The Static Trade-Off against the Pecking Order Hypotheses of Firms' Capital Structure: A Survey of Testing Methodology and Proxy Variable

Andriansyah, Andriansyah

Ministry of Finance of the Republic of Indonesia

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Andriansyah[1]

Research and Information Technology Bureau
Bapepam-LK

I. Background

Capital structure policy is still considered as unsolved problems and of the most ten controversies in finance (Brealey *et al.* 2003) or 'a puzzle' (Myers 1984). The debate is mainly focus on whether changes in composition of capital of a firm could maximize the firm's market value. Under the frictionless capital market assumptions and no-arbitrage argument, Modigliani & Miller (1958) argued that capital structure decision and dividend policy are irrelevant to a firm market value. By relaxing the assumption of no-taxes, however, Modigliani & Miller (1963) suggested that a firm market value could be increased by increasing the financial leverage. This may happen due to the benefit of tax shields that the firm could receive according to corporate income taxes. The rational consequence of this is that the optimal capital structure is all debt-financed policy. Miller (1977), however, showed that by incorporating personal taxes, the benefit of debts is reduced. In reality firms do not apply these extreme policies (all debt-financed policy and irrelevant capital structure policy) and their financial leverage vary either inter- or intra-industry. There are many arguments that do not support that policy such as the static trade-off hypothesis and pecking order hypothesis.

The static trade-off hypothesis argues that financial leverage also creates financial distress and bankruptcy costs. Therefore, the firm should balance the benefit and the costs of leverage. The optimum capital structure is then achieved when the marginal benefit of debt equals to the marginal cost of debt. This hypothesis implies that firms have a long-term leverage target. The pecking order theory of Myers & Majluf (1984) and Myers (1984), on the other hand, argues that firms do not have the long-term leverage target. The financial leverage of a firm depends on the firm's net cash flows, not on the trade-off between the benefits and the costs of debts.

When there is no agreement in theories, an empirical test is needed to identify whether a firm's or average firms' capital structure in a country can be explained by a specific hypothesis. However, one needs to decide what methodology should be applied in the

[1] This paper was written as part of and when the author did Master of Finance at ANU, Australia.

empirical test. Furthermore, the methodology depends on data chosen and variables used as the proxy of a specific factor or determinant in the hypotheses. The use of debt-to-equity data as proxy for financial leverage ratio, for instance, seems to be straightforward but in fact we have to determine whether we want to use book or market value. The alternative of debt-to-equity ratio is debt-to-total equity and debt that is also frequently used in empirical research. The proxies of the other variables that are needed to be identified are tax shield benefit, agency cost, financial distress/bankruptcy costs, etc. These choice, eventually, affect the result of an empirical studies. This paper is trying to survey the methodologies and proxy variables used to test some hypotheses on capital structure. The objective is to understand the ideas behind the use of a particular methodology and is not intended to give the full descriptions or mechanics of the methodology nor to be a complete historical review (for complete review see Harris & Raviv (1991) and Myers (2003)). In this paper, the term of methodology also refers to the model used.

This paper only focuses on two hypotheses: the trade-off static hypothesis that identifies the trade-off between bankruptcy costs and tax shield benefits and the pecking-order hypothesis. These hypothesis are argued by Myers (1984) and Fama & French (2002) as the mainstreams, while such other hypotheses as agency costs, product/input market interactions, and corporate control consideration theories – that are called as "the managerial theories" – are not considered as the mainstreams because they "cut the umbilical cord that ties managers' acts to stockholders' interests" (Myers 1984:576). The organisation of this article is as follows. Section II and III briefly explain the static trade-off and pecking order hypotheses and their predictions about the relationship between particular factors/variables and leverage. While Section IV discusses several proxy variables for leverage determinants discussed in both hypotheses, Section V presents some methodologies including models that can be used to test the hypotheses empirically. Section VI summaries and concludes.

II. The Static Trade-Off Hypothesis

In searching of optimal capital structure, a firm must equate the benefit and costs of debts at the margin. While interest tax shield push the curve up, the costs of financial distress will push the curve down. The optimum debts will be achieved when the marginal value of NPV tax shields offset the marginal value of NPV financial distress costs. So if debts do not create financial stress and agency costs for a firm, then the optimum capital structure of the firm is all debt-financed capital structure, meaning that 100% of the firm's financing source is debts. Interestingly, this also means that the firm is practically being an all-equity financed

firm because the creditors of the firms are the only owner of the firm. However, in reality, there is no such firm that have 100% debt financing due to financial distress and agency costs. Financial distress is the condition where a firm experiences the difficulties to pay its debts – either the interests or the principal. The higher a firm uses debts as one of the financing sources, the higher the probability that the firm experiences financial distress. Financial distress costs, according to Brealey *et al.* (2003), are the costs of using the legal mechanism in taking over of a firm in the case of liquidation or receivership. There are direct and indirect costs of financial distress costs. The directs costs are legal and administrative costs; while the indirect costs, among others, are detraction of management time and efforts to run the business, and the reduction of customers confidence on the firm products and services. Another cost of debt is free cash flow problem that arises from conflict of interest between managers and shareