Debt Capacity and Tests of Capital Structure Theories*

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Abstract

The impact of explicitly incorporating a measure of debt capacity in recent tests of competing theories of capital structure is examined. Controlling for debt capacity, the pecking order appears to be a good description of financing behavior for a large sample of firms over a long horizon. Our main results are first, that internally generated funds appear to be the preferred source of financing for all firms. Second, if external funds are required, in the absence of debt capacity concerns, debt appears to be preferred to equity. Concerns over debt capacity largely explain the use of new external equity financing by publicly traded firms. Thirdly, when possible, debt capacity is "stockpiled." Further, we provide evidence of the stockpiling of debt capacity by profitable, low leverage firms with minimal transactions costs for issuing new securities. This evidence, while consistent with the pecking order, is difficult to reconcile with the tradeoff theory. Finally, we present evidence that reconciles the frequent equity issues by small, high-growth firms with the pecking order.

Recently, an interesting discussion has been generated in studies designed to detect which of the predominant theories of capital structure, the tradeoff or the pecking order theory, best describes the financing choices of corporations. Shyam-Sunder and Myers (1999) provide evidence, using a simple empirical model and a sample of 157 U.S. firms, suggesting the pecking order theory is a good first-order description of the financing behavior of these firms. Chirinko and Singha (2000) use three examples to illustrate potential problems with using the Shyam-Sunder and Myers test to evaluate the pecking order theory. Frank and Goyal (2003) argue that the strong results of Shyam-Sunder and Myers do not hold up when a broad sample of firms and a longer time series is used. Fama and French (2002) find that short term variation in earnings and investment is mostly absorbed by debt, as predicted by the pecking order, but that the pecking order has other failings (namely significant equity issues by small, high-growth firms). This paper explores the role of debt capacity in tests of capital structure theories within the Shyam-Sunder and Myers framework in order to better understand the contrasting results of these studies and to provide new evidence concerning the competing theories of capital structure.

We present evidence that firms follow a pecking order in incremental financing choice and offer substantial support for the pecking order theory articulated in Myers (1984) by explicitly recognizing the role of debt capacity in the theory. Our main finding is that, based on a version of the Shyam-Sunder and Myers test, the pecking order theory provides a good description of financing behavior for a broad cross-section (and a long time horizon) of firms once concerns over debt capacity are controlled for. Internally generated funds appear to be the first choice of financing for all firms. Firms unconstrained by concerns over debt capacity primarily use debt to fill their financing deficit while constrained firms exhibit a heavy reliance on external equity financing. We show that firms appear to "stockpile" debt capacity. When possible, internally generated funds are used to finance new investment and to reduce debt levels. Directly contrary to the tradeoff theory, we find that profitable, low leverage firms with minimal transactions costs for raising new debt use their cash flow to retire debt and reduce leverage.

Citing the idea that the firms with the greatest potential for asymmetric information will have the greatest incentive to follow the pecking order Frank and Goyal (2003) conclude that finding large, mature firms (rather than small, high-growth firms) perform “best” in the Shyam-Sunder and Myers test is contrary to the pecking order theory (see also Fama and French (2002)). Our evidence shows that it is precisely the small, high-growth firms that face the most restrictive debt capacity constraints. We also provide evidence concerning differences in the costs associated with announcements of equity issues (which have been argued to be the result of asymmetric information) across groups of firms. The evidence from announcement effects for new equity issues shows that young, high-growth firms actually face lower costs of asymmetric information than do large mature firms. We conclude that finding small, high-growth firms to be the predominant issuers of equity is not in fact contrary to the pecking order hypothesis.

The remainder of this paper is organized as follows. Section 1 describes prior tests of the pecking order and develops our hypotheses. Section 2 describes our data. Section 3 presents our main results on the effect of controlling for debt capacity. Section 4 examines an aspect of financing behavior for which the tradeoff theory and the pecking order provide conflicting predictions. Section 5 examines the intuition that firms facing greater amounts of asymmetric information should follow the pecking order more closely, and Section 6 concludes.

1. Tests of Capital Structure Theory

The tradeoff theory of capital structure predicts that firms will choose their mix of debt and equity to balance the costs and benefits of debt. Tax benefits and control of free cash flow problems are argued to push firms to use more debt, while bankruptcy and other agency costs provide firms with incentives to use less. The theory describes a firm's optimal capital structure as the mix of financing that equates the marginal costs and benefits of debt. In static versions of the tradeoff model these forces determine an optimal capital structure. In dynamic versions of the model (*e.g.* Fisher, Heinkel, and Zechner (1989)) the optimum is characterized as an interval, and violation of the endpoints of the interval lead to revisions in the firm's financing mix.

Myers (1984), based on the argument in Myers and Majluf (1984), presents a pecking order theory of financing choice. The major prediction of the model is that firms will not have an optimal capital structure, but will instead follow a pecking order of incremental financing choice that places internally generated funds at the top of the order, followed by debt, and finally, when the firm reaches its "debt capacity," new external equity. This theory is based upon costs derived from asymmetric information between managers and the market and the idea that tradeoff theory costs and benefits of debt financing are of second order importance when compared to the costs of issuing new securities in the presence of asymmetric information. The development of a pecking order based upon costs of adverse selection requires an *ad hoc* specification of the manager's incentive contract (see Dybvig and Zender (1991)) and a limitation on the types of financing strategies that may be pursued (see Brennan and Kraus (1987)). Nevertheless, despite these theoretical criticisms, Myers' version of the pecking order theory remains one of the predominant theories of incremental financing choice.

Dynamic versions of the pecking order model result in firms saving debt capacity for future possible needs. (Myers (1984) describes this loosely while Vishwanath (1993) and Chang and Dasgupta (2003) present formal models.) The extent of this "savings" behavior will depend on how changes in the firm's investment opportunity set and changes in the asymmetry of information are modeled. Regardless of the specific modeling choices, the qualitative predictions of dynamic models concerning financing behavior remain the same. On average, firms requiring outside financing will use a mix of debt and equity in which the weights will depend on the probability of reaching their debt capacity given their current leverage, the debt capacity level, current growth, and expectations for these characteristics in the future. All else equal, those firms expecting little or no growth, whose debt capacity is far from their current debt level, will finance predominantly (or even entirely) with debt while extremely high growth firms or those at or near their debt capacities will rely more heavily on equity. Intermediate firms will use a mix of the two securities with the weights being determined by the likelihood of reaching their debt capacity based on their future requirements for external financing.

In a recent set of papers, tests designed to distinguish between these theories have been developed. Shyam-Sunder and Myers (1999) introduce a test of the pecking order theory. Their test is based on the pecking order's prediction for the type of financing used to fill the "financing deficit." The financing deficit is defined, using the cash flow identity, as the growth in assets less the growth in current liabilities (except the current portion of long term debt) less the growth in retained earnings. According to the identity, this deficit must be "filled" by the (net) sale of new securities. Shyam-Sunder and Myers argue that, except for firms at or near their debt capacity, the pecking order predicts that the deficit will be filled entirely with new debt issues. The empirical specification of their test is:

$$\Delta D_{it} = \alpha + \beta_{PO} DEF_{it} + \varepsilon_{it} \tag{1}$$

where ΔD_{it} is the net debt issued by firm *i* in period *t*, and DEF_{it} is the corresponding financing deficit. Changes in the use of debt should be driven by the deficit and not consideration of an optimal capital structure. The test itself, however, ignores the issue of debt capacity.

Shyam-Sunder and Myers argue that the "simple" version of the pecking order predicts $\alpha = 0$ and $\beta_{PO} = 1$. Intuitively, the slope coefficient in this regression indicates the extent to which debt issues cover the financing deficit. They acknowledge that β_{PO} may be less than 1 for firms near their debt capacity, however, the firms in their sample should not be significantly constrained by such concerns. They find $\beta_{PO} = 0.75$ with an R^2 of 0.68 (see column 2 of their Table 2) when they estimate equation (1). They interpret this as evidence that "the pecking order is an excellent first-order descriptor of corporate financing behavior" (Shyam-Sunder and Myers (1999) pg.242) for their sample. They also find that a target adjustment model based on the tradeoff theory has little power to explain the changes in debt financing for these firms.

This paper has generated an interesting discussion in the literature. Chirinko and Singha (2000) illustrate, via several examples, that the Shyam-Sunder and Myers test has no power to distinguish between plausible alternative hypotheses. Frank and Goyal (2003) also question the conclusions drawn by Shyam-Sunder and Myers (1999) on several fronts. The most interesting challenges are the extent to which the Shyam-Sunder and Myers findings hold for a broader sample of firms, whether the results hold over a longer time horizon (in particular including the 1990's) and whether their findings hold for subsamples of firms with high levels of asymmetric information. For their broader sample of firms, Frank and Goyal show that the prediction $\beta_{PO} = 1$ in equation (1) does not hold and that it significantly weakens in the 1990's, even for the types of firms (large, mature) examined by Shyam-Sunder and Myers (1999).

Fama and French (2002) examine many of the predictions of the tradeoff and the pecking order theories with respect to capital structure and dividend policy. They argue that for the majority of the predictions the two theories agree and generally report findings consistent with these shared predictions. Consistent with Shyam-Sunder and Myers (1999), Fama and French (2002) find that (for their large sample) debt is used to address variations in investment and earnings in the short-term. However, they also find, as in Frank and Goyal (2003), that small, high-growth companies issue most of the equity (see also Fama and French (2005)). Fama and French join Frank and Goyal in arguing that this finding contradicts the pecking order theory.

