Testing the Pecking Order Hypothesis: Regression Models versus Surveys

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ABSTRACT

A number of studies test the pecking order hypothesis. However, the empirical model used in the literature suffers from some specification issues. We argue that surveys provide an attractive alternative for testing the pecking order hypothesis. We conduct a survey of 127 CFOs and find that on average they follow the precise financing sequence predicted by the theory. When we estimate the empirical model for the survey firms, as in Frank and Goyal (2003) we find little support for the pecking order hypothesis. Furthermore, testing pecking order by controlling for debt capacity (Lemmon and Zender (2009)) does not qualitatively change the results. Future research needs to address the contradictory conclusions of survey and regression based tests.

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1. Introduction

In their seminal papers, Myers (1984) and Myers and Majluf (1984) formulate financing decisions in a framework where securities involve adverse selection costs. Their contribution – known as the pecking order hypothesis (POH) – argues that since information asymmetry between investors and managers about asset values exist for all external securities, firms prefer internal sources of funds, and access external markets only when their financing needs exceed internally available funds.[2] Furthermore, the POH argues that adverse selection costs are positively correlated with the risks of securities issued. Thus, the pecking order posits a particular financing hierarchy: firms first exhaust their internal funds, followed by the issuance of short-term debt. If they still have unmet financing needs they then issue long-term debt. Equity is used only as a last resort since it involves the highest degree of information costs.

To test the pecking order behavior Shyam-Sunder and Myers (1999, SSM) specify a simple empirical model where long-term debt is the dependent variable and external financing needs is the independent variable. The model is designed to test one particular prediction of the POH – that firms use long-term borrowings before issuing equity. They argue that the estimates for the intercept and slope coefficients they obtain support the null hypothesis that debt is used before equity. Frank and Goyal (2003, FG), estimate the same equation but find that SSM's findings are specific to the sample period and the sample selection criteria used, and conclude that there is little empirical support for the POH.

Some serious econometric issues have been raised about the model estimated by SSM and FG. In this paper, we advance some additional concerns. These problems raise questions about whether the SSM model can be used for testing the POH. Survey methodology may

[2] Information costs are not the only determinant of financing decisions. A number of studies, including Barclay and Smith (1995) and Krishnaswami, Spindt and Subramaniam (1999), argue that moral hazard and asset substitution related considerations increase agency costs associated with debt issues.

provide an attractive alternative for testing the POH. A partial list of the advantages of surveys over regression models in testing the POH includes the following: First, regression coefficients are likely to identify the proportions of debt and equity used by firms and not necessarily the order in which various financing sources are used. Second, surveys can test the full set of predictions of the POH by asking the participants to rank all available financing alternatives, rather than just testing the sequence of debt versus equity that earlier studies focus on. Third, the prediction of the POH that firms use internal financing sources before accessing capital markets cannot be tested by a regression model since contemporaneous operating cash flows are exogenous to the firm. Fourth, as we discuss below, survey-based data is agnostic about many of the methodological, econometric, and data construction issues associated with the standard empirical model estimated by earlier studies.

The results we obtain from our survey strongly support the full set of the predictions of the POH. In particular, when we ask survey participants to rank the financing sequence they follow, their response shows that they use internal financing sources (excess cash and operating profits) before raising external funds. Furthermore, they indicate that when they access external capital markets, they first raise funds via short-term borrowing, followed by long-term debt. Finally, they rank equity issues as their last financing choice.

Since we know the identity of our firms we also estimate the empirical model used by the earlier studies for our survey sample of firms to see whether the results support the conclusion of earlier studies. We already know that managers of survey firms claim to behave in the manner predicted by the POH while firms that make up the samples of earlier studies may or may not follow the financing sequence of the POH. Thus, our estimates are likely to provide valuable information about the ability of the model used in the literature to test the POH. In contrast to our survey findings, the estimates of the empirical model for our survey sample are similar to

those obtained by FG and, hence, do not support the prediction of POH that firms borrow long-term funds before issuing equity. The fact that our survey findings support the precise financing sequence predicted by the POH, while the estimates obtained from the regression model for the same set of firms do not support even one particular prediction of the POH – that long-term debt precedes equity financing – is puzzling. The similarity between the empirical estimates obtained from the survey sample and earlier studies also suggests that even though our survey sample has a smaller number of firms than the samples used by these studies, apparently the two sets of data have similar statistical properties. The contrasting results raise questions about the whether or not pecking order represents an accurate description of firms' financing behavior. Alternatively, it may be the case that pecking order holds but surveys provide a better framework for testing the model.

Lemmon and Zender (2009, LZ) modify the model proposed by SSM by controlling for debt capacity. They argue that firms that have easy access to borrowing are likely to follow pecking order more diligently. While their modified model produces results that are closer to the predictions of the specification of Shyam-Sunder and Myers (1999), the estimates still fall short of supporting the null hypothesis.

The remainder of the paper is organized as follows. Section 2 discusses the basic empirical model used by earlier studies. Section 3 compares the weaknesses/strengths of the survey and regression based tests and the nature of the data used by the two approaches. Our survey findings are presented in Section 4. The results obtained from estimating the empirical specification of earlier studies for our survey sample are reported in Section 5. Section 6 examines the impact of acknowledging debt capacity constraints. Finally, Sections 7 and 8 discusses survey and regression based results and concludes.

