% bootstrap confidence interval. Panel B presents the prediction accuracy results for the extended cash target and maximum debt specifications in equations (15) and (16).

Panel A: Pecking Order

Observed Decision	Predicted Financing Decision	
	Internal	External
Internal	67.47%	32.53%
External	25.38%	74.62%
Average Correct [95% CI]	71.05%	[70.43%, 71.72%]
Sample Adherence	64%	

Observed Decision	Predicted Financing Decision		
	Internal	Debt	Equity
Debt	24.99%	41.82%	33.19%
Equity	26.43%	28.82%	44.75%
Average Correct	43.29%		
Improvement [95% CI]	5.98%	[5.00%, 7.01%]	
Sample Adherence	36%		

Panel B: Expanded Specification

Observed Decision	Predicted Financing Decision	
	Internal	External
Internal	75.79%	24.21%
External	26.87%	73.13%
Average Correct [95% CI]	74.46%	[73.64% , 75.28%]
Sample Adherence	74%	

Observed Decision	Predicted Financing Decision		
	Internal	Debt	Equity
Debt	28.25%	51.52%	20.23%
Equity	23.07%	22.88%	54.05%
Average Correct	52.78%		
Improvement [95% CI]	16.22%	[15.14% , 17.29%]	
Sample Adherence	77%		



**Table 5**  
**Model Prediction Accuracy By Measures of Information Asymmetry**

The sample comes from the annual Compustat, SDC Platinum and Dealscan files during the period 1971-2001 and I/B/E/S summary history files from 1976-2001. The table presents the average prediction accuracy for debt and equity issuances from the empirical model discussed in the text. “Hot” and “cold” periods are defined using a variant of that used by Bayless and Chaplinsky (1996), which enables us to use our entire sample. That is, we rank each year according to the total net issuance volume scaled by the total market value of equity in the sample. We then define hot years (low information asymmetry) to be those in the upper quartile, based on this ranking, and cold years (high information asymmetry) to be those in the bottom quartile. *Analyst Coverage* is a binary variable equal to 1 if a firm is covered in the I/B/E/S summary history files for a given year. High (low) information asymmetry is associated with *Analyst Coverage* = 0 (1). *Forecast Dispersion* is the standard deviation of the one-year ahead EPS forecast for the first month in each fiscal year. High (low) information asymmetry is associated with the upper (lower) third of the distribution. *Pub/Priv* is a designation for issuances identified as either public or private debt issuances by matching issuances identified using our Compustat sample (see text for details) with the SDC Platinum, Dealscan and FISD databases. High (low) information asymmetry is associated with public (private) issuances. *Firm Age* is the number of years the firms has been on Compustat. High (low) information asymmetry is associated with the lower (upper) third of the distribution. *Tangible Assets* is defined as the ratio of net property, plant and equipment to total assets. High (low) information asymmetry is associated with the lower (upper) third of the distribution.

Information							
Asymmetry	Hot/Cold Periods	Firm Age	Tangible Assets	Analyst Coverage	Forecast Dispersion	Pub/Priv	
High	45%	31%	26%	33%	36%	44%	
Low	38%	44%	43%	39%	47%	13%	

**Table 6**  
**Comparison of Equity Issuers and Private Borrowers**

The table presents a comparison of firm characteristics for two samples of firms: (1) borrowers in the private debt market and (2) Equity issuers identified by our empirical model as violating the pecking order's financing hierarchy ("Equity Violators"). Private lender data come from an August, 2002 extract of the Dealscan database, marketed by Loan Pricing Corporation (LPC), which consists of dollar denominated private loans made by bank (e.g., commercial and investment) and non-bank (e.g., insurance companies and pension funds) lenders to U.S. corporations during the period 1987-2001. *Book Leverage* is defined as the sum of short term and long term debt divided by the book value of assets; *Market Leverage* is defined as the sum of short term and long term debt divided by the sum of short term debt, long term debt, and market equity. *Profitability* is the ratio of EBITDA to total assets. *Maturity Structure* is the ratio of long term debt to the sum of short term and long term debt. *Market-to-Book* is defined as the ratio of total assets minus book equity plus market equity to total assets; *Financing Deficit* is the sum of common dividends plus capital expenditures plus the change in net working capital minus cash flow all divided by total assets. *Current Investment* is the ratio of capital expenditures to total assets. *Total Assets* is the book value of assets in millions of year 2000 dollars. *Z-Score* is defined as the sum of 3.3 times earnings before interest and taxes plus sales plus 1.4 times retained earnings plus 1.2 times working capital divided by total assets. *Tangible Assets* is defined as net property, plant and equipment; *Current Ratio* is the ratio of current assets to current liabilities. Other variables are as defined in Table 3. The t-stat tests the null hypothesis that the sample means are equal and uses standard errors adjusted for dependence at the firm level.

