An empirical test of the Pecking Order theory

on Medium Firms

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Firm size category: Medium

1. Introduction

The Pecking Order (PO) theory which is one of the most influential theories in corporate capital structure, predicts a hierarchy in funding in which firms prefer internal financing over external financing due to the absence of adverse selection costs. Adverse selection arises due to information asymmetry between a firm's management and outside investors. The three main sources of funding are as follows-

1. **Retained earnings/profits**- An internal source of funding where a company reinvests its own profits.

2. **Debts**- An external source of funding that includes bank loans and bonds issued by the company for external investors to buy.

3. **Equities**- An external source of funding where the company issues shares for outside investors.

The PO theory suggests that while firms prefer internal financing, they tend to prefer debt over equity financing when outside funds are necessary. This is due to lower information costs associated with raising finance through debts as an investor's risk is limited to default risk. Whereas, when issuing new shares, it may indicate to investors that management are taking advantage of stock overvaluation leading to a negative stock price reaction (adverse selection effect). Since debt is a fixed obligation and does not dilute ownership, it is generally perceived as a less negative signal than issuing equity. Therefore, from the firm's perspective it is more costly to fund projects through equity and cheapest to use internal funds.

In the past, empirical tests of the PO theory have given mixed results. Shyam-Sunder and Myers (1999), found initial support for the theory, showing that firms predominantly use debt to cover financing deficits. However, Frank and Goyal (2003) challenged these findings by showing that equity issuance was more common than predicted, especially among smaller firms. Their research suggests that the firm size will play a key role in examining the PO theory.

In our group research, we examine if the PO theory accurately explains the financing behaviour of medium firms in the US, by applying statistical and regression analysis to determine this. This study aims to empirically test the validity of the PO Theory by examining the relationship between financing deficit and net debt issued. If the theory holds, firms should prefer internal funds first, followed by debt issuance, and only resort to equity as a last option. The core

hypothesis to be tested is whether firms match their financing deficit with debt issuance on a dollar-for-dollar basis. The study extends its analysis by incorporating additional firm-level factors, such as tangibility of assets, market-to-book ratio, firm size, and profitability, to assess whether these factors influence corporate leverage decisions in a way that aligns with the PO theory.

2. Data

Our data sample is derived from Wharton Research Data Services and consists of a random sample of medium-sized US firms over the period 2014-2023. The dataset, contained in the Excel file *mediumfirm.xlsx*, includes several variables for each company over a series of years. Each company is represented by its GVKEY and is recorded and presented over time, with values recorded for key financial metrics. Some of the key financial indicators which are under consideration include cash dividends, long-term debt issuance and reduction, changes in working capital, cash flow and profitability, among others (measured in millions, USD). The dataset is structured as panel data, meaning it tracks multiple firms across multiple years, allowing for both cross-sectional and time-series analysis.

The dataset contains 16 variables

Variable	Description
gvkey	Global company key
fyer	Financial year
conm	Company name
curcd	ISO currency code
ggroup	Global Industry Classification (GIC) group
div (DIV)	Cash dividends in fyer (in million, USD)
invest (I)	Net investment in fyer (in million, USD)

wcap_delta(ΔW)	Change in working capital in fyer (in million, USD)
cashflow(c)	Cash flow after interest and taxes in fyer (in million, USD)
dissue	Long-term debt issuance in fyer (in million, USD)
dreduce	Long-term debt reduction in fyer (in million, USD)
tang_delta(ΔT)	Change in tangibility defined as the ratio of fixed assets to total assets
mtb_delta(ΔMTB)	Change in market-to-book ratio defined as the ratio of market value of assets (book value of assets plus the difference between market value of equity and book value of equity)
lsale_delta (ΔLS)	Log change in net sales
profit_delta (ΔP)	Change in profitability is defined as the ratio of operating income to book value of assets.
totalasset	Total assets (book value of assets, in million, USD)

3. Results and discussion

a) Financing deficit and Net debt issued

$$Net\ Debt\ Issued = \text{Debt Issuance} - \text{Debt Reduction}$$

Financing Deficit = Dividends + Net Investment + Change in Working Capital − Cash Flow