2. Testing Pecking Order

Shyam-Sunder and Myers (1999) propose the following model for testing the pecking order hypothesis:

$$\Delta D_{it} = a_{POH} + b_{1,POH} DEF_{it} + e_{it} \quad (1)$$

ΔD is long-term debt issues, DEF is the deficit that needs to be financed externally, and is defined as the sum of dividends, investments in both fixed and current assets minus the cash flow after interest and taxes, and e_{it} is the error term.[3] POH states that once firms exhaust their internal funds and their short-term debt capacity, they meet their remaining financing needs by long-term borrowings, and that equity is almost never used. Under these conditions, the null hypothesis for the "strong-form" of the POH is that $a_{POH} = 0$ and $b_{1,POH} = 1$. However, in satisfying their external financing needs firms may find it necessary to issue some equity for reasons such as debt capacity constraints and financial flexibility considerations (Myers and Majluf (1984), Fama and French (2005) and Lemmon and Zender (2009)). This suggests that parameter estimates close to but less than 1 for $b_{1,POH}$ and close to zero for a_{POH} may be interpreted as supporting the "semi-strong form" of the hypothesis. Shyam-Sunder and Myers (1999) estimate (1) using Compustat data for 157 firms during 1971-1989 and report estimates that are in the range of 0.75 to 0.85 for $b_{1,POH}$ and 0.001 to 0.002 for a_{POH}. Based on these estimates the null hypotheses involving the intercept and slope coefficients are statistically rejected. However, since the estimated intercept and slope coefficients are close to the predicted values, they conclude that their empirical results support the semi-strong form of the POH.

Shyam-Sunder and Myers (1999) show that static trade-off model has low power against the POH when the data is generated by the pecking order model. Additionally, Chirinko and

[3] Short-term debt and cash balances including excess cash are included in the definition of DEF as components of net working capital.

Singha (2000) point out that the empirical specification in question suffers from misleading inferences in evaluating possible external financing patterns. First, they argue that the model represents a joint test of the financing hierarchy of debt versus equity and the extent firms rely on these two financing sources. They argue that increased reliance on equity may in correctly result in rejection of the pecking order by lowering the estimate for the slope coefficient. They also argue that if even if equity is in the middle of the financing sequence involving internal funds, equity and debt, the estimated slope coefficient could be close to one and lead to the incorrect inference that equity is used last, and thus, pecking order holds. Finally, they show that if firms use debt and equity in fixed proportions, the estimate will reflect the proportion of debt in external financing and when this proportion is high there will be an incorrect inference that pecking order holds. Frank and Goyal (2003) acknowledge but do not address these concerns. Using SSM's sample period and selection criteria (no gaps are permitted in the data, which produces a sample with a disproportionate number of large firms) they replicate the results obtained by SSM. However, when they allow gaps in the data they obtain slope coefficient estimates that are much smaller even for SSM's sample period (around 0.27).[4] Furthermore, estimating the model for 1990-1998 produces slope coefficients in the 0.15-0.33 range, independent of whether or not they permit gaps in the data. Based on these results, they conclude that the support Shyam-Sunder and Myers (1999) find for the POH holds only for large firms and only when the sample period is restricted to 1971-1989.

We have some additional concerns regarding specification (1). First, (1) is designed to test only one of the predictions of pecking order (that long-term borrowings precede equity

[4] Correcting the large sample firm bias and including more small firms in the sample should produce estimates that provide stronger support for the POH since the pecking order behavior is driven by adverse selection costs which are likely to be more severe for smaller firms. On the other hand, relative to large firms, smaller firms are more likely to have limited access to debt markets and hence follow POH less strictly. The results suggest that the latter effect dominates the firm-size related differences in information costs.

issues) rather than testing the financing sequence the model predicts about the full array of financing sources. Second, (1) is also problematic from a methodological perspective: it tests whether debt issues precede equity financing in a setting where POH's other predictions – that internal funds and short-term borrowings are used before long-term debt – are *assumed* to hold true. However, the sequence of internal (and short-term financing) is a crucial prediction of pecking order that needs to be *tested* rather than *assumed* away.[5] For example, a finding that long-term borrowings precede equity issues while short-term debt and internal financing alternatives are used after equity offerings would hardly be considered evidence in favor of the POH. Finally, the construction of the variable for financing deficit (DEF) assumes that cash balances and short-term debt are exogenous to the firm. While it is reasonable to assume that the operating portion of cash balances is exogenous, the same cannot be said about excess cash. It is even more difficult to argue that short-term debt is not a decision variable. The definition of financing deficit also treats dividends and investments as exogenous variables. However, a case for endogeneity can be made for each of these variables. These concerns combined with the criticism of Chirinko and Singha (2000) raises questions about whether (1) can be used to test the POH.

3. Survey versus Regression Methodology and Data

Our survey was sent to 4,600 CFOs of U.S. companies listed in the Compustat name file. We excluded financial firms and firms in health, education, and social services sectors.[6] The

[5] Furthermore, the definition of the variable DEF does not specify any ordering between cashflows, excess cash, and short-term debt. Instead, they are all assumed to be used simultaneously before the firm borrows long-term funds.

[6] The survey was mailed on September 12, 2003. The firms that were excluded were all finance and insurance companies with the major SIC code in the ranges 6000-6499, 6700-6799, as well as health, education, social services, and museums (7200+), and radio and TV broadcasting, cable, and other pay TV services.

survey contained questions on both investment and financing issues. However, since the focus of this paper is testing the pecking order, we do not examine the participants' response to questions on cashflows and hurdle rates. In order to be able to match the responses from the survey with Compustat data, we asked the participants to reveal the identity of their firms. 83.5% of the survey firms supplied their name and/or ticker. We received a total of 127 responses to the survey of which 114 answered the questions regarding pecking order.

Data obtained from financial tapes and surveys each have their strengths and weaknesses. One advantage of using data from financial databases such as Compustat is that these samples constructed contain a substantial number of observations, which increases the level of confidence regarding the accuracy of the tests conducted. Additionally, unlike the subjective nature of survey data, the data in financial tapes is determined objectively. However, this objectivity may come at a cost. Since models of financial decisions posit how managers *do* or *should* behave, ideally, the predictions of the models should be tested with data that reflects the *behavior* of managers. However, data from financial tapes only partially reflects how managers behave since the data represents realizations of financial variables. These realizations are determined not only by the behavior of managers, but also by the behavior of other economic agents as well as by the parameters of the exogenous environment.[7]

The strength of testing financial decisions by surveys is that survey data directly reveals how managers claim to behave. On the other hand, tests based on survey data also have some potential weaknesses. First, surveys typically do not produce as many observations as the financial databases. Additionally, if questions are not phrased carefully, surveys can produce

[7] For example, the realized level of sales of a firm does not only reflect how successful or unsuccessful managers were in their past investment decisions, but it also reflects factors such as the current state of the economy, consumer demand for the particular product, investments of competitors, etc. Thus, tests that use financial databases may reveal whether a particular investment decision was a success or a failure *ex-post*, but they do not necessarily fully reflect whether the success or failure of the project is solely the result of the procedures managers followed *ex-ante*.

misleading results. However, since in the survey we conducted we simply asked the survey participants to rank the order in which they would use various financing alternatives, the question is unlikely to suffer from ambiguity. Another potential problem with surveys is that the participants may respond in a manner that they think will please the survey conductor.[8] We tried to mitigate this potential by avoiding the term "pecking order" in the survey. Also, it is not clear that survey participants would necessarily think that there is a "correct" financing hierarchy.

One of the most important advantages of testing pecking order by surveys is that we can determine whether firms use the full array of financing sources available to them in the precise order predicted by the POH – including the prediction about use of internal funds which cannot be tested in a regression framework. Additionally, testing pecking order by using survey methodology avoids the specification issues surrounding (1) that we discussed above. For example, unlike (1) which assumes both investments and dividends to be exogenous, survey methodology is agnostic about the endogenous/exogenous nature of these variables.

4. Survey Findings

The survey participants were given six financing choices and asked to rank the order in which they would use them from 1 (first choice) to 6. The financing alternatives were operating profits, excess cash balances, short-term debt, long-term debt, equity issues, and "other". These alternatives were presented in a random order in the questionnaire. As shown in Table 1 excess cash balances were ranked first by 83.3% of the respondents and ranked second by 11.4%. The other internal funding alternative – operating profits – was ranked first by 21.2% and ranked second by 61.6% of the participants. These results provide strong support for the prediction of

[8] This is known as the "social desirability hypothesis". For example, if the participants are asked for the capital budgeting technique they use, they may claim that they use a discounted cash flow methodology even if they in fact use criteria like payback since they may know that payback should not be used.

the POH that firms use internal financing sources before accessing external capital markets. In fact, the table shows that excess cash was either the first or the second choice of 94.7% of the survey participants while operating profits represented the first or second choice of 82.8% of the respondents.

The mean ranks displayed in Table 1 show that excess cash is ranked highest. On a scale of 1 to 6, its mean rank score is 1.25, indicating that it is by far the first financing source that survey firms use. The second choice is operating profit which has a mean score of 2.06. The third choice is short-term debt (mean score is 2.97). With a mean score of 3.34, long-term debt is ranked fourth. Finally, equity has a mean score of 3.99, and is ranked last.[9] These results strongly support the precise financing sequence predicted by the POH. Apparently, not only firms exhaust internal financing sources before raising external funds, in raising external funds the order in which they issue securities is perfectly correlated with the riskiness (adverse selection costs) of the securities in question. In sum, our survey findings indicate that the POH provides an accurate account of the financing behavior of firms.

5. Estimating the Standard Model with the Survey Sample

In this section we estimate (1) for the firms that participated in the survey. We argue that using the survey sample constitutes a stronger test of the pecking order of the SSM model compared to the tests of the earlier studies since the survey sample is composed of firms whose managers claim to strictly follow the financing sequence predicted by pecking order while we do not know whether or not this is the case for samples used by earlier studies. We use Compustat data from 1993 to 2006. This covers both pre- and post-survey years. All dollar variables in

[9] The category "other" was last with a mean ranking of 6. However, only 3 CFOs included this alternative in their rankings.

Compustat data are converted to constant 2003 dollars using the GDP deflator.[10] We recode balance sheet and cash flow statement variables with a missing value or a "C", indicating that the variable is combined with another data item, to zero as in Frank and Goyal (2003).[11] Furthermore, to limit the impact of outliers for each year we trim the top and bottom 0.5% of the firm years from the sample.

Tables 2 and 3 compare the firm characteristics of responding firms for which we can match Compustat data and Compustat firms that were not part of the survey. The significant differences in median book value and mean/median market value of assets show that survey participants tend to be larger than the average firm in the Compustat universe. Frank and Goyal (2003) argue that pecking order seems to perform better for large firms. Thus, relative to the Compustat sample, using the survey sample is likely to produce results that favor the POH. As shown in Table 3, mining and manufacturing sectors are over-represented in the survey (48.3% versus 38.7% in the Compustat universe). This probably accounts for the fact that the survey respondents hold a larger fraction of tangible assets and exhibit higher capital expenditure ratios. In 2003, average operating income and net income of respondents, measured as a fraction of total book value of assets, exceed the profitability of the Compustat peers. Additionally, firms in the two samples in question have similar leverage ratios (total debt divided by book value of assets). Table 4 shows that the highest pair-wise correlation coefficients are between financing deficit and equity issues followed by financing deficit and net debt issues for both the Compustat and survey samples.

[10] Data on the GDP deflator is from the website of the Bureau of Economic Analysis (BEA): http://www.bea.gov/bea.

[11] Effective for fiscal years ending July 15, 1988, U.S. firms adopting the Statement of Financial Accounting Standard (SFAS) #95 disclose their cash flows in a uniform way (#318 = format code 7). We drop the 82 (0.81%) observations with format codes 1-6, which are mostly American Depository Receipts or Canadian firms. We also recode the variable "minority interest" (Compustat item #49) as zero if it is missing or combined with another data item, which is not indicated in Table 8 of Frank and Goyal (2003, page 242).

The results obtained from estimating (1) for net long-term debt issues for the survey firms during the sample period 1993-2006 are shown in the second column of Table 5.[12] As in Frank and Goyal (2003), we allow for gaps in the data. We also estimate the model for the Compustat sample of firms that are not in the survey sample over the same time period and report these results in the fourth column (Compustat, (1)) of the table. The estimates of the slope coefficients for the financing deficit that are displayed in Table 5 are substantially less than one. The estimate for this variable in the survey sample is 0.265 and statistically significantly different from one at the 1% level. The intercept is 0.002 and not statistically significant. The estimates for the slope and intercept coefficient for the Compustat universe of firms are 0.169 and -0.005, respectively. These coefficients are in line with the estimates obtained by Frank and Goyal (2003). Furthermore, Figures 1A and B show that, as in FG, equity issues track financing deficit more closely than debt issues. The relative size of the correlation coefficients between financing deficit and equity issues (0.882 and 0.901 for survey firms and Compustat sample, respectively) and correlation coefficients between financing deficit and net long-term debt issues in the two samples (0.458 and 0.408, respectively) further confirm the observation made on the basis of Figures 1A and B.

We consider these results to be important. First, in spite of its smaller size, the estimates obtained from the survey sample are similar to the estimates of the Compustat sample. This suggests that firms in the survey sample have similar statistical properties as samples that contain a larger number of observations (such as FG's samples). More importantly, the fact that estimates of (1) do not support the prediction of the POH regarding the relative sequence of debt

[12] We investigate the relationship between financing deficit and net debt issues rather than gross debt issues because Frank and Goyal (2003) find the slope coefficient to be larger for this variable. Additionally, the larger estimate for the slope coefficient in the survey sample may reflect the larger firm size in this sample compared to the Compustat sample.

and equity issues for the survey sample even though the survey findings show that the firms in question, on average, follow the POH ordering for the full set of financing alternatives is puzzling.

6. Testing the Pecking Order by Accounting for Debt Capacity

The pecking order predicts that firms will issue debt before equity offerings. However, due to debt capacity constraints, some firms may have limited or no access to debt markets and may satisfy their external financing needs by issuing some equity. Small firms, firms with high market-to-book ratios, low profitability firms, as well as firms that face the possibility of financial distress may have limited access to debt markets. In their concluding section Myers and Majluf (1984) discuss the possibility that high growth firms may issue equity for reasons of financial flexibility. Fama and French (2005) find that small firms, and firms with high growth opportunities and firms with low earnings are rational opt-outs allowed by the pecking order model. Gatchev, Spindt, and Tarhan (2009) cast further doubt on the dominance of adverse selection costs in firms' financing decisions.[13] Additionally, given their high business risk, some firms, for example firms in the technology sector, appear to actually prefer to have an all-equity capital structure. These arguments suggest that use of little or no debt by some firms does not necessarily mean that pecking order behavior does not hold. But, what it means is that tests of pecking order need to control for debt capacity considerations.

Lemmon and Zender (2009) extend the basic SSM model by estimating:

$$\Delta D_{it} = a_{POH} + b_{1,POH}\, DEF_{it} + b_{2,POH}\, DEF_{it}^2 + e_{it} \qquad (2)$$

[13] In fact, they show that in addition to firm characteristics, the financing decisions depend on the types of investments firms undertake. They show that as the opacity of both firm and investment characteristics increase debt contracting costs dominate adverse selection costs of equity and firms rely on relatively more equity relative to debt.

Including the squared financing deficit as an additional independent variable controls for "small" and "large" deficits. LZ argue that holding debt capacity constant, firms are likely to use debt to fund small deficits but rely on equity increasingly more as the size of the deficit increases. They find that (2) yields larger estimates for the slope coefficient of the financing deficit variable. Additionally, they find that the estimate for the squared deficit is negative suggesting that firms show greater reliance on equity financing in the case of large deficits. Columns 3 and 5 of Table 5 confirm these findings both for the Compustat and survey samples.

To further control for debt capacity, Lemmon and Zender (2009) estimate the Shyam-Sunder and Myers (1999) model for subsamples of firms formed on the basis of the probability of firms having a bond rating (estimated from a logit model). Their findings show that their modified model of pecking order performs better for firms that are less likely to face debt capacity concerns (i.e., firms that are likely to have a bond rating). In this paper we account for firms' bond market access constraints by relying on four variables. One measure we use is the bankruptcy probabilities of the survey firms as captured by Shumway's (2001) hazard model. Shumway (2001) calculates bankruptcy probabilities using the following model:

$$\Pr = e^{\left[-13.303-1.982(\mathrm{NI/TA})+3.593(\mathrm{TL/TA})-0.467\ln(\mathrm{Relative\,Size})-1.809(\mathrm{Ret}_{t-1}-\mathrm{Ret\,Market}_{t-1})+5.791(\mathrm{Sigma})\right]},$$

where NI/TA is net income divided by total assets, TL/TA is total liabilities divided by total assets, Relative Size is the natural log of firm market capitalization divided by the total market capitalization of the NYSE and Amex, Ret_{t-1} – $\mathrm{Ret\,Market}_{t-1}$ is the firm's equity return over the prior year minus the market return over the prior year, and Sigma is the standard deviation of the residual from a regression of firm returns on market returns over the prior year. To classify firms according to bankruptcy probabilities, we calculate the median of the predicted bankruptcy probability for each year of the sample period. Firm-years with probabilities above the median

are classified as debt-capacity constrained, firm-years with bankruptcy probabilities below the median are classified as having freer access to debt markets. Because of the ordinal nature of this categorization scheme, the precise level of bankruptcy probability produced by Shumway's model is not important for our purposes.