In a recent paper, Leary and Roberts (2007) also question the ability of the pecking order to explain financing decisions. Using a different empirical approach, they find little support for the pecking order, even for subsamples of firms for which the pecking order should be most likely to hold. We discuss differences between our conclusions and theirs later in the paper.

Understanding what drives these contrasting findings is important for furthering our understanding of capital structure and financing choices by firms. We provide evidence in an attempt to reconcile some of these findings by focusing on the role of debt capacity. This is an idea introduced in Myers (1984) and is an important element of the pecking order hypothesis that is commonly ignored in empirical tests.

1.1. Empirical Strategy

As discussed above, the Shyam-Sunder and Myers test, while very intuitive, has no power to distinguish between alternative hypotheses. We modify the Shyam-Sunder and Myers test in two ways. First we separately examine firms that are expected to be constrained by concerns over debt capacity and those that are not. In this way we exploit the cross sectional heterogeneity in debt capacity that exists in the sample. The contrast between these two groups is an important aspect of our empirical design. Secondly, we include as an additional independent variable the square of the financial deficit:

$$\Delta D_{it} = \alpha + \beta_{PO} DEF_{it} + \gamma DEF_{it}^2 + \varepsilon_{it} \tag{2}$$

As Chirinko and Singha (2000) illustrate, the relation between the change in debt and the financial deficit when firms face debt capacity constraints is not linear but concave. The square of the financial deficit is included in order to capture the concave nature of the pecking order relation and to capture differences in financing choice between large and small deficits.

For firms that follow the pecking order and are unconstrained by concerns over debt capacity, the original Shyam-Sunder and Myers test (equation (1)) should perform very well (a β_{PO} coefficient estimate near 1 and a high R square). There should also be little change in these results when equation (2) is estimated. In contrast, for pecking order firms that are constrained by concerns over debt capacity, the test in equation (1) should perform poorly with an estimate of β_{PO} that is far from 1 (see the discussion in Chirinko and Singha (2000)) and a low R square. For such firms, however, estimating equation (2) should result in an estimate of the γ coefficient that is negative and significant, a substantial increase in the estimate of the β_{PO} coefficient, and an increase in the R square relative to equation (1). For firms that follow the pecking order and are constrained by debt capacity, debt is used to fill small financial deficits (those that do not violate the firm's debt capacity constraint) but for larger deficits these firms use equity.

In order to demonstrate the ability of our tests to identify pecking order behavior in the presence of concerns over debt capacity we provide evidence generated using simulated data. We closely follow Leary and Roberts (2007) in simulating financing deficits and debt capacities (the simulation procedure is described more completely in the appendix) for firms that follow a pecking order in incremental financing. The parameters of the simulations are chosen to match the characteristics of the actual data. We simulate data for two sets of firms that follow the pecking order. The first set of firms is relatively unconstrained by concerns about debt capacity, while the second set of firms faces more binding debt capacity constraints. For both set of firms we simulate 10,000 observations of financing behavior that correspond to the pecking order. Specifically, if the size of the financing deficit is less than the remaining debt capacity of a given firm, the deficit is assumed to be filled entirely with debt. If the financing deficit exceeds the remaining debt capacity of the firm, then the firm is assumed to issue debt until the point of that firm's debt capacity and is assumed to fill the remainder of the deficit using equity.

Note that our financing scheme differs slightly from that used by Leary and Roberts (2007) to simulate pecking order behavior in their paper. In their simulations, Leary and Roberts treat debt capacity by assuming that if by covering the deficit for a firm entirely with debt will violate that firm's debt capacity, the entire deficit is covered with an equity issue instead. Such an assumption can be justified if the fixed cost of financing overwhelms the incremental costs generated by the asymmetric information problem motivating the pecking order. However this assumption does not correspond to the predictions of the simple or the dynamic pecking order, nor does it comport with the actual financing behavior of firms.[1]

As a basis for comparison we also simulate 10,000 observations of financing behavior under the assumption that financing policies are simply random in the sense that a coin flip determines whether the firm issues either debt or equity, where the probability of a debt issue in a given year is simply set to match the average frequency of debt issues in the subsamples. For this financing scheme the coefficient on the square of the financial deficit should be insignificant

[1] Dual issues make up a significant portion of the issues in our sample. Leary and Roberts (2007), on the other hand, report that only a tiny fraction of the issues in their sample are dual issues. This seems to be due to their identification scheme that requires an issue of debt or equity to amount to a change in assets of at least 5%. A dual issue is therefore a firm raising new capital in excess of 10% of existing assets, making them a rare event.

as the size of the deficit is unrelated to the choice of security the firm will issue. Leary and Roberts also examine this naïve financing policy as an alternative to pecking order behavior.

Table 1 presents the results of our tests using the simulated pecking order and random financing data. For each financing arrangement (pecking order and random) firms are separated into two groups, those with high levels of debt capacity and those with low levels of debt capacity. We then estimate equations (1) and (2) to illustrate the impact of controlling for the level of debt capacity and for the square of the financing deficit. Panel A presents the results for the simulated pecking order firms. The first and third columns present the estimates for the original Shyam-Sunder and Myers test (equation (1)). Two features are worth noting. First, the model fits much better for the set of firms with high levels of debt capacity. For this set of firms, the intercept while significant is close to zero and the slope coefficient on the financing deficit is 0.733. The results of the simulation closely match the findings of Shyam-Sunder and Myers (1999). Second, also as predicted, for the firms with a tight debt capacity constraint this model fits much worse. The intercept is still near zero but the slope coefficient is only 0.299. This result closely matches the findings for small firms presented in Frank and Goyal.

Panel B presents the results based on random financing. Comparing these results to the same columns in Panel A illustrates the critique of the Shyam-Sunder and Myers test raised by Chirinko and Singha (2000). In particular, the coefficient estimates on the financing deficit for both groups of firms mirror those presented in Panel A. Estimating equation (1) alone has no power to distinguish pecking order from other financing behavior.

The second and fourth columns in Panels A and B present the results of estimating equation (2) using the simulated data. As seen in the table, the addition of the square of the financing deficit as an explanatory variable in the regression results in a test that can distinguish pecking order behavior from random financing. For the low debt capacity firms, the addition of the square of the financing deficit has two effects. First, the coefficient on the financing deficit increases substantially rising from 0.299 (column 1) to 0.422 (column 2). This indicates that, as constructed, smaller deficits are more likely to be filled using debt because smaller deficits are unlikely to violate the firm's debt capacity constraint. Second, the coefficient on the square of the deficit is negative and statistically significant, indicating a concave relation between net debt issues and the financial deficit. The concavity in this relationship arises because firms facing debt capacity constraints fill larger deficits with issues of equity.[2]

For the firms with high levels of debt capacity (column 4) the addition of the square of the financing deficit has almost no impact. The coefficient on the financing deficit does not change appreciably and the coefficient on the square of the deficit, while negative is not significantly different from zero. For firms with high debt capacities, both small and large deficits tend to be filled using debt issues.

Finally, we note that the coefficient on the squared deficit can also discriminate pecking order behavior from two other financing alternatives described by Chirinko and Singha (2000). First, if the financing hierarchy is reversed, such that small financing deficits are filled using equity and large deficits are filled with debt, then the relationship between debt issues and the financing deficit will be convex and the coefficient on the square of the financing deficit will be positive. Second, if the firm always issues debt and equity in fixed proportions, then the size of the deficit does not affect financing and the coefficient on the square of the deficit will be zero.

In summary, the simulations demonstrate the importance of controlling for the level of

[2] Leary and Roberts (2007) also find that the coefficient on the square of the financing deficit is negative when a sufficient fraction of firms in their simulations are assumed to follow the pecking order. In their simulations they do not examine differences in this coefficient as a function of debt capacity, which is our focus.

debt capacity in the Shyam-Sunder and Myers test and the usefulness of including the square of the financing deficit as an additional explanatory variable in providing the test with the power to discriminate amongst competing hypotheses for incremental financing decisions.

1.2. Measuring debt capacity

Debt capacity was originally defined by Myers (1977) as the point at which an increase in the use of debt reduces the total market value of the firm's debt. More recently, Myers (1984), Shyam-Sunder and Myers (1999) and Chirinko and Singha (2000) define it as "sufficiently high" debt ratios so that costs of financial distress curtail further debt issues. The combination of debt capacity defined in these terms and the pecking order theory suggests that costs of adverse selection are dominant for "low to moderate" leverage levels but that tradeoff-theory-like forces become primary motivators of financing decisions at "high" levels of leverage. The use of this definition of debt capacity makes it more difficult to distinguish between the competing theories.

This definition of debt capacity also has no obvious empirical implementation. The only guidance given is that debt capacity is a point at which the cost of issuing additional debt increases rapidly (the expected costs of distress take a preeminent role in the financing decision for the firm at this point). This suggests that in order to empirically measure debt capacity we need a measure of the extent to which firms have relatively low cost access to debt capital.