Variable	Private Debt Firms			Equity Violators			Difference in Means	
	25 <sup>th</sup> -Percentile	Median	75 <sup>th</sup> -Percentile	Mean	Median	Mean	t-stat	t-stat
Book Leverage	0.14	0.30	0.46	0.33	0.22	0.22	17.12	17.12
Market Leverage	0.09	0.25	0.46	0.30	0.13	0.18	16.42	16.42
Profitability	0.08	0.13	0.18	0.09	0.09	0.02	4.42	4.42
Maturity Structure	0.60	0.86	0.96	0.73	0.74	0.63	7.70	7.70
Market-to-Book	1.06	1.38	1.98	1.85	1.74	2.25	-6.03	-6.03
Financing Def.	-0.02	0.02	0.15	0.77	0.05	0.15	2.13	2.13
Current Investment	0.03	0.05	0.10	0.08	0.05	0.09	-1.18	-1.18
Firm Size	47.68	178.07	794.66	1971.58	58.99	373.13	15.55	15.55
Total Assets	59.40	219.50	904.29	1759.07	46.87	329.16	17.51	17.51
Cash Flow Vol.	0.04	0.06	0.10	0.09	0.09	0.16	-6.56	-6.56
Z-Score	0.91	1.80	2.62	1.52	1.01	0.54	7.96	7.96
Tangible Assets	0.14	0.27	0.48	0.33	0.25	0.32	0.82	0.82
Current Ratio	1.16	1.70	2.45	2.16	1.78	2.23	-0.72	-0.72

**Table 7****Actual and Estimated Promised Yields for Borrowers and Equity Issuers**

Private lender data come from an August, 2002 extract of the Dealscan database, marketed by Loan Pricing Corporation (LPC), which consists of dollar denominated private loans made by bank (e.g., commercial and investment) and non-bank (e.g., insurance companies and pension funds) lenders to U.S. corporations during the period 1987-2001. Corresponding firm characteristics come from the annual Compustat database during the period 1987-2001. Panel A presents the estimated coefficients of a linear regression of the promised yield of a loan (measured in basis points above the 6-month LIBOR) on various covariates, which are defined in the previous tables. Test statistics (t-stat) are adjusted for dependence at the firm level. Dummy variables corresponding to year and industry (Fama and French 38) are suppressed. Panel B presents descriptive statistics of the loan yield distribution for our sample of Private Borrowers, Equity Violators, Equity Non-Violators, and all Equity Issuers. Equity Violators (Non-Violators) are those equity issuances identified by our empirical model as violating (not violating) the financing hierarchy.

Panel A: Estimates of Loan Yield Determinants

Variable	Estimate	t-stat
Intercept	412.50	19.53
Book Leverage	94.82	8.02
Size	-37.19	-31.48
Tangible Assets	-23.33	-1.89
Profitability	-125.16	-4.82
Cash Flow Volatility	94.05	3.76
Log(Market-to-Book)	8.07	1.77
Maturity Structure	-17.08	-2.40
Z-Score	-6.70	-3.39
Current Investment	25.49	0.76
Adjusted $R^2$	45%	

Panel B: Loan Yield Distributions

Sample	25 <sup>th</sup> -Percentile	Median	75 <sup>th</sup> -Percentile	Mean
Bank Borrowers	100.00	225.00	300.00	218.90
Equity Issuers	189.97	257.94	334.09	267.06
Equity Non-Violators	231.84	298.18	376.84	307.66
Equity Violators	184.10	250.52	319.97	256.82

**Table 8**  
**Cash Target and Maximum Debt Estimated Determinants**

The sample comes from the annual Compustat files during the period 1971-2001. The table presents coefficient estimates and t-statistics (t-stat) adjusted for clustering at the firm level of the extended bivariate probit specification. The estimated coefficients can be interpreted in terms of the marginal impact on the likelihood of turning to external financing ( $\beta$ ) or turning to equity financing ( $\gamma$ ). *Dividend Payer* is a dummy variable equal to 1 if a firm paid a positive dividend in year t; *R & D* is research and development expense as a percent of sales; *RDD* is a binary variable equal to one if R & D is missing and zero otherwise. *Net Working Capital* is defined as Current Assets excluding cash minus Current Liabilities excluding short term debt. *Depreciation* is depreciation and amortization expense. *Operating Loss Carryforward* is unused net operating loss carryforward as a percent of sales. *Industry Leverage* is the median total leverage of firms in the same 1-digit SIC industry. *Selling Expense* is selling, general and administrative expenses as a percent of sales. *Stock Return* is defined as last periods annual stock return. The remaining variable definitions are as defined earlier.