We also control for debt capacity by forming subsamples using three other variables that are found to be related to debt capacity constraints. These variables are size (total assets), market-to-book ratio, and profitability (ROE).[14] The hypothesis is that firms that are less concerned about debt capacity should follow pecking order more closely (firms with low probability of financial distress, larger firms, low M/B firms, and firms with high profitability). Table 6, Panel A, shows the estimates obtained from (1) and (2) for the two bankruptcy subsamples. The results show that, as expected, the model performs better for the low bankruptcy probability subsample relative to the high financial distress subsample (slope coefficient is 0.329 versus 0.258, and R-square is 0.24 compared to 0.18). Furthermore, when the squared deficit is included as an additional variable, the estimated financing deficit coefficients in the two subsamples increase to 0.557 and 0.591, respectively. These results suggest that financially healthier firms have easier access to debt markets and come closer to the POH prediction that long-term debt is used before equity.

The estimates obtained from size (market value of assets), market-to-book ratio, and profitability (ROE) based subsamples are reported in Panels B, C, and D, respectively. Large firms, firms with low growth opportunities, and profitable firms are less likely to have larger debt capacities than firms with opposite characteristics, and hence are expected to follow pecking

[14] Fama and French (2005) and Gatchev, Spindt, and Tarhan (2009) find that firms with high market-to-book ratios, small firms, and firms with low profitability use more equity and less debt than their peers that have the opposite characteristics. We also used return on assets (ROA) instead of ROE as the profitability measure, but obtained similar results.

order more diligently. Three observations stand out. First, specifications that include the squared financing deficit variable provide "stronger" support for pecking order than the basic SSM model (larger financing deficit variable estimates and also higher R-squares). Second, independent of the model used, accounting for debt capacity concerns improves the results: In addition to the results from subsamples based on bankruptcy probability discussed above we find that the estimated coefficient is higher for the large firms subsample than it is for the small firms subsample (0.547 and 0.631 versus 0.201, and 0.404 for models (1) and (2), respectively).[15] It is also the case that, compared to their higher market-to-book peers, low-growth firms have larger financing deficit coefficients (0.627 and 0.878 versus 0.175 and 0.322 for models (1) and (2), respectively).[16] Similarly, high profitability firms have larger financing deficit slope estimate than the lower ROE sample of firms (0.363 and 0.620 compared to 0.244 and 0.465 for models (1) and (2), respectively). Third, while these results show the importance of controlling for debt capacity in testing the POH, the slope coefficients of the financing deficit never comes close to one, and thus, the results do not support the pecking order behavior.

The general conclusion regarding the empirical tests for the survey sample remains the same: To the extent Shyam-Sunder and Myers (1999) model and its extension by Lemmon and Zender (2009) represent reasonable specifications, even the narrower version of the pecking order hypothesis (that long-term borrowings precede equity offerings) does not hold even for the subsample of firms whose managers claim to strictly follow, on average, the precise financing sequence predicted by the POH.

[15] For the size-based quartiles of the survey sample, the estimated coefficients of Model (1) are (smallest to largest) 0.113, 0.162, 0.262, and 0.511.

[16] For M/B based quartiles the survey sample estimates for the financing deficit variable of Model (1) are (from the lowest M/B to the highest) 0.312, 0.319, 0.192, and 0.103.

7. Does the Pecking Order Hypothesis Hold?

In sum, based on the standard regression model of SSM and its version that accounts for debt capacity considerations, it appears that pecking order does not hold. On the other hand, the survey findings provide strong support for the sequence of financing predicted by the pecking order behavior. Why do survey findings support the precise sequence of financing predicted by POH, while regression results do not support even one particular prediction of the POH that debt issues precede equity offerings? One possibility is that POH represents an accurate account of firms' financing behavior, but that, due to econometric problems that are raised by Chirinko and Singha (2000) and the additional concerns we raised above, model (1) is not capable of testing the validity of the POH. This suggests that if POH is to be tested in a regression framework the model specifications need to address the shortcomings of (1). Alternatively, it may be the case that it is not possible to design a regression based model to test the pecking order and that survey methodology might be better suited for testing the POH. If this is the case, to verify whether or not pecking order holds, more surveys need to be conducted to check the robustness of our findings. It is also possible that while in surveys managers express their intentions to follow the financing ordering predicted by the POH, for some reason they may be unable to implement their preferred sequence of financing. This possibility can be explored by including more detailed questions in future surveys.

8. Conclusion

In replicating the findings of Shyam-Sunder and Myers (1999), Frank and Goyal (2003) show that the support that SSM find for pecking order is sample specific and that the null hypothesis that firms borrow long-term funds before issuing equity is rejected. As recognized by a number of papers, pecking order may not hold strictly since some firms face debt market

access constraints. Additionally, some firms may prefer to have an all-equity capital structure. Lemmon and Zender (2009) show that while accounting for debt capacity improves the performance of the modified version of SSM's model, the findings do not rise to the level of supporting the pecking order behavior. However, both the original SSM specification and LZ's modification have a number of serious shortcomings. Furthermore, the model in question is designed to test only one particular prediction of the POH that firms issue long-term debt before issuing equity. For these reasons, we argue that surveys provide a good alternative for testing pecking order behavior. Our survey of 127 CFOs shows that on average they claim to follow the precise ordering predicted by the pecking order model.[17] However, even though the firms in our survey claim to abide by the financing sequence predicted by the POH, when we estimate the empirical models of earlier studies using our survey sample, we do not find support for the prediction that debt issues precede equity offerings. We argue that future work needs to address the contradictory conclusions from survey and regression findings. First, more surveys should be conducted to determine if our survey results are robust. Second, attempts should focus on developing empirical models that address the problems of the model advanced by Shyam-Sunders, and Myers (1999).