A firm's level of debt capacity may in general be driven by both demand and supply side considerations. On the demand side, firms with more uncertain cash flows and those whose value is derived primarily from growth opportunities (Myers (1977)) will face relatively lower demand for debt financing. On the supply side, an additional factor limiting the amount a firm will be able to borrow stems from the possibility that lenders will ration some borrowers when there is asymmetric information between the firm and the market (Stiglitz and Weiss (1981)).[3]

Our primary indicator of debt capacity is therefore whether the firm has, based on its underlying characteristics, a high probability of having rated debt outstanding in a given year. Firms with rated debt are able to access the public debt market. Such firms have cash flows that are sufficiently stable, sufficiently large pools of existing collateral, and sufficient informational transparency to allow access to relatively large amounts of arms-length debt. These firms are willing to comply with the strict disclosure requirements and are able to satisfy the scrutiny of an investment bank so that it will certify a public bond offering. They also borrow in a market for which the interest rate equilibrates the supply and demand for capital. This is the implicit assumption concerning the debt market made by Myers and Majluf (1984) and so firms that are able to issue rated debt most closely conform to the assumptions underlying the pecking order.

Firms without rated debt are (for the most part) borrowing via loans from banks or other financial intermediaries. It is the firms that borrow from these "relationship lenders" who are most likely to be subject to an externally imposed debt capacity in the form of rationing. In addition to their role in solving information problems, Cantillo and Wright (2000) argue that financial intermediaries are also more efficient at reorganizing firms as compared to arm's length investors. They predict that the firms able to obtain bond ratings and borrow in the public debt markets are those with lower expected costs associated with financial distress (*e.g.*, those with more tangible assets, fewer growth opportunities, and low cash flow volatility).

The use of this proxy for debt capacity is directly supported by the theoretical results of Bolton and Freixas (2000). They present a model of capital structure and financing choice. In their model, firms may raise external financing using equity, bank debt, or via the bond market.

[3]Hellman and Stiglitz (2003) model the impact of asymmetric information on the debt and equity markets.

There is an informational dilution cost to issuing equity in the presence of asymmetric information as in Myers and Majluf (1984). When issuing debt, firms may choose between bank debt and public bonds. Banks have an advantage in minimizing costs of financial distress but face their own intermediation costs that are passed onto the borrower so bank debt is nominally more expensive than public debt. Bonds carry a lower interest rate but borrowers in the public debt market face higher costs if they become distressed. Their model results in a market segmentation in which the safest firms use the public debt market for financing, these firms have a very low probability of distress and so avoid the intermediation costs incurred with bank debt. More risky firms use the more flexible but more expensive bank debt, and the riskiest use equity.

Also consistent with the use of rated debt as an indication of debt capacity, Whited (1992) uses the existence of a bond rating as an empirical measure of whether firms are effectively constrained from using the external financial markets. Faulkender and Petersen (2006) show that, all else equal, firms without a bond rating have lower leverage ratios than firms with rated debt, which they interpret as evidence of credit rationing.

While the presence (or absence) of rated debt for a firm provides an indication of the extent to which the firm has access to relatively low cost borrowing and so suggests a relatively large (or small) debt capacity, the use of the actual presence or absence of a bond rating as a measure of debt capacity is problematic. We are particularly worried about firms without bond ratings that have chosen to rely on equity financing (perhaps for reasons outside of the pecking order) despite having the capacity to issue rated debt. To identify such firms as being constrained by concerns over debt capacity is a mistake, and would bias our results in favor of the pecking order. To minimize these concerns we use a predictive model of whether a firm has rated debt outstanding as the primary indication of the extent of a given firm's debt capacity.

A final complication is that dynamic versions of the pecking order suggest that it is the distance a firm is from its debt capacity that is of interest. This distance is difficult to measure and the likelihood of having rated debt is a noisy proxy of this quantity. However, to the extent that our proxy misclassifies firms with a large debt capacity but high current leverage as being unconstrained by concerns over debt capacity or firms with small debt capacity but little or no leverage as being constrained, its use will generate a bias against the predicted outcomes.

As robustness checks we also perform all analysis using two alternative indicators of the size of a firm's debt capacity, the volatility of a firm's stock return in a given year as a proxy for the volatility of its cash flows and firm age. As discussed above, cash flow volatility should be an indication of both the extent to which a firm desires to borrow and the desirability of that firm as a borrower. Firm age is used as a measure of the informational transparency of the firm and the predictability of its cash flow, indications of lenders' willingness to lend. Both of the alternative proxies are suggested by Bolton and Freixas (2000).

2. Data

The data consist of all firms on both the CRSP and Compustat databases for the period 1971-2000. We begin in 1971 because we require flow of funds data to compute the financing deficit and this data is not available prior to 1971. Using the flow of funds data, we follow Frank and Goyal (2003) and compute the financing deficit as the sum of internal cash flow, the change in working capital, investments, and cash dividends.[4] By definition, the financing deficit is equal to the sum of net debt (data 111 - data 114) and equity issues (data 108 - data 115). In contrast, Shyam-Sunder and Myers (1999) also include the current portion of long-term debt as part of the

[4]The individual Compustat variables used to compute the components of the deficit vary by format code (as reported in Compustat). See Frank and Goyal (2003) for details on computing individual components of the financing deficit.

financing deficit beyond its role in the change in working capital. Frank and Goyal find empirically that the current portion of long-term debt should not be included as part of the deficit, and we follow their definition here. We exclude regulated (SICs 4900-4999) and financial (SICs 6000-6999) firms and firms with minimum total assets less than $1 million or minimum sales less than zero. We further exclude individual firm-years with missing values for the financing deficit and net debt or equity issues. The financing deficit and net security issues are scaled by book assets (data 6) at the end of the previous year. In order to reduce the impact of outliers on the results, we eliminate firm-year observations for which the financing deficit or net issues of debt or equity are greater than 200% of the firm's total book assets at the end of the previous year. For each firm year, we also compute leverage as the ratio of long-term debt (data 9 + data 44) to total assets.

We also use a number of variables that have been identified as affecting leverage in the previous literature on capital structure (*e.g.*, Rajan and Zingales (1995), Frank and Goyal (2003), and Fama and French (2002)). Asset tangibility is measured as the ratio of property plant and equipment (data 8) to total assets. Firms with more tangible assets are expected to have lower costs associated with financial distress. The market-to-book ratio ((data 6-data 60+data 24*data 25)/data 6) is used as a proxy for growth opportunities. Myers (1977) argues that firms with more growth opportunities have a greater potential for underinvestment problems arising from the use of debt. Profitability is measured as the ratio of operating profits (data 13) to total assets. Prior research has found an inverse correlation between profitability and leverage, which has often been interpreted as evidence in favor of the pecking order (*e.g.*, Fama and French (2002)). As a proxy for the volatility of a firm's cash flow in a given year we use the volatility of that firm's daily stock returns during the year. Cash flow volatility and stock price volatility should be tied by pricing in the equity market. Empirically, for a subset of firms with sufficient data to accurately measure cash flow volatility, we find that the rank correlation between these two volatility measures is 0.53.[5] All else equal, a firm with more volatile cash flows can borrow less either because the debt overhang problem (Myers (1977)) is more severe or because it is more likely to be unable to meet the payments on its debt obligations.

Finally, firm age is measured as the age of the firm relative to the first year the firm appears on Compustat. We also create a variable indicating whether a firm has rated debt outstanding in a particular year as recorded by Compustat. This variable (data 280) is only available beginning in 1986. Our final sample is comprised of 67,200 firm-year observations.

2.1. Estimating debt capacity

As discussed above, our main measure for debt capacity is based on the probability a firm has rated debt outstanding in a given year. In order to measure this probability we estimate a logit model in which the dependent variable is one if a firm has rated debt outstanding in a particular year and zero otherwise. The estimation uses data from 1986-2001; the part of our sample period for which bond ratings are available in Compustat. The firm characteristics used in the logit regression are firm size (log of total assets), profitability (ROA), the fraction of total assets that are tangible, the market to book ratio, leverage, firm age (the natural log of the number of years since the firm first appeared on compustat), the standard deviation of stock returns, and, in one version, industry dummies for each 2-digit SIC code in the sample.[6] All of the independent variables are lagged one period to reduce problems associated with endogeneity. Smaller and younger firms are likely to have a shorter track record and be more opaque from the

[5]Measuring cash flow volatility directly is problematic because in a given year many firms will have relatively few past observations of cash flow with which to estimate its volatility. Using quarterly Compustat data we compute the volatility of a firm's return on assets for a subsample of our firms using at least 8 and as many as 12 quarters of data.

standpoint of lenders, suggesting that they will be less likely to have bond ratings. Smaller firms face proportionally higher fixed costs of issuing bonds in the public debt markets (*e.g.*, Altinkilic and Hansen (2000)). To the extent that relationship lenders are more efficient at *ex post* monitoring and restructuring in the event of distress (*e.g.*, Cantillo and Wright (2000)), we expect that firms that are likely to face higher costs of financial distress and distortions to their investment policy, such as those with high volatility, fewer tangible assets, and high market-to-book ratios, will be less likely to have a bond rating. Finally, all else equal, more profitable firms are better able to make required payments to debtholders and so can support more debt, and firms with more debt outstanding have proven their ability to borrow.

Table 2 presents the results of the logit regressions. Robust t-statistics that are corrected for nonindependence of observations within a firm are reported in parentheses below the regression coefficients. Model (1) shows that firm size, firm age, the standard deviation of stock returns, the market-to-book ratio, and leverage have the expected signs and all are significant predictors of the likelihood that a firm has a bond rating. Interestingly, the financial constraints literature also identifies firm size and firm age as proxies for the general level of financial constraints facing a firm, lending further support to the use of our model for the likelihood of having rated debt as a measure of whether a firm is constrained or unconstrained by concerns over debt capacity. The model fit as measured by the pseudo R-squared is 0.52. Model (2) shows that inclusion of industry effects improves the fit of the model only slightly.

The estimated coefficients (based on data from 1986-2001) from Model (1) are used to obtain an estimated probability that a given firm has rated debt for each year in the period 1971-2001. Beyond minimizing the potential bias associated with using the actual presence of rated

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[6]The independent variables are similar to those used in a Faulkender and Peterson (2006).

debt, this approach also allows us to begin our sample period in 1971 (when the statement of cash flow data becomes available) rather than in 1986 (when bond ratings are first reported in Compustat). In each year we form three quantiles based on the predicted probability of having a bond rating. The low quantile contains firms in the lowest third of predicted probabilities of having a bond rating based on their characteristics, and the high quantile contains firms in the highest third of predicted probabilities of having a bond rating.

Table 3 presents summary statistics for subsamples of firms based upon whether they have a low or a high probability of having rated debt outstanding. The data is consistent with the idea that concerns over debt capacity drive financing behavior. The most notable differences between the subsamples are that, firms with a high probability of having rated debt outstanding (high predicted bond rating) have lower average financing deficits, finance these deficits much more heavily with debt financing, and on average grow more slowly than firms with a low probability of having a bond rating (low predicted bond rating). The lower growth rates and smaller financing deficits for firms in the high predicted bond rating group means that these firms can finance a larger proportion of their financing deficits with debt without significantly increasing their leverage ratios (so approach their debt capacities much more slowly), while those firms in the low predicted bond rating group would experience a significant change in their leverage ratios by issuing debt to fund their financing deficits. To illustrate this concretely, we calculate a variable labeled predicted leverage change that measures the change in leverage that would occur if firms financed their entire deficit with debt. Table 3 shows that, on average, firms in the high predicted rating group would see their leverage ratios increase by 1.0% if they followed a strict pecking order, while those in the low predicted bond rating group would see an annual increase in their leverage ratios of 6.5% on average.

3. Testing the pecking order with debt capacity

Based on our simulation results we present tests of the pecking order with debt capacity using our predicted debt ratings groups and the augmented Shyam-Sunder and Myers regression in equation 2. Under the pecking order, holding the size of the financing deficit constant, firms with less restrictive debt capacity constraints will use more debt to fill their external financing needs. Holding debt capacity constant, firms should use more debt to fund small deficits, but will increasingly turn to equity when external financing needs are large.

Table 4 presents the results of these tests. The first column in the table presents the results of the basic Shyam-Sunder and Myers test of the pecking order on those firms most likely to be constrained by debt capacity considerations (those in the low predicted bond rating group). As expected, the Shyam-Sunder and Myers test performs particularly poorly for this set of firms. The estimate of the slope coefficient on the financing deficit is only 0.30 and the R-squared indicates that the financing deficit explains only 29% of the variation in net debt issues.

The second column in table 4 considers the same firms but extends the Shyam-Sunder and Myers test by including the squared deficit as an additional independent variable in order to consider differences in the behavior of firms facing “small” and “large” financing deficits. The results are consistent with the predictions of the pecking order theory in the presence of concerns about debt capacity. The slope coefficient on the financing deficit increases significantly to 0.53, indicating that “small” deficits are financed by about half debt and half equity. The coefficient estimate on the squared deficit is -0.24, indicating that these firms rely much more heavily on equity financing when deficits are “large”. The R-squared of the regression increases to 0.34.

An interesting contrast to these results is presented in the final two columns of Table 4, which examines the subsample of firms with the highest likelihood of having a bond rating.

These columns show that for a very large cross-section (and a long time series) of firms that are predicted not to face debt capacity constraints, the financing deficit explains debt issues very well. In the basic Shyam-Sunder and Myers test the slope coefficient is 0.750 and the R-squared is 75%.[7] When the squared deficit is included, the slope coefficient on the deficit increases to 0.793. The coefficient on the squared financing deficit is significantly negative but is small in magnitude (-0.076), indicating that, for those firms least likely to be constrained by debt capacity, debt is the primary security used to fill the financing deficit, even "large" deficits.

The medium predicted rating group exhibits behavior that lies between that of the low and high predicted rating groups. Overall, the results presented in Table 4 indicate that the use of debt and equity across groups conforms well with the predictions of the dynamic pecking order theory. The more restrictive is a firm's debt capacity constraint the greater the firm's observed dependence on external equity financing. Further, for a given level of debt capacity, the firm's reliance on external equity financing increases with the size of the financial deficit. Finally, it is worth noting that the results closely mirror those estimated using the simulated financing data that assumes firm's follow the pecking order in the presence constraints imposed by consideration over debt capacity.

To examine the robustness of our conclusions, Table 5 Panel A considers these same regressions dividing the sample into three groups based upon the firm's stock return volatility as an alternative measure of debt capacity. At the beginning of each calendar year we form three groups based on the prior year's stock return volatility. The low volatility group contains firms in the lowest quartile of volatility in each year, and the high volatility group contains firms in the

[7] In contrast to Frank and Goyal (2003), we find little evidence that, for firms unconstrained by debt capacity, the pecking order performs worse in the latter half of the sample period. For firms in the high predicted rating group, the slope coefficient in the regression is 0.793 in the pre 1986 period and 0.746 in the post-1986 period.

highest quartile. The medium volatility group contains the remaining firms.[8] The firms with the tightest debt capacity constraint are expected to be those with the highest levels of stock return volatility, our proxy for cash flow volatility. The results are very similar to those reported based on the predicted bond rating groups. In the highest volatility group, the slope coefficient in the basic Shyam-Sunder and Myers regression is 0.40. As in the Table 4 regressions, for the most constrained firms, including the squared deficit term improves the fit of the regression and increases the slope coefficient on the financing deficit substantially. The estimated coefficient on the deficit is 0.61 when the squared deficit is included, again indicating that, even for the most constrained firms, when the level of the deficit is low the predominant form of external financing is debt. The estimated coefficient on the squared deficit is -0.23, indicating that when the deficit is "large" for constrained firms, much more emphasis is placed on the use of external equity.

For the least constrained firms, the lowest volatility group, the basic Shyam-Sunder and Myers regression fits very well. The estimated slope coefficient is 0.74, indicating a heavy reliance on the use of debt financing. In this group the inclusion of the squared deficit does not have a significant impact on the regression. This indicates that for firms with the least volatile cash flow, even large deficits are filled predominantly with debt financing. Finally, note that the same pattern across the groups appears, with the use of equity financing increasing as the firms are more constrained by debt capacity or face greater requirements for external financing.[9]

Panel B of Table 5 presents the same regressions using firm age to proxy for debt capacity. At the beginning of each calendar year we form three groups based on firm age. The

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[8]We also considered asset volatility computed by multiplying equity volatility by the ratio of equity to total assets. The results were similar. The results are also robust to different cutoffs for dividing the firm-years into subsamples.

[9]As an additional robustness check we also allowed for differing coefficients for positive and negative deficits. The inferences were unchanged from those reported.

low age group contains firms in the lowest quartile of firm age in each year, and the high age group contains firms in the highest quartile. The medium age group contains the remaining firms. The firms with the tightest debt capacity constraint are expected to be the youngest firms. Again, the results conform closely to our predictions. In the low age group, the slope coefficient in the basic Shyam-Sunder and Myers regression is 0.36. Including the squared deficit term improves the fit of the regression and increases the slope coefficient on the financing deficit substantially to 0.57. The estimated coefficient on the squared deficit term is -0.21.

For the least constrained firms, the high age group, the basic Shyam-Sunder and Myers regression fits very well. The estimated slope coefficient is 0.77, indicating a heavy reliance on the use of debt financing. In this group the estimated coefficient on the deficit squared term is positive but quite small. As is the case with the other measures of debt capacity, firms in the middle group exhibit behavior intermediate to those of the other two groups.[10]

4. Distinguishing the Pecking Order from the Tradeoff Theory

Once consideration of debt capacity is taken into account in the pecking order it becomes more difficult to distinguish it from a dynamic version of the tradeoff theory with adjustment costs (*e.g.*, Fischer, Heinkel, and Zechner (1989)). For firms with high levels of leverage (firms at or near their debt capacity or near the upper level of their adjustment bounds) the behavior predicted by both theories is that they will seek to reduce their leverage.

The two theories provide contrasting hypotheses, however, for highly profitable firms

[10] As a final robustness check we sorted the subsamples of firms based on the predicted bond rating measure (low, medium and high) into small and large firms. Within both the small and large firm subsamples the results of the estimation show that as the probability of the firm having a bond rating rises, the firms behave as if they are less constrained by debt capacity. The results of this exercise also show that the predicted bond rating measure has informational content beyond simply as a proxy for firm size. These results are not reported for the sake of brevity.

that are far below their debt capacities. The pecking order theory, both static and dynamic, suggests that profitable firms with low leverage have no incentive to increase their leverage. Such firms will prefer instead to "stockpile" debt capacity for the future as long as internal funds are sufficient to fund the firm's investment needs. Conversely, the dynamic tradeoff theory predicts that in such situations new debt financing would be preferred to an increased use of (internal) equity when the benefits of increased leverage outweigh the adjustment/transactions costs. Specifically, highly profitable firms with very low leverage will actively re-balance their capital structures; increasing their leverage to take advantage of the valuable tax deductions associated with debt financing.

To directly test the tradeoff theory against the pecking order we attempt here to capture the dynamic nature of the decision to increase leverage. Our approach is to consider the financing behavior of firms over a significant time period as opposed to examining their behavior annually. To do so, we form six non-overlapping five-year panels beginning in 1971.[11] We allow firms to enter and exit each panel, but require a firm to have three years of data within a panel for its inclusion in our final analysis. Leary and Roberts (2005) find that firms actively adjust their capital structures on average about once a year. This suggests that a five-year horizon should be more than sufficient to allow for the infrequent adjustment in capital structures implied by the dynamic tradeoff theory.

For each firm in the panel we compute its debt ratio the year it enters the panel and the last year it appears in the panel. Over the years the firm is in the panel, firm specific averages of size, profitability, market-to-book, and asset tangibility are computed. For each firm we also

[11]Note that the last panel contains six years. The choice of five years as the time frame is somewhat arbitrary. We have checked the robustness of this choice and the qualitative results do not change with an increase or decrease in the length of the panels by one year.

create a measure of the firm's actual leverage relative to the leverage of similar firms at the time it enters the panel.[12] This model is used to generate an indicator variable that indicates whether a firm has low (the relative leverage measure is divided into three equal quantiles and those firms with relative leverage in the lowest quantile are labeled low relative leverage) or high relative leverage (all other firms) at the beginning of the panel. The low debt indicator is intended to identify those firms far below their target or expected leverage that should have the largest potential benefits from increasing their leverage. Further we create an indicator variable for firm size that also indicates whether a firm is big (in the largest third of firms based on the level of book assets at the beginning of a panel) or small (all other firms). The size variable serves as a proxy for the relative level of transaction costs for new issues of debt. Altinkilic and Hansen (2000) show that the largest firms have issue costs that are about a third the size of those of small firms. Thus, the big firm indicator should identify firms with the lowest adjustment costs.

Table 6 presents a regression analysis of the five-year change in leverage on average profitability and several control variables. As controls we include firm size, market-to-book, and asset tangibility, all measured as firm specific averages over a given panel. We also include the firm's leverage ratio at the beginning of the panel to account for mean reversion in leverage arising from the fact that leverage ratios are bounded between zero and one. To directly test the tradeoff theory prediction that firms with very low leverage and low adjustment costs will be more likely to seek to add debt the higher are their profits we include interactions of profitability with the low relative leverage indicator, and the big firm indicator variables.

[12]Specifically, the firm's relative leverage is the residual from a cross-sectional regression of the debt-to-assets ratio on lagged firm size, market-to-book, asset tangibility, profitability, and the probability that the firm has a bond rating from our predicted model of ratings in Table 2. The regression also includes indicators for each two-digit SIC code. The results are unchanged if we instead use the firm's leverage relative to the industry median.

In this specification, the coefficient on profitability alone measures the effect of profitability on the change in debt ratio for small firms that enter the panel with debt ratios near or above their predicted levels. Both the tradeoff and pecking order theories predict that this coefficient will be negative. The coefficient on the interaction term between profitability and the low debt indicator captures the added effect of profitability for small firms that enter a panel with debt far below their predicted values. The tradeoff theory would suggest a positive coefficient on this interaction term as very low leverage firms should be more likely to increase their leverage to take advantage of the benefits of debt. In contrast, the pecking order predicts that these firms will not exhibit any preference for increasing leverage when profitability increases, but will instead prefer to stockpile additional debt capacity. The coefficient on the interaction between profitability and the large firm indicator captures the additional effect of profitability for very large firms that enter the panel near or above their predicted leverage. The dynamic version of the tradeoff theory suggests a negative coefficient on this term as larger firms with low issuance costs are predicted to be more aggressive about moving toward their target leverage when they have high expected profits as compared to firms with higher issuance costs (small firms). The pecking order also predicts a negative coefficient estimate on this variable. Finally, the interaction between profitability, the low leverage indicator, and the big firm indicator captures the incremental effect from profitability for the largest firms who enter a panel far below their predicted leverage. The dynamic tradeoff theory, predicts that the coefficient estimate on this variable will be positive. Large, low leverage firms are far below their predicted values of leverage and face the smallest transaction costs for new issues of debt. As profitability increases these firms should exhibit the largest net benefits from an increase in leverage relative to the other firms. Again, the pecking order predicts that these firms will not exhibit strong incentives to increase leverage as profitability increases.

The regression results are reported in Table 6.[13] The coefficient on average profitability is reliably negative as is the coefficient on the interaction between profitability and the big firm indicator. Consistent with both the pecking order and tradeoff theories, these estimates support the notion that firms (small and big) with relatively high initial leverage use profits to reduce their leverage over time. The estimated coefficient on the interaction term between the low debt indicator and profitability is positive but small and is insignificantly different from zero. This implies that the impact of profitability on leverage does not differ between small firms that enter the panel near or above their predicted leverage (their beginning leverage averages 23% and these firms are on average 6% above their predicted leverage levels) and those who enter the panel far below their predicted leverage (average beginning leverage for these firms is 6% and they are 15.5% below their predicted leverage on average). Small firms, however, have relatively large transactions costs for new issues of debt (Altinkilic and Hansen (2000)) and so this finding is not necessarily inconsistent with the dynamic tradeoff theory.

Finally, the estimated coefficient on the interaction term between profitability, the low leverage indicator and the big firm indicator is reliably negative. This result suggests that those firms with the greatest incentive as well as the lowest cost to increasing their use of debt actually see their leverage drop faster with added profits than do firms with higher transactions costs and

[13]It is more common to allow for different intercepts for each of the groups (i.e. high leverage, large firms, etc.) however doing so makes the presentation of the results more difficult to discuss. Unreported analysis shows that the same conclusions are drawn from the more common specification and differences in the responses of leverage to profitability across the groups have the same significance as those reported here. As a further robustness check, we repeat the analysis using the values of the explanatory variables at the beginning of each panel. So long as the levels of the variables are persistent, the beginning of period values should be a reasonable proxy of expectations for the future. The results are qualitatively the same as those reported. All else equal, for low leverage firms, there is a negative correlation between profitability and the change in the leverage ratio, and the negative relationship between profitability and leverage exists for both firm size groups.

already high leverage. This finding is difficult to reconcile with the dynamic tradeoff theory, but is consistent with the pecking order's prediction that firms will attempt to stockpile debt capacity by using internal funds for investment.

Model 2 in Table 6 repeats the analysis including a measure of the marginal tax rate computed by Graham (1996) to directly control for tax effects. The coefficient estimate on the marginal tax rate is positive, but not statistically significant. The results regarding the effects of profitability on leverage are unchanged from Model 1.

In sum, the results presented in Table 6 provide evidence that internally generated funds are the preferred source of financing, regardless of existing leverage and expected profitability. They also suggest that taxes are not a primary motivator of financing choice. Firms stockpile debt capacity by using internal equity when profits are sufficient to fund asset growth. Moreover, even firms with low initial leverage and low costs of issuing debt use excess profits to reduce their leverage ratios over time. These findings are difficult to reconcile with the tradeoff theory, but are consistent with the pecking order theory.

5. Asymmetric Information, Debt Capacity, and Financing Choice

The pecking order is derived based on the underlying assumption that costs of asymmetric information drive firms' financing choices. Based on this, Frank and Goyal (2003) and Fama and French (2002) argue that firms with more asymmetric information should follow the pecking order more diligently. These studies cite the finding that small, high-growth firms are the predominant issuers of equity and the evidence that the Shyam-Sunder and Myers test performs poorly on a sample of small, high-growth firms and well on a sample of large, mature firms as inconsistent with the pecking order. Their conclusions are based on the observation that the former group of firms should face larger problems of asymmetric information than the latter.

While this intuition is appealing, note that the model predicting whether a firm can issue rated debt finds firm size, age, and volatility to be major predictors of whether a firm will have rated debt outstanding. Thus small and/or young firms are much more likely to be constrained by debt capacity concerns. Additionally, high-growth firms with significant external financing needs, all else equal, are moving towards their debt capacities more quickly. The recognition that small, high-growth firms may have greater concerns over debt capacity implies that finding frequent equity issues by such firms is not necessarily contradictory to the pecking order.

It is also true that the theoretical basis of the Myers and Majluf (1984) argument, the foundation of the pecking order theory, is the wealth loss to existing shareholders from new equity issues. This cost is derived from a comparison of the cost due to asymmetric information concerning the assets in place versus the expected value of the firm's growth options. While small, high-growth firms can reasonably be expected to have greater amounts of asymmetric information with respect to their assets in place than do large, mature firms, they can also reasonably be expected to have more valuable growth options relative to the value of assets in place. If they have growth options that are significantly more valuable (relative to the assets in place) than the growth options of large firms, then small firms, according to the Myers and Majluf (1984) model, will face lower adverse selection costs associated with an equity issue.

