Testing Pecking Order Theory and Trade-off Theory
A System Dynamics Approach

Abstract

The fundamental objective of this paper is to present a dynamic framework to test the two competing theories; the Pecking Order Theory (POT) and the Trade-off Theory (TOT); that explain the capital structure behavior of firms. For this purpose we use System Dynamics (SD) method to develop a generic simulation model of a manufacturing firm based on generally accepted accounting principles. We model the capital structure decision conforming to POT and TOT to test the two competing theories, in isolation and in combination. The firms may pursue POT or TOT for their capital structure decision, but it is generally agreed that while doing so their prime objective is to maximize the firm value. Hence we presume that the managers stick to the core objective of firm value maximization.

Literature generally suggests the two competing theories as substitutes. We, however, demonstrate the firms following synergy of the two theories would outperform the firms following two theories independently in their pursuit of firm value.

Keywords – Capital structure, pecking order, trade-off theory, system dynamics.

1. Introduction

The complexity and strategic importance of long term capital structure behavior of the firms has resulted into a voluminous debate in corporate finance literature. Pecking Order Theory (POT) and Trade-off Theory (TOT) are two such competing and influential explanations. POT, while explaining corporate leverage behavior of the firms, suggests that there is no well-defined target capital structure rather asymmetric information between the firm and the market creates a hierarchy of costs in the use of external financing which is broadly common to all firms and the choice of debt or external equity is a partial function of management's view of the firm's future prospects. The firms prefer internal to external financing not only to avoid cost but also to avoid attention by not going to financial markets in view of asymmetric information. However, if external financing is a must the firms prefer debt over equity because of lower information costs associated with debt (Myers 1984).

The observations of Myers (1984) are contrary to the TOT, the other competing theory of firms' leverage behavior. The proponents of TOT suggest that the firms pursue an optimal capital structure by evaluating the costs and benefits of the additional financing. For a comprehensive literature review of both the theories please see (Harris and Raviv 1991). Corporate finance literature presents three main methods to test the two theories: empirical evidence, interview or survey, and model based approach. Empirical evidences from various contexts are mixed and inconclusive (Graham and Harvey 2001; Prasad, Green and Murinde 2001; Fama and French 2002). Some studies support POT (Baskin 1989; Allen 1993; Adedeji 1998; Shyam-Sunder and C. Myers 1999; Tong and Green 2005; Qureshi 2009) while others do not (Brennan and Kraus 1987; Vilasuso and Minkler 2001). This indicates that the outcomes of empirical study may heavily depend on its setting. Likewise, interview or survey may also assess the expected leverage behavior of the firms' policy makers in a given setting. Instead of putting forward some empirical evidence or carrying out interview or survey and hence avoiding bias due to setting of the study, we develop a generic simulation model of a manufacturing firm (hereinafter *'the firm'*) using System Dynamics method based on generally accepted accounting principles, and model the capital structure decision conforming to POT and TOT to test the two competing theories in isolation and in combination. The firms may pursue POT or TOT for their capital structure decision, but it is generally agreed that while doing so their prime objective is to maximize the firm value.

Hence, we presume that the managers stick to their core objective of firm value maximization.

Apart from introduction in this section we organize rest of the paper as follows: section 2 discusses the model, section 3 presents the analysis, section 4 presents conclusions and policy recommendations and bibliography is at the end.

2. The Model

The POT and TOT have different implications for leverage behavior of the firms, but it is difficult to adequately distinguish between the two due to complex network of feedbacks among different variables (Fama and French 2002). Therefore we consider it useful to represent this network by using SD method[1]. The Figure 1 depicts the structure of financial system of our virtual *'the firm'* which also defines the conceptual framework of the model.