[17] While on the basis of our survey findings we reach the same conclusion as Shyam-Sunder and Myers (1999) in that our findings support the POH, it is important to point out that our results support the POH (i.e., Myers (1984) and Myers and Majluf (1984)), and not the empirical model Shyam-Sunder and Myers (1999) use to test the POH.

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Appendix A: Variable Definitions

Book value of equity	equity_bk = #60
Market value of equity	equity_mkt = #130 + #199 × #25

For the four firms where market values are missing, we use book value.

Long term book value of debt	lt_debt_bk = #9
Total book value of debt	debt_bk = #34 + #9
Book value of assets	assets_bk = #6
Net book value of assets	net_assets_bk = #6 – #5
Market value of assets	assets_mkt = #181 + equity_mkt
Book value of sales	sales = #12
Market-to-book ratio	assets_mkt_bk = assets_mkt/assets_bk
Tangibility	#8/assets_bk

Definitions Frank and Goyal (2003)

Cash dividends	cash_divs_scf = #127
Net investments	net_inv_scf = #128 + #113 + #129 – #107 – #109 – #309 – #310
Net change in working capital	d_net_wk_cap_scf = –#302 – #303 – #304 – #305 – #307 + #274 – #312 – #301
Cash flow	cf_scf = #123 + #124 + #125 + #126 + #106 + #213 + #217 + #314
Net short-term issues	net_d_st_debt_scf = #301
Net debt issues	net_d_debt_scf = #111 – #114
Gross debt issues	gross_d_debt_scf = #111
Net equity issues	net_d_equity_scf = #108 – #115
Financing deficit	fin_def_scf = cash_divs_scf + net_inv_scf + d_net_wk_cap_scf – cf_scf

Table 1: Survey result on ranking of financing resources.

The table shows the percentage of CFOs that assign rank 1 (first choice) to 5 for a given source of financing listed in the questionnaire. The list of financing sources in the questionnaire is re-ordered by the mean rank assigned by respondents. Three respondents checked "other" and all three assigned rank 6 to it (not reported here). The bars illustrate the mean rank reported in the last column.

In deciding how to finance projects in your firm, in what order would you use the following sources of capital to fund profitable projects? (1 for first choice, 2 if the first choice does not raise sufficient amount of capital, 3, 4, 5, etc.)

Rank	1	2	3	4	5	# obs	0 Mean rank 5
Internally available excess cash	83.3	11.4	2.6	1.8	0.9	114	1.25
Operating profits	21.2	61.6	8.1	8.1	1.0	99	2.06
Short-term debt	5.5	11	36.7	37.6	9.2	109	2.97
Long-term debt	6.1	29.6	37.8	14.3	12.2	98	3.34
Equity issues	3.3	4.4	27.3	27.8	41.1	90	3.99

Table 2: Comparison of survey firm characteristics with the full Compustat sample.

Firm characteristics for the survey firms for which we can match with Compustat and the all U.S. firms in Compustat at the beginning and end of the estimation period, and the year of the survey. We exclude utilities, radio/TV broadcasting, cable, and other pay TV services (4840-4999), finance and insurance companies (SIC codes 6000-6499, 6700-6799), and health/education/social services, and museums (7200+), and firms involved in a major merger at some point during the sample period (Compustat footnote aftnt1 = AB). All dollar variables are converted to constant 2003 dollars using the GDP deflator of the Bureau of Economic Analysis (BEA). Panel A shows mean and medians for selected firm characteristics from Balance Sheet data (all levels are in millions). Book value of assets (in millions) is Compustat item #6. Market value of assets is defined as book value of liabilities (#181) and preferred stock (#130) plus the market value of common equity (#199 × #25). Total debt is debt in current liabilities plus long-term debt (#34 + #9), tangibles are measured by property, plant and equipment (#8), operating income is before depreciation (#13). The Compustat items for capital expenditures and net income are #128 and #172. Panel B replicates the variables related to the pecking order test as in Frank and Goyal (2003, Table 2, p.229). All variables in this panel are based on information from the Statement of Cash Flows and divided by total book assets (#6). The definitions of the variables are detailed in Appendix A. We trim the top and bottom 0.5% of the firms. Additionally, for market-to-book ratios, firms with book value of assets below 1 million are excluded. The columns "Diff." show the *p*-values for the difference in mean *t*-test and Fishers's exact test for differences in medians under the null hypothesis of zero mean and median, respectively.

A: Size, market-to-book ratio, leverage, and tangibility.

Year	1993			2003			2006		
	Survey	Compustat	Diff.[a]	Survey	Compustat	Diff.[a]	Survey	Compustat	Diff.[a]
Number of observations	71	6,424		92	6,469		75	4,381	
Mean book assets	1,545	935	0.1462	2,456	1,905	0.415	3,179	2,515	0.504
Median book assets	247	67	0.005	553	158	0.000	670	269	0.002
Mean market-to-book	2.038	1.978	0.765	2.054	2.372	0.231	2.137	2.365	0.335
Median market-to-book	1.612	1.399	0.179	1.700	1.529	0.054	1.967	1.746	0.547
Mean leverage	0.198	0.174	0.331	0.215	0.186	0.272	0.201	0.168	0.220
Median leverage	0.164	0.104	0.022	0.186	0.093	0.003	0.177	0.087	0.011
Mean tangibility	0.419	0.307	0.000	0.358	0.259	0.000	0.364	0.232	0.000
Median tangibility	0.336	0.241	0.000	0.298	0.176	0.000	0.288	0.145	0.000

[a] Means: *p*-value for *t*-test; Medians *p*-value for Fisher's exact test.