To explore how debt capacity concerns and costs of adverse selection might affect financing behavior, we begin by presenting a characterization of firms that issue significant amounts of new equity. Table 7 presents summary statistics for firms sorted into three groups based upon their estimated probability of having a debt rating.[14] These groups are further sorted

[14] If we instead use firm age or volatility as a measure of debt capacity the same results are obtained.

into those firms that issue significant amounts of equity in a given year and those that do not. Using the Compustat data, we define a significant issue of equity as an issue that equals or exceeds five percent of the value of the firm's total assets at the end of the previous period.[15] We refer to these firms as "issuers" for simplicity.[16]

For the subsample of firms most likely to face debt capacity constraints (the low predicted rating group) we find significant differences in the characteristics of issuers and non-issuers. Most dramatically we see that the issuers of significant amounts of equity are, on average, growing very fast (average growth in assets is 49.8% annually as compared to 10.6% for the non-issuers). Further, this growth is largely dependent upon external financing (the average deficit for issuers is 42.9% and their average return on assets is -2.4%).

Issuers also have relatively low leverage measured both by the 13.4% book leverage and an excess leverage (relative to the predicted value from the cross-sectional regression) of -6.0%. Although they have low leverage prior to the issue, the predicted leverage change (the change in the firm's book leverage ratio that would occur if their deficits completely financed with debt) of 29% is quite large, indicating that if these firms used only debt financing their debt ratios would on average increase from about 13% to over 42%. Given their growth and profitability, such an increase in leverage would likely violate any reasonable expected level of debt capacity.[17] In contrast, the financing choices made by these firms result in the actual change in leverage for

[15]The five percent cutoff for identifying issuers with Compustat data has also been used by Hovakimian et al. (2001), Korajczyk and Levy (2003), and Leary and Roberts (2004).

[16]All of the differences in means between issuers and nonissuers of the variables reported in Table 6 are significant at the five percent level with the exception of lagged total assets and lagged property plant equipment for the low predicted rating group and lagged property plant equipment for the medium predicted rating group.

[17] Leary and Roberts (2007) find that, based on a comparison of ex ante firm characteristics, firms issuing equity in violation of the pecking order are predicted to be able to borrow at rates near those in the public debt markets. Based on this they argue that most violations of the pecking order by equity issuers are for reasons not related to debt capacity. Our findings suggest that small firms that issue equity would very likely violate their debt capacities were they to use debt rather than equity.

being essentially zero. The non-issuers, on the other hand, have a predicted leverage change of only 2.7% and an actual leverage change of 1.7%. Finally, compared to non-issuers, the issuers are smaller ($16.7 Million in assets vs. $17.4 Million), younger (6.3 vs. 9.2 years), have higher market-to-book ratios (3.4 vs. 1.6), and higher volatility of stock returns (0.84 vs. 0.71). Given their characteristics, it is not surprising that these firms use equity rather than debt financing.

The firms with medium and high estimated probabilities of having a bond rating should be less likely to be rationed by lenders, but may be reluctant to pursue further borrowing because they are unable to support additional debt. Consistent with this view, the issuing firms in these groups are growing much more rapidly and have significantly higher leverage prior to the issue than the non-issuers. As a specific example, consider the firms in the high predicted rating group. Within this subsample, the firms issuing significant amounts of equity have leverage of 37.8% and excess leverage of 10.4%. The predicted change in leverage (based on no new equity) is 7.4%, which would push these firms, on average, to a book leverage of 45%. Instead, the actual financing choices made by these firms result in *reductions* in their book leverage ratios by an average of 5.1%. In contrast, firms not issuing significant amounts of equity have average leverage of 29% (2.2% excess leverage) and a predicted leverage change of 0.5%. This predicted leverage change is very close to their actual change in leverage of 0.4%.

Finally, note that across all three groups of firms, there is a clear pattern comparing issuers versus non-issuers. Issuers are younger firms that are growing much more rapidly. They also have more volatile stock returns (indicating more volatile cash flows) and are less profitable. In the highest and lowest groups, the issuers are also smaller firms, on average, with the issuers and non-issuers being of about equivalent size in the medium group. These results suggest that those firms who issue the majority of external equity can be classified as constrained by concerns over debt capacity, and provide a reconciliation of the results in Fama and French (2002) and Frank and Goyal (2003) with the pecking order.

Lastly, we examine whether small, high-growth firms, which we argue are those most likely to be constrained by considerations of debt capacity, face higher or lower adverse selection costs associated with equity issues as measured by the market reaction to the announcement of an equity issue.[18] To the extent that small, high-growth firms have significant growth opportunities and are constrained from issuing debt, the market should react less negatively to the announcement of an equity issue for these firms. In order to measure the cost of an equity issue we examine announcement effects for all issues of seasoned equity for firms in our sample with announcements of equity issues reported in the SDC database between 1980 and 2001.[19] We measure the three-day cumulative abnormal return (CARs) around equity issue announcements relative to a market model estimated over the 200-day period ending 21 days prior to the announcement of the equity issue. The final sample consists of 2,275 equity issue announcements, and the average three-day announcement CAR in the sample is -0.026.

The first two columns of Table 8 present the results of cross-sectional regressions explaining the announcement CARs using firm size, the market-to-book ratio, leverage, the fraction of secondary shares in the issue, and indicators for each sample year as control variables. We create an indicator variable equal to one for firms in the low predicted bond rating group. In addition to identifying the firms most likely to be concerned about debt capacity, the summary statistics presented in Table 7 clearly indicate that firms with the lowest estimated probability of

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[18]In an empirical examination of the Myers and Majluf (1984) model Korajczyk, Lucas, and McDonald present evidence consistent with the idea that announcement effects are driven by adverse selection.
[19]Note that the SDC sample contains fewer equity issues than in Table 6. This is because Table 6 defines equity issues based on the statement of cash flows, and includes equity transactions, such as private equity issues and debt conversions, beyond those reported in SDC. Hovakimian, *et al.* (2001) discuss this issue in more detail.

having a bond rating are also the smallest, youngest, and fastest growing firms. An examination of their costs of issuing equity relative to other firms will indicate the validity of the intuition that firms in this group have the greatest exposure to problems of asymmetric information and therefore, should follow the predictions of the static pecking order more closely.

The first column in Table 8 examines the full sample of equity issuers, while the second estimates the regression on a sample restricted to include only those firms that make significant issues of equity (based on the 5% cutoff used previously). In both cases we see that, on average, the constrained firms have less negative market reactions to announcements of equity issues compared to other firms. All else equal, the firms in the low predicted rating group see their stock prices fall by about 1% less relative to other firms at the announcement of an equity issue. Columns three and four repeat the analysis, but use a different dependent variable to measure the market reaction to an issue of equity. The result in Myers and Majluf (1984) is driven by the wealth loss to existing shareholders rather than simply the CAR. We follow Stein (1992) and compute the dollar loss to existing shareholders (equal to the market value of equity prior to the issue multiplied by the CAR) scaled by the proceeds of the issue.[20] Based on this measure of the cost of an equity issue we again see that firms in the low predicted ratings group face lower costs compared to other firms at the announcement of an equity issue. On average, the existing shareholders of firms in the low predicted rating group face a cost associated with a new equity issue that is $0.085 (per dollar raised) lower than do the shareholders of other issuing firms.

The results are consistent with three interpretations. The first is that although the small, high-growth firms in the low predicted rating group may face more asymmetric information concerning the value of their assets in place, they also face relatively more valuable investment

[20]If we do not scale by the proceeds of the issue the same qualitative results are obtained.

opportunity sets. The second is that the market realizes that, due to the constraint imposed by debt capacity, the firm has little or no flexibility in its choice of financing instruments and so the announcement of an equity issue is less of a bad signal than it would be for a similar firm that could also choose to issue low risk debt. Last, if small, high-growth firms are better at "timing" their equity issues we would expect to see this pattern. It is difficult to control for timing ability, however, given the differences in growth rates (which is correlated with the demand for external financing) between these firms and the rest of the sample, the small, high-growth firms should also have less flexibility in choosing when to issue than more mature firms.

As a final point, some caution should be used in interpreting these results as we only observe the market reactions of those firms that have chosen to issue equity. This selection bias makes it less likely for us to find any significant differences across the groups of firms. Nonetheless, our results provide a rationale within the pecking order framework for the frequent equity issues by small, high-growth firms, which others have posed as a challenge to the theory.

6. Conclusion

We demonstrate the importance of controlling for debt capacity and the rate at which the firm expects to use external financing when testing the pecking order theory. When this is done, we find that the pecking order theory is a good descriptor of the observed financing behavior of a broad cross-section of firms. The finding that, on average, large, profitable, low leverage firms use internally generated funds to finance their growth and allow their leverage ratios to drop over an extended period is consistent with the pecking order. The fact that those firms with the most to gain and the least to lose from an increase in leverage allow their leverage to fall when profits are high is difficult to reconcile with the tradeoff theory. By closely examining the small, high-growth firms that issue equity we show that equity may be their only option. We also present evidence from market reactions to equity issues that are consistent with the observed patterns of equity issuance across large, mature and small, high-growth firms.