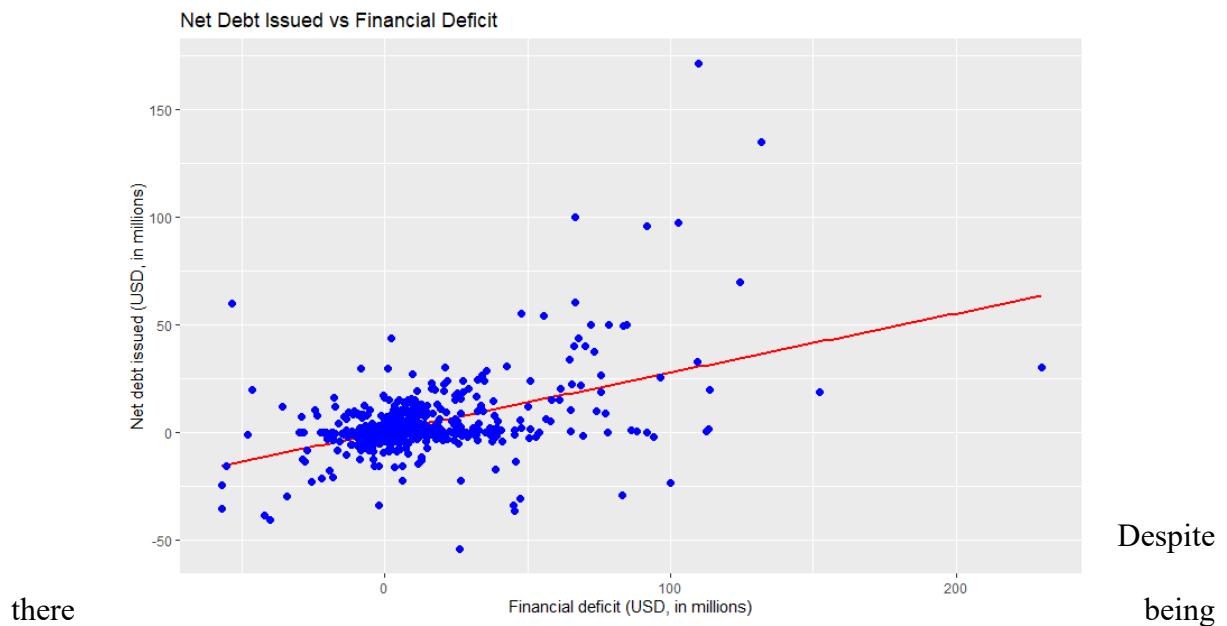|	Financing Deficit (in million, USD)	Net Debt Issued (in million, USD)
Mean	9.89	2.83
Median	3.61	-0.05
Standard Deviation	25.96	14.98

The median value for the financing deficit is lower than the mean indicating that the data is rightly skewed (there are a few firms with very large financing deficits pulling the mean higher).

The mean net debt suggests, on average, firms issue more debt than they reduce. However, the median implies that more than half of the firms are reducing debt rather than issuing it which shows that not all firms are actively increasing their leverage. Low median for net debt issuance suggests that firms can rely on internal financing or equity issuance for their capital needs rather than leaning heavily on debt.

Both financing deficit and net debt issued have high standard deviation showing diverse firm behaviour

b) Scatterplot showing net debt issued in relation to financial deficit

Despite there being some extreme values, the points revealed a clear upward trend indicating a broadly linear relationship between net debt issued and financial deficit. This suggests that as the financing deficit increases firms tend to issue more debt. The well-fitting regression line further supports the theory that firms will resort to external debt to cover the "Financing Gap" which aligns with the predictions of the PO theory.

c) Estimate the regression model:

$$\Delta D_i = \beta_0 + \beta_1 DEF_i + \varepsilon_i$$

 ➤ *Dependent variable ΔD_i = Net debt issued*
 ➤ *Independent variable DEF_i = Financing deficit*

Intercept (β_0)	Slope (β_1)	R-Squared
0.105	0.275	0.228

The above univariate model shows that net debt increases by \$0.275 million for every \$1 million increase in financing deficit which is significantly lower than the 1-1 relationship predicted by the PO theory. The intercept (0.1048) predicts the net debt issued when the financing deficit is zero but is statistically insignificant (p=0.841). The model explains 22.8% of the variation in net debt issued among firms highlighting that while financing deficit influences debt issuance, firms also rely on other sources of financing such as retained earnings or equity. The high residual standard error suggests significant unexplained variation, highlighting the need for additional explanatory variables.

d)Test the hypothesis implied by PO theory

$$H_0: \beta_0 = 0 \text{ and } H_0: \beta_1 = 1$$

Individually:

- $H_0: \beta_0 = 0$ $H_A: \beta_0 \neq 0$

  We fail to reject H0 (p-value =0.841) and conclude that when firms have no financing deficit they do not issue or reduce debt.