B: Means for pecking order test variables constructed from the Statement of Cash Flows.

Year	1993			2003			2006		
	Survey	Compustat	Diff.[b]	Survey	Compustat	Diff.[b]	Survey	Compustat	Diff.[b]
Number of observations	71	6,424		92	6,469		75	4,381	
Cash dividends	0.023	0.012	0.006	0.014	0.007	0.006	0.020	0.012	0.049
Investments	0.113	0.094	0.297	0.087	0.052	0.041	0.082	0.080	0.920
Δ Working capital	0.028	0.020	0.781	0.040	-0.105	0.191	-0.001	-0.004	0.994
Internal cash flow	0.078	0.057	0.066	0.068	0.018	0.593	0.094	0.039	0.438
Financing deficit	0.124	0.131	0.883	0.081	0.095	0.833	0.027	0.120	0.084
Net debt issues	0.040	-0.002	0.043	0.025	0.010	0.566	0.012	0.025	0.521
Net equity issues	0.087	0.139	0.222	0.064	0.083	0.657	0.017	0.091	0.082
Net external financing	0.130	0.138	0.864	0.092	0.102	0.876	0.030	0.125	0.096

[b] *p*-value for *t*-test.

Table 3: Industry breakdown of survey respondents and Compustat firms.

The table compares the number of observations and the corresponding percentages for the survey respondents and the Compustat sample for each one-digit SIC industry. The Compustat sample contains all U.S. firms in Compustat, excluding financial firms, utilities, and firms involved in a major merger. The data period is 1993-2006.

Industry		Survey firms		Compustat sample	
SIC code	Description	Observations	Percentage	Observations	Percentage
0	Agricultural products, livestock/animal, agricultural services, forestry, fishing/hunting/trapping	0	0.00	452	0.46
1	Metal/coal mining, oil/gas extraction, quarry non-metallic minerals, construction	102	9.21	7,558	7.75
2	Food products, tobacco, textile mill products, apparel/finished products, lumber/wood products, furniture/fixtures, paper products, printing/publishing, chemicals, petroleum refining	325	29.35	17,063	17.50
3	Rubber/plastics/leather/stone/clay/glass/concrete products, primary metal industries, fabricated metal, industrial/commercial machinery, computer/electric equipment, transportation equipment, measurement/photo instruments, watches	433	39.11	30,175	30.95
4	Railroad/transit/passenger transportation, motor freight transportation/ warehouse, postal service, water/air transportation, pipe lines, transportation services, communications, electric/gas/sanitary services	125	11.29	7,775	7.97
5	Wholesale durable/nondurable goods, building/material/hardware/ garden retail, general merchandise stores, food stores, auto dealers/gas stations, apparel/accessory stores, home furniture/equipment stores, eating/drinking places, miscellaneous retail	110	9.94	11,253	11.54
7	Hotels/lodging, personal/business services, auto repair/services/parking, misc. repair services, motion pictures, amusement/recreation	12	1.08	18,395	18.87
8	Health/legal/educational/social services, museum/gallery, botanic, membership organizations, engineering/accounting/management services, private households	0	0.00	4,828	4.95
Total		1,107	100.00	97,503	100.00

Table 4: Pairwise correlation coefficients between pecking order test variables.

The table shows the pairwise correlation coefficients between the financing deficit and debt and equity issues that we use to test pecking order. All variables are based on information from the Statement of Cash Flows and scaled by net assets, which is defined as total book assets (#6) minus current liabilities (#5). The definitions of the variables are detailed in Appendix A. The time period is 1993-2006.

A. Correlations for survey firms.

	Financing deficit	Net short-term debt issues	Net long-term debt issues	Gross debt issues
Financing deficit	1.000			
Net short-term debt issues	-0.022	1.000		
Net long-term debt issues	0.458	0.016	1.000	
Gross debt issues	0.202	0.007	0.411	1.000
Net equity issues	0.882	-0.034	-0.013	0.011

B. Correlations for Compustat firms.

	Financing deficit	Net short-term debt issues	Net long-term debt issues	Gross debt issues
Financing deficit	1.000			
Net short-term debt issues	0.024	1.000		
Net long-term debt issues	0.408	-0.017	1.000	
Gross debt issues	0.201	0.002	0.447	1.000
Net equity issues	0.901	0.034	-0.025	0.010

Table 5: Pecking order test using panel regression with fixed effects.

The pecking order test of Frank and Goyal (2003; Table 4, page 234) is specified as $\Delta DLT_{i,t} = a + b_{1,POH}DEF_{i,t,} + e_{i,t}$, (model (1)) where ΔDLT is net change in long-term debt (Compustat item #111 – #114) and the financing deficit *DEF* is defined as cash dividends + net investments + net change in working capital – internal cash flow (the Compustat variables used to construct this variable are shown in Appendix A). Estimates from this model are shown in the columns FG. Lemmon and Zender (2009) add the squared financing deficit $DEF_{i,t}^2$ as an additional explanatory variable (model (2)). Standard errors are reported below in brackets and are controlled for firm-level clustering. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level for testing intercept = 0, $b_{1,POH} = 1$ and coefficient of the squared financing deficit $b_{2,POH} = 0$, respectively. The time period is 1993-2006.