An issue left to future research is the interaction between the growth in assets, profitability, and financing. We have implicitly assumed that asset growth and profitability are exogenous to the financing decision in this analysis. Theoretically, with perfect markets, this would be correct. Once one assumes a role for capital structure, however, we are necessarily removed from the Modigliani and Miller world, and it would be interesting and important to consider the link between a firm's financing and capital budgeting decisions.

Appendix
Pecking Order Simulations

The pecking order with debt capacity assumes that a given financing deficit will be filled with debt up to the point that a firm exhausts its debt capacity and the remainder will be filled using equity. Formally:

$$Debt_{it} = \begin{cases} Def_{it}\ , if\ \ Def \leq D^*_{it} \\ D^*_{it}\ ,\ \ if\ \ Def_{it} > D^*_{it} \end{cases} \qquad \text{(A1)}$$

where $Debt_{it}$ is the amount of debt issued, Def_{it} is the financing deficit, and D^*_{it} is the incremental debt capacity of firm i in period t. To simulate data we parameterize the simulations by specifying the first and second moments of the financing deficit and debt capacity. Specifically, we require estimates of the mean vector of $(Def_{it}\ , D^*_{it})$ and of the covariance matrix, which we denote by

$$V = \begin{bmatrix} \sigma^2_{Def} & \sigma_{Def\,,\,D^*} \\ \sigma_{Def\,,\,D^*} & \sigma^2_{D^*} \end{bmatrix} \qquad \text{(A2)}$$

The financing deficit is observable, and we choose the first and second moments to match the estimates computed from the data. Debt capacity is unobservable, but the amount of debt actually issued, $Debt_{it}$, is observable. Therefore we choose the first and second moments of D^*_{it} and the correlation coefficient between the financing deficit and debt capacity such that the first and second moments of debt issues as parameterized in equation (A1) match the moments in the actual data. We parameterize the simulations separately for two sets of firms using our measure of debt capacity based on the likelihood of having a bond rating. Specifically, we simulate financing decisions for firms in the lowest third (low debt capacity) and firms in the highest third (high debt capacity) of the distribution of predicted bond ratings. We simulate 10,000 financing decisions for each group of firms by drawing observations for the financing deficit and for debt capacity from a multivariate normal distribution. For each draw of the financing deficit and debt capacity we simulate a debt issuance decision that corresponds to the pecking order as parameterized in equation (A1).

In addition to the financing behavior simulated under the pecking order we follow Leary and Roberts (2007) and also simulate financing behavior under a random financing rule. Specifically, for each draw of the financing deficit we simulate a debt issuance decision according to the following rule

$$Debt_{it} = \begin{cases} Def_{it}, if \ \tilde{U} \leq \overline{C} \\ 0, \quad if \ \tilde{U} > \overline{C} \end{cases} \tag{A3}$$

where $\tilde{U}$ is a draw from a uniform (0,1) distribution and $\overline{C}$ is a parameter that we choose such that the proportion of debt and equity issues match those in the sample. Under the random financing rule, the firm's financing decisions are independent of its debt capacity.

The simulated financing data under both financing rules, pecking order and random is then used to estimate the Shyam-Sunder and Myers (1999) regression in equation (1) and our augmented version of the regression in equation (2). The results are reported in Table 1.

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Table 1

Shyam Sunder-Myers regressions based on simulated financing behavior under the pecking order with debt capacity and under random financing.

Panel A. Simulated Financing Behavior Under Pecking Order With Debt Capacity				
	Dependent Variable is Net Debt Issued			
Variable	Low Debt Capacity		High Debt Capacity	
Intercept	0.018	0.006	-0.006	-0.007
	(11.69)	(2.67)	(-6.06)	(-4.66)
Financing Deficit	0.299	0.422	0.733	0.736
	(57.14)	(28.36)	(175.07)	(61.67)
Squared Financing Deficit	---	-0.180	---	-0.006
		(-8.80)		(-0.31)
N	10,000	10,000	10,000	10,000
R-Squared	0.246	0.252	0.754	0.754

Panel B. Simulated Financing Behavior Under Random Financing				
	Dependent Variable is Net Debt Issued			
Variable	Low Debt Capacity		High Debt Capacity	
Intercept	0.003	0.001	0.006	0.005
	(1.35)	(0.29)	(0.33)	(1.84)
Financing Deficit	0.300	0.322	0.746	0.700
	(39.05)	(14.67)	(102.93)	(33.90)
Squared Financing Deficit	---	-0.030	---	0.079
		(-1.03)		(2.35)
N	10,000	10,000	10,000	10,000
R-Squared	0.132	0.132	0.514	0.515

Table 2

Logit regressions predicting bond ratings. The dependent variable is an indicator equal to one if the firm has a bond rating from Compustat in that year. The independent variables include the natural log of total book assets, return on assets, the fraction of total assets in property plant and equipment, the market-to-book ratio and leverage,. All explanatory variables are lagged one period. Model (2) includes indicator variables for each two-digit SIC code. The initial sample consists of 67,200 firm-year observations from the period 1971-2001. The subsample of firms used in the regressions is from 1986-2001, the time period that bond ratings are available on Compustat. z-statistics based on robust standard errors adjusted for nonindependence of observations within firms are reported in parentheses.

	Dependent Variable is one if the firm has a bond rating in that year	
Variable	Model (1)	Model (2)
Intercept	-10.048	-10.234
	(-30.91)	(-19.29)
Log (Assets)	1.212	1.238
	(25.49)	(24.75)
Return on Assets	0.028	0.237
	(0.07)	(0.57)
Property Plant & Equipment	-0.136	-0.702
	(-0.63))	(-2.44)
Market-to-Book	-0.077	-0.054
	(-2.17)	(-1.57)
Leverage	3.917	4.052
	(13.66)	(14.96)
Log(Firm Age)	0.363	0.391
	(6.36)	(6.64)
Standard Deviation of	-4.944	-5.619
Stock Returns	(-2.43)	(-2.72)
Industry Indicators	No	Yes
N	37,342	37,342
Pseudo R-Squared	0.519	0.532

Table 3

Summary statistics for subsamples of firms based on the likelihood of having a bond rating. The initial sample consists of 67,200 firm-year observations for 1971-2001. The sample reported in the table contains only data for firms with the lowest and highest predicted probabilities of having rated debt as defined by model (1) in Table 2. The financing deficit and net debt and equity issues are defined using the flow of funds data on Compustat. Firm age is measured relative to the first year the firm appears on Compustat. Excess leverage is the difference between the firm's leverage ratio and the predicted value of leverage from a cross-sectional regression (based on all firms in the sample in that year) of leverage on log total assets, the ratio of property plant and equipment to total assets, market-to-book, return on assets, the predicted probability that a firm has bond rating from model (1) in Table 3, and indicator variables for each two-digit SIC code in the sample. The predicted change in leverage is the change in the firm's leverage ratio over the year if the firm financed its entire financing deficit with debt.

Variable	Low Predicted Bond Rating (N=22,400)				High Predicted Bond Rating (N=22,400)			
	Mean	Std. Dev.	25th Pctile	75th Pctile	Mean	Std. Dev.	25th Pctile	75th Pctile
Financing Deficit/Total Assets	0.081	0.241	-0.015	0.077	0.027	0.139	-0.026	0.049
Net Debt Issued/Total Assets	0.026	0.134	-0.015	0.019	0.021	0.122	-0.021	0.042
Net Equity Issued/Total Assets	0.055	0.204	0.000	0.011	0.006	0.070	-0.001	0.004
Three Year Average Future Financing Deficit	0.068	0.144	-0.008	0.093	0.023	0.084	-0.017	0.045
Growth in Total Assets	0.164	0.421	-0.034	0.262	0.100	0.246	-0.009	0.159
Three Year Average Future Asset Growth	0.159	0.246	0.019	0.249	0.100	0.153	0.017	0.156
Firm Age (Years)	8.740	6.423	4.000	12.000	21.655	12.171	11.000	30.000
Total Assets	20.566	21.040	8.350	26.058	2294.583	7194.108	257.450	1582.725
Net Prop. Plant & Equip./Total Assets	0.267	0.200	0.118	0.361	0.405	0.217	0.234	0.564
Market-to-Book Ratio	1.748	1.947	0.865	1.895	1.453	0.936	0.982	1.596
Return on Assets	0.073	0.237	0.016	0.192	0.137	0.126	0.097	0.183
Long-Term Debt/Total Assets	0.129	0.149	0.004	0.206	0.296	0.256	0.162	0.390
Excess Leverage	-0.077	0.122	-0.156	-0.011	0.028	0.184	-0.093	0.123
Change in Leverage	0.014	0.104	-0.020	0.026	-0.001	0.175	-0.032	0.026
Predicted Change in Leverage	0.065	0.204	-0.014	0.095	0.010	0.450	-0.028	0.040
Annual Standard Deviation of Stock Returns	0.733	0.468	0.449	0.880	0.434	0.245	0.281	0.511

Table 4

Pooled time-series cross-section regressions of net debt issued on the current financing deficit and the squared value of the current financing deficit. Net debt issues and the financing deficit are computed using flow of funds data from Compustat. All variables are scaled by total assets at the end of the previous year. The sample consists of 67,200 firm-year observations from the period 1971-2001. Firms are sorted into subsamples based on the predicted probability that the firm has a bond rating computed from model (1) from the logit regressions in Table 3. t-statistics based on robust standard errors adjusted for nonindependence within firms are reported in parentheses.