  Supports PO theory.

- H0: $\beta 1 = 1$ HA: $\beta 1 \neq 1$

  We reject H0 as there is sufficient evidence (p-value = 2.2e-16) to suggest that the relationship between financing deficit and net debt issued is significantly different from 1.

  Doesn't support PO theory which implies a 1-1 relationship.

Jointly:

- H0: $\beta 0 = 0$ and $\beta 1 = 1$ HA: $\beta 0 \neq 0$ or $\beta 1 \neq 1$

  We reject H0 (p-value = 2.2e-16) since at least one of the assumptions ($\beta 0 = 0$ and $\beta 1 = 1$) is violated.

  Firms therefore don't strictly follow PO theory and may use a combination of financing sources rather than rely on debt exclusively to cover financing deficits.

e) Multivariate Model

$$\Delta D_i = \beta_0 + \beta_1 DEF_i + \beta_2 \Delta T_i + \beta_3 \Delta MTB_i + \beta_4 \Delta LS_i + \beta_5 \Delta P_i + u_i$$

- *Dependent variable ΔD_i* = Net debt issued

- *Independent variables: (DEF_i, ΔT, ΔMTB, ΔLS_i and ΔP_i)*

- PO theory: $\beta_2 > 0$, $\beta_3 < 0$, $\beta_4 > 0$ and $\beta_5 < 0$

Independent Variable	Value	P-value	Supports PO theory	Statistically Significant?
Financing deficit DEF_i	0.275	<2e-16	✓	✓
Change in tangibility ΔT	4.318	0.419	✓	✗
Change in Market-to-book ratio ΔMTB	-0.078	0.522	✓	✗
Change in sales $ΔLS_i$	0.139	0.810	✓	✗
Change in profitability $ΔP_i$	0.486	0.757	✗	✗

Overall, the table indicates that firms largely respond to financial deficits by issuing debt and other explanatory variables included in the model are not statistically significant suggesting that these factors don't play a decisive role in explaining net debt issued in this sample. The positive indication for profitability directly contradicts PO theory as well as being statistically insignificant, implying that certain companies may issue debt even when prosperous.

f) Compare Model 1 and 2

Regression Model Comparison

	Dependent variable:	
	Net Debt Issued	
	Univariate Model	Multivariate Model
	(1)	(2)
Financing Deficit	0.275***	0.275***
	(0.019)	(0.019)
Change in Tangibility		4.318
		(5.335)
Change in Market-to-Book Ratio		-0.078
		(0.123)
Change in Log Sales		0.139
		(0.577)
Change in Profitability		0.486
		(1.571)
Constant	0.105	0.008
	(0.523)	(0.535)
Observations	726	726
R^2	0.228	0.230
Adjusted R^2	0.227	0.224
Residual Std. Error	13.169 (df = 724)	13.193 (df = 720)
F Statistic	213.851*** (df = 1; 724)	42.900*** (df = 5; 720)
Note:		$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

The multivariate regression does not significantly improve the univariate model. The univariate model already explains a significant portion of the variance in net debt issued. Although R-squared increases slightly in model 2, it has a lower adjusted R-squared suggesting that the additional predictors do not improve model fit.

Therefore, the financing deficit remains the primary driver of net debt issued, with a strong positive and statistically significant relationship that aligns with the PO theory. The additional variables (tangibility, market-to-book ratio, sales, and profitability) contribute little explanatory power.

4. Concluding remarks

Overall, our results show that medium-sized firms partially follow the Pecking Order theory. While there is evidence that firms with financing deficits are more likely to issue debt, the relationship is not perfectly proportional (dollar-for-dollar), and most firms are not aggressively increasing leverage. The additional explanatory variables had weak statistical significance with the net debt issued indicating that the financing deficit remains the dominant factor when making debt issuance decisions, which reflects predictions from the PO theory. However, the assumption of the dollar-for-dollar basis between financing deficits and debt issuance is violated meaning firms can deviate from the PO theory.

Additionally, the industry a firm operates in, and its broader financial position could significantly shape its capital structure choices. Therefore, future research could explore other factors such as industry-specific trends, macroeconomic conditions or regulatory environments to enhance the explanatory power of the model. Moreover, some firms may prefer alternative sources of financing such as convertible debt or structured financing to increase financial flexibility or optimise capital costs. These variations in financing behaviour help explain why the PO theory while useful is not always strictly adhered to in practice.

5. References

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