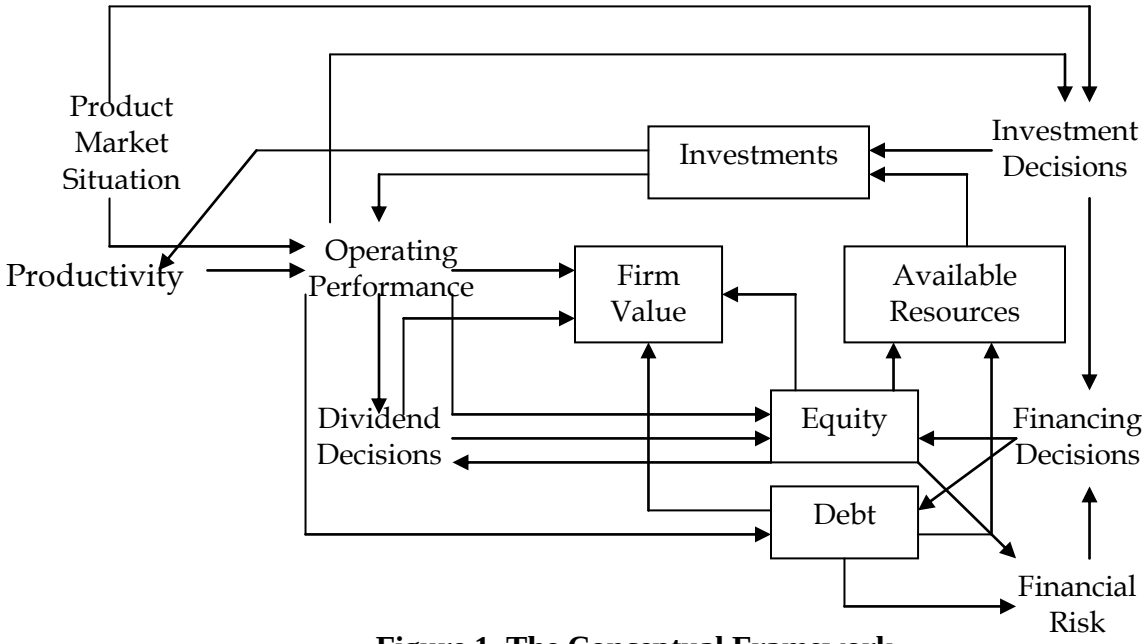

Figure 1. The Conceptual Framework
Adopted from: Qureshi (2007, p.27)

Available production capacity of *'the* firm' will be guided by its expected order rate and this serves as investment decision of *'the firm'*. It is generally observed that equity holders of low return firms would like to have firm's earnings paid as dividends so that they can invest in

[1] For a detailed explanation please see http://www.ifi.uib.no/sd/sdinfo.html

high return firm. On the contrary, investors of high return firm would like the firm to retain the firm's earnings and reinvest (Lyneis 1988), and as such we model the dividend decision of *'the firm'* as a nonlinear function of return on equity ratio (Figure 2).

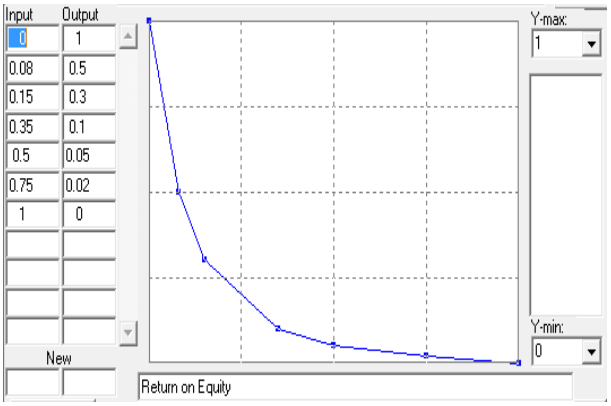

Figure 2. Dividend Decision

We consider that the management of *'the firm'* will stick to the *firm value maximization* construct in its decision making process, financing decision being one such decision. Initially, *'the firm'* is indifferent to debt and equity and hence initial debt to assets ratio is 0.5. However, to model the future financing decision we first calculate net cash flow of each period (t) as follows:

$$NCF_t = CR_t + B_t + NE_t - NI_t - DC_t - I_t - P_t - T_t - D_t \quad \text{.....Eq. 1}$$

where NCF_t = Net cash flow
CR_t = Cash receipts; cash sales plus collection of credit sales
B_t = Borrowing
NE_t = New Equity
NI_t = New Investment
DC_t = Direct costs
I_t = Interest payment
P_t = Principal payment
T_t = Tax payment
D_t = Dividend payment