	Dependent Variable is Net Debt Issued					
Variable	Low		Medium		High	
Intercept	0.002	-0.002	-0.002	-0.002	0.000	0.001
	(2.95)	(-3.74)	(-3.69)	(-3.46)	(0.88)	(1.58))
Financing Deficit	0.299	0.529	0.611	0.676	0.750	0.793
	(25.42)	(34.81)	(37.01)	(40.45)	(55.38)	(70.93)
Squared Financing Deficit	---	-0.235		-0.090	---	-0.076
		(-12.49)		(-2.55)		(-2.83)
N	22,343	22,343	22,420	22,420	22,437	22,437
R-Squared	0.286	0.340	0.597	0.601	0.751	0.753

Table 5

Pooled time-series cross-section regressions of net debt issued on the current financing deficit and the squared value of the current financing deficit. Net debt issues and the financing deficit are computed using flow of funds data from Compustat. All variables are scaled by total assets at the end of the previous year. The sample consists of 67,200 firm-year observations from the period 1971-2001. In Panel A, firms are sorted into subsamples based on the volatility of stock returns. In Panel B, firms are sorted into subsamples based on firm age. t-statistics based on robust standard errors adjusted for nonindependence within firms are reported in parentheses.

Panel A. Subsamples based on standard deviation of stock returns

	Dependent Variable is Net Debt Issued					
Variable	Low		Medium		High	
Intercept	0.007	0.006	-0.003	-0.003	0.000	-0.003
	(14.31)	(12.77)	(-6.75)	(-7.96)	(0.42)	(-5.34)
Financing Deficit	0.737	0.722	0.471	0.663	0.395	0.614
	(40.19)	(36.63)	(37.64)	(49.87)	(24.58)	(31.40)
Squared Financing Deficit	---	0.028		-0.238	---	-0.233
		(0.53)		(-10.46)		(-8.22)
N	17,055	17,055	33,483	33,483	16,662	16,662
R-Squared	0.720	0.720	0.465	0.507	0.377	0.420

Panel B. Subsamples based on firm age

	Dependent Variable is Net Debt Issued					
Variable	Low		Medium		High	
Intercept	0.001	-0.004	-0.001	-0.007	0.003	0.003
	(1.26)	(-6.09)	(-2.34)	(-1.64)	(6.98)	(6.61)
Financing Deficit	0.365	0.573	0.530	0.698	0.767	0.727
	(27.78)	(30.37)	(35.80)	(53.50)	(43.46)	(37.50)
Squared Financing Deficit	---	-0.213		-0.229	---	0.082
		(-8.49)		(-8.80)		(2.61)
N	16,377	16,377	34,330	34,330	16,496	16,496
R-Squared	0.350	0.387	0.508	0.542	0.745	0.748

Table 6.

Regression analysis of five year change in leverage ratios. The data are computed using six non-overlapping five year panels beginning in 1971 and ending in 2001. Firms are allowed to enter and exit each panel, but must have three-years of data to be included in a given panel. The five year change in the debt ratio is the difference between the ratio of long-term debt to assets at the end of each panel and the leverage ratio at the beginning of the panel. The independent variables in the regression include the natural log of total assets, the ratio of property plant and equipment to total assets, market-to-book, return on assets, and interaction terms between the return on assets and a low debt indicator and an indicator for large firms. The regressions also include the firm's leverage ratio at the beginning of the panel, and model 2 includes the firm's marginal tax rate. All of the independent variables with the exception of the low debt and big firm indicators, the marginal tax rate, and the beginning of period leverage are measured as averages over the years the firm is in the panel. The low debt indicator is computed based on the difference between the firm's leverage at the beginning of the panel and the predicted value of leverage from a cross-sectional regression (based on all firms in the sample in that year) of leverage on log total assets, the ratio of property plant and equipment to total assets, market-to-book, return on assets, and indicator variables for each two-digit SIC code in the sample. The low debt indicator is equal to one for firms in the bottom third of leverage relative to the target. Big firms are firms in the top third of total assets. The initial sample consists of 67,200 firm-year observations from the period 1971-2001. t-statistics based on robust standard errors are reported in parentheses.

	Dependent Variable is the Five Year Change in Debt Ratio	
Variable	Model 1	Model 2
Intercept	0.043	0.031
	(9.73)	(4.34)
Size	0.010	0.010
	(10.53)	(7.11)
Market-to-Book	-0.008	-0.007
	(-7.23)	(-4.53)
Prop. Plant & Equip.	0.112	0.106
	(14.89)	(10.00)
Marginal Tax Rate		0.012
		(1.13)
Return on Assets (ROA)	-0.156	-0.153
	(-9.06)	(-6.12)
ROA*Low Debt Indicator	0.015	0.040
	(0.74)	(1.35)
ROA*Big Firm Indicator	-0.147	-0.117
	(-6.45)	(-3.31)
ROA*Low Debt*Big Firm	-0.102	-0.118
	(-3.65)	(-2.85)
Debt Ratio at Beginning	-0.363	-0.327
of Panel	(-33.38)	(-22.66)
N	13,408	6,764
R-Squared	0.162	0.139

Table 7

Summary statistics for subsamples of firms issuing and not issuing significant amounts of equity sorted by predicted bond rating groups. The predicted rating groups are formed based on the predicted probability of the firm having a bond rating from model (1) in Table 3. The financing deficit and net debt and equity issues computed using flow of funds data from Compustat. The financing variables are scaled by total assets at the end of the previous year. Issuers are defined as those firm-years where net equity issues exceed 5% of the firm's total assets at the end of the previous period. The initial sample consists of 67,200 firm-year observations from the period 1971-2001.

Predicted Rating Group	Low		Medium		High	
Variable	Non-issuers	Issuers	Non-issuers	Issuers	Non-issuers	Issuers
Financing Deficit/Total Assets	0.022	0.429	0.020	0.295	0.014	0.204
Net Debt Issued/Total Assets	0.025	0.031	0.024	0.031	0.020	0.036
Net Equity Issued/Total Assets	-0.003	0.397	-0.004	0.265	-0.006	0.168
Lagged Leverage	0.112	0.134	0.202	0.246	0.290	0.378
Excess Leverage	-0.080	-0.060	0.025	0.077	0.022	0.104
Change in Leverage	0.017	-0.003	0.008	-0.035	0.004	-0.051
Predicted Change in Leverage	0.027	0.290	0.015	0.166	0.005	0.074
Growth in Assets	0.106	0.498	0.100	0.443	0.083	0.332
Lagged Total Assets	17.405	16.765	82.948	85.338	2190.405	1270.262
Lagged Return on Assets	0.107	-0.024	0.138	0.101	0.143	0.114
Lagged Market to Book	1.580	3.372	1.404	2.285	1.448	1.729
Lagged Property Plant & Equipment	0.261	0.262	0.320	0.325	0.404	0.434
Age	9.168	6.260	13.864	9.809	22.042	16.570
Annual Standard Deviation of Stock Returns	0.712	0.840	0.544	0.631	0.427	0.497

Table 8

Regression analysis of market reaction to equity issue announcements. The dependent variable in the regressiosn is either the three-day cumulative abnormal returns around equity issue announcements or the dollar loss to existing shareholders scaled by proceeds of the offering. Independent variables include an indicator for firms in the low predicted bond rating group defined based on the probability of having a bond rating from model (1) in Table 3, the natural log of the issue proceeds, market-to-book, leverage, the fraction of secondary shares in the issue, and indicators for each year. Abnormal returns are estimated over the three-day period {-1,1} surrounding the issue announcement based on residuals from a market model estimated over the period beginning 220 days and ending 21 days prior to the announcement. Equity issue announcements come from the Securities Data Corporation New Issues Database and cover the years 1980-2001. Large issuers are classified as those where the proceeds from the issue are greater than 5% of total book assets measured at the end of the year prior to the issue. The initial sample consists of 67,200 firm-year observations from the period 1971-2001. t-statistics based on robust standard errors are reported in parentheses.

	All Issuers CAR {-1, +1}	Large Issuers Only CAR {-1, +1}	All Issuers Dollar Loss	Large Issuers Only Dollar Loss
Intercept	-0.044	-0.032	-0.177	-0.074
	(3.81)	(-0.91)	(-2.68)	(-0.43)
Low Predicted Rating Group	0.009	0.012	0.085	0.085
	(2.52)	(2.99)	(4.31)	(4.21)
Log(Proceeds)	0.003	0.005	0.002	0.008
	(1.96)	(2.92)	(0.31)	(0.97)
Market-to-Book Ratio	-0.002	-0.002	-0.013	-0.009
	(-2.66)	(-1.80)	(-2.84)	(-1.82)
Leverage	0.005	0.002	0.053	0.051
	(0.68)	(0.29)	(1.37)	(1.28)
Fraction Secondary Shares	-0.005	-0.015	-0.043	-0.046
	(-1.51)	(-2.80)	(-2.16)	(-1.67)
Year Dummies	Yes	Yes	Yes	Yes
N	2,275	1,932	2,126	1,840
R-Squared	0.014	0.018	0.024	0.020