	Survey		Compustat	
	(1)	(2)	(1)	(2)
Intercept	0.002	0.001	-0.005***	-0.003***
	(0.004)	(0.004)	(0.001)	(0.001)
Financing deficit[a]	0.265***	0.490***	0.169***	0.188***
	(0.017)	(0.027)	(0.001)	(0.002)
Squared financing deficit		-0.207***		-0.016***
		(0.020)		(0.001)
N	1,019	1,019	87,845	87,845
Overall R^2	0.212	0.275	0.144	0.156

Table 6: Pecking order tests for subsamples.

Panels A-D report the results of pecking order tests when the survey sample is split into above and below median subsamples using four characteristics: (A) Default probability from the Shumway (2001) model, (B) market value of total assets (size), (C) market-to-book ratio, and (D) profitability measured by return on equity (ROE). Model (1) columns report the results for the pecking order test of Frank and Goyal (2003). Model (1) is specified as $\Delta DLT_{i,t} = a + b_{1,POH} DEF_{i,t,} + e_{i,t}$, where ΔDLT are net changes in long-term debt and *DEF* is the financing deficit as defined by Frank and Goyal (2003) and in the caption of Table 5. Model (2) represents the extension proposed by Lemmon and Zender which includes the squared financing deficit $DEF_{i,t}^2$ as an additional explanatory variable. All panel regressions are estimated with firm fixed effects. Standard errors are reported below in brackets and controlled for firm-level clustering. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level for testing intercept = 0, $b_{1,POH} = 1$ and coefficient of the squared financing deficit $b_{2,POH} = 0$, respectively. The time period is 1993-2006.

A. Subsamples based on default probabilities.

Variable	Default probability			
	Low		High	
	(1)	(2)	(1)	(2)
Intercept	0.002	0.009***	0.010	0.000
	(0.003)	(0.003)	(0.007)	(0.007)
Financing deficit	0.329***	0.557***	0.258***	0.591***
	(0.029)	(0.038)	(0.030)	(0.050)
Squared financing deficit		-0.523***		-0.255***
		(0.063)		(0.032)
N	446	446	444	444
R^2	0.235	0.370	0.181	0.275

B. Subsamples based on size.

Variable	Size			
	Small		Large	
	(1)	(2)	(1)	(2)
Intercept	-0.008	-0.013**	0.008*	0.012***
	(0.007)	(0.007)	(0.004)	(0.004)
Financing deficit	0.201***	0.404***	0.547***	0.631***
	(0.022)	(0.041)	(0.030)	(0.038)
Squared financing deficit		-0.159***		-0.230***
		(0.028)		(0.065)
N	485	485	535	535
R^2	0.195	0.237	0.348	0.383

C. Subsamples based on market-to-book ratios.

Variable	Market-to-book			
	Low (mature firms)		High (growth firms)	
	(1)	(2)	(1)	(2)
Intercept	-0.002	0.000	0.005	0.003
	(0.003)	(0.003)	(0.009)	(0.007)
Financing deficit	0.627***	0.878***	0.175***	0.322***
	(0.023)	(0.027)	(0.024)	(0.042)
Squared financing deficit		-0.463***		-0.121***
		(0.035)		(0.029)
N	492	492	528	528
R^2	0.562	0.687	0.151	0.166

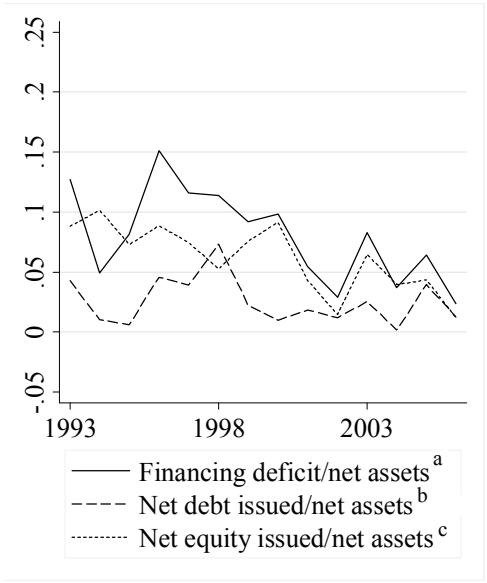
D. Subsamples based on return on equity.

Variable	Return on equity (ROE)			
	Low profitability		High profitability	
	(1)	(2)	(1)	(2)
Intercept	-0.007	-0.011**	0.009	0.013***
	(0.006)	(0.006)	(0.005)	(0.004)
Financing deficit	0.244***	0.465***	0.363***	0.620***
	(0.024)	(0.043)	(0.031)	(0.040)
Squared financing deficit		-0.218***		-0.234***
		(0.035)		(0.026)
N	520	520	512	512
R^2	0.208	0.255	0.238	0.341

Figure 1: Average financing deficit, net debt and equity issues.

Panel A plots the ratios financing deficit/net assets, net debt issued/net assets, and net equity issued/net assets for the 92 survey firms for which we can match Compustat data in 2003 (71 in 1993). Panel B shows the same graph for all U.S. firms in Compustat, excluding financial firms (SIC codes 6000-6999), utilities (4900-4999), and firms involved in a major merger at some point during the sample period (Compustat footnote aftnt1 = AB). For the definitions of the variables used, see Appendix A. This line graph corresponds to Figure 1 in Frank and Goyal (2003, page 230) for the sample period 1993-2006. All dollar variables are converted to constant 2003 dollars using the GDP deflator of the Bureau of Economic Analysis (BEA). Each year, the top and bottom 0.5% of all firms are trimmed (for survey firms we apply the same cutoff points as for the full Compustat sample). The survey sample covers 1,019 firm-year observations over the period 1993-2006 and the Compustat sample 87,845 firm year observations.

A: Survey firms.



B: Compustat sample.