The NCF_t each period is added to the beginning cash balance to give ending cash balance which is compared against minimum cash balance determined by the cash policy of *'the firm'*. The difference of minimum cash balance and ending cash balance gives the desired cash financing (C_t) at the end of period t. The Eq. 2 depicts modeling of total desired external financing ($TDEF_t$) of *'the firm'*.

$$TDEF_t = max(0, NI_t + P_t + C_t - NICF_t) \quad \text{.....Eq. 2}$$

whereas we model net internal cash flow ($NICF_t$) of each period, Eq. 3, following general pattern of a cash flow statement.

$$NICF_t = CR_t - DC_t - I_t - T_t - D_t \quad \text{.....Eq. 3}$$

Following Eq. 4 shows modeling of net desired external financing ($NDEF_t$) of *'the firm'* giving first priority to retained earnings (RE_t) (Myers 1984).

$$NDEF_t = TDEF_t + max(0, RE_t) \quad \text{.....Eq. 4}$$

POT gives second preference to debt and external equity is used as only the last resort. For this purpose we use the optimization feature of *Vensim*® grounded in *firm value maximization* construct to find out the optimal composition of debt and equity by specifying a reality check for each stock.

On the other hand, financing decision of *'the firm'* under TOT, takes into consideration trade-off between the debt tax shield which accrues due to presence of debt in capital structure and the bankruptcy costs. Figure 3 depicts non-linear function we assume to depict the effect of this trade-off on capital structure decision; between normalized interest tax shield and the debt assets ratio which we take as proxy of bankruptcy costs. The combined effect of these two will determine debt financing fraction for each period.

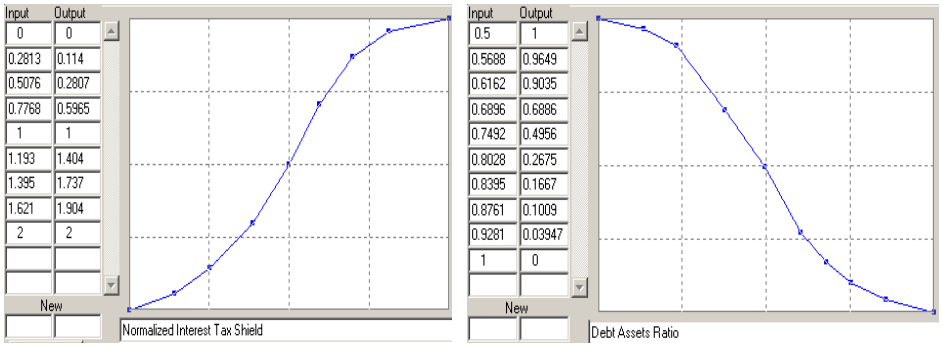

Figure 3. Effect of Interest Tax Shield and Bankruptcy Costs on Debt Financing Fraction

We multiply this fraction with $TDEF_t$ (Eq. 2) to determine new borrowing while testing TOT in isolation. However, when testing TOT in combination of POT we multiply this fraction with $NDEF_t$ (Eq. 4) to determine new borrowing.

As there is no widespread agreement on whether book or market values are more appropriate for tests of capital structure theory (Baskin 1989; Prasad, Green and Murinde 2001; Tong and Green 2005), we use net worth per share as proxy for firm value. This keeps the focus of this study endogenous.