Variable	External Decision		Equity Decision	
	Estimated Coefficients ( $\beta$ )	t-stat	Estimated Coefficients ( $\gamma$ )	t-stat
Constant	-0.473	-5.96	-0.809	-4.65
Firm Size	-0.028	-4.43	0.000	-0.04
Anticipated Investment	0.338	10.81	0.161	4.04
Anticipated Cash Flow	-0.359	-7.64	0.011	0.18
Cash Flow Volatility	0.284	1.78	1.233	5.68
Dividend Payer	-0.095	-4.37	-0.118	-3.45
Z-score	0.039	3.61	-0.122	-7.34
R&D / Sales	0.919	3.91	1.181	3.48
RDD	0.061	2.63	-0.097	-2.55
Market-to-Book	0.215	16.70	0.200	11.46
Net Working Capital	-0.394	-6.04	-0.592	-5.46
Book Leverage	-0.243	-3.93	0.805	9.03
Tangible Assets			-0.751	-7.68
Depreciation			1.963	3.20
Operating Loss Carryforward			-0.016	-0.62
Industry Leverage			-0.752	-1.72
Selling Expense			0.206	2.30
Firm Age			-0.009	-5.45
Stock Return			0.169	7.72

Table 9

**Model Prediction Accuracy for Alternative Variable Definitions and Model Specifications**

The sample comes from the annual Compustat files during the period 1971-2001. Column (1) repeats the results from Table 4. In column (2), the definition of investment is broadened to include advertising expense and research and development expenditure. In columns (3) and (4), debt issuance is calculated using total and long-term net debt issuance from Compustat statement of cash flows data, respectively. In columns (5) and (6), the percent of assets cutoff for defining an issuance is reduced to 3% and 1%, respectively. In columns (7) and (8), equity issuance is defined as the product of (i) the split-adjusted growth in shares and (ii) the average of the split adjusted stock price at the beginning and end of the fiscal year; results using a cutoff of 3% and 1% of assets, respectively, to define an issuance are reported. Numbers reported next to each financing decision are the percent of those actual decisions correctly predicted by the model. The “Average Correct” row presents an equal weighted average of the correct classifications. The “Improvement” row in the debt-equity decision shows the model’s improvement in prediction accuracy relative to a naive estimator that would, on average, get half of the accurately identified external issuances correct. For example, the baseline model accurately predicts 67.5% of internal financings, 74.6% of external financings, 41.8% of debt issuances, and 44.7% of equity issuances. The internal-external (debt-equity) average prediction accuracy of 71.0% (43.3%) translates into 64% (36%) of the sample firms adhering to the model’s decision rules. The 6.0% Improvement shows the model’s improvement over a naive estimator that would correctly classify half of the accurately classified external issuances. Thus, the improvement is  $43.3\% - 74.6\%/2 = 6.0\%$ . The Sample Adherence is obtained from simulation results.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Actual	Baseline	Expanded	SCF	SCF	LT Debt Iss	SCF	LT Debt Iss	SCF
Decision	Model	Investment	Total Debt Iss	Total Debt Iss	3% cutoff	1% cutoff	3% cutoff	1% cutoff
Internal Finance	67.5%	69.8%	65.5%	70.3%	65.8%	63.7%	62.7%	61.7%
External Issuance	74.6%	74.1%	75.9%	77.4%	73.5%	70.1%	69.6%	66.9%
Average Correct	71.0%	71.9%	70.7%	73.9%	69.7%	66.9%	66.1%	64.3%
Sample Adherence	64%	67%	63%	72%	61%	53%	51%	45%
Debt Issuance	41.8%	40.1%	41.3%	43.0%	38.1%	31.5%	32.5%	29.2%
Equity Issuance	44.7%	47.6%	42.4%	42.5%	45.9%	41.1%	38.9%	38.8%
Average Correct	43.3%	43.9%	41.9%	42.8%	42.0%	36.3%	35.7%	34.0%
Improvement	6.0%	6.8%	3.9%	4.1%	5.3%	1.3%	0.9%	0.6%
Sample Adherence	36%	40%	24%	25%	33%	11%	10%	5%

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