4. Analysis

For the purpose of this study we first simulate this model to see if POT or TOT is more effective to maximize the value, and second we also depict combined impact of POT and TOT on value maximization. Generally any effort to model corporate behavior considers sales as exogenous and takes certain assumptions about it. For this purpose we consider three scenarios regarding sales; scenario1 assumes no growth, scenario 2 assumes 1% growth, scenario 3 assumes decline with -1% growth. Moreover, we assume the objective function of *'the firm'* is to bring increasing trend in book value per common stock. Furthermore, we assume that all other stocks except debt, equity and cash will at least maintain their initial level. This assumption not only puts a reality check in place but also helps to isolate capital structure decision and its impact. Under the three scenarios we simulate the model, for POT and TOT in isolation as well as in combination, by taking capital structure decision of 0%, 20%, 40%, 60% and 80% debt respectively and remaining to be financed through external equity. This enables us to demonstrate the impact of increasing leverage on corporate objective of firm value maximization under different theoretical frameworks.

4.1. Scenario 1 (No Growth)

Figure 1 depicts the simulation results under scenario 1 and different assumptions about debt. The results demonstrate that the two competing theories are at par if *'the firm'* assumes a low leverage policy. But TOT proves to be superior to POT if *'the firm'* gradually increases its dependence on leverage. However, in all policy options for leverage, except for very high debt dependence (80% debt) where TOT is a bit better than combination of POT and TOT, a combination of POT and TOT outperforms the TOT. It is also interesting to note that a low

leverage policy is relatively more useful for firm value maximization objective whatever capital structure theory, POT or TOT or a combination, the firms may follow.

4.2. Scenario 2 (Growth)

We present the simulation results under scenario 2 in Figure 2 while taking different assumptions about debt. The results demonstrate that TOT initially outperforms POT with low debt (20%) but in the long run POT proves to be better. Under the same debt assumption (20%) TOT initially stands at par with the combination of POT and TOT to achieve firm value maximization objective but in the long run it loses its strength and gives way to the combination of POT and TOT. We also observe similar behavior of 'book value per common' under 40% and 60% debt assumption but with 80% debt assumption TOT and the combination of POT and TOT stand at par to achieve firm value maximization objective. However, in all the three cases (40%, 60% and 80% debt) POT under performs. Moreover, Figure 2 depicts that a low leverage policy is relatively more useful for firm value maximization objective whatever capital structure theory, POT or TOT or a combination, the firms may follow. A supplementary observation is that higher debt dependence exacerbates underperformance of POT.

4.3. Scenario 3 (Decline)

Figure 3 presents simulation results under scenario 3 under different assumptions about debt. The results demonstrate that POT underperforms under all debt levels. But the TOT which is generally at par with the combination of POT and TOT to achieve firm value maximization objective remains a bit better than the combination with higher debt (80%). As we observed in other two scenarios a low leverage policy is relatively more useful for firm value maximization objective whatever capital structure theory, POT or TOT or a combination, the firms may follow. But a supplementary observation is that higher debt dependence initially exacerbates underperformance of TOT and the combination of POT and TOT but the firm value, 'book value per common' being its proxy, bounces back. Such an observed virtual behavior conforms to the *agency theory* of debt.

5. Conclusion and policy implications

For the purpose we develop an SD model of *'the* firm' conforming to the generally accepted accounting standards and model its financing decision conforming to POT and TOT. Without considering the firm value, POT explains managerial priority structure of financing sources to dynamically represent changes in debt levels. And we conform to value maximizing construct of TOT and instead of a static view we assume a dynamic role of debt level to define trade-off of interest tax shield and bankruptcy costs to determine future capital structure. Considering capital structure as a strategic decision in pursuit of value maximization agenda we observe that generally TOT proves to be better to POT in achieving the firm value maximization objective. We put forward POT as a complement to TOT rather than its substitution and demonstrate that a combination of POT and TOT is better to TOT as well as POT in isolation. The policy implication of this conclusion is that the firms may determine their financing needs by giving first priority to internal equity, most commonly observed corporate behavior, and then consider the trade-off of the costs and benefits of debt to decide the level of debt in their financing choices. Second policy implication that the firms may generally adhere to low debt policy in pursuit of their firm value maximization agenda is an outcome of our observation that low leverage policy generally performs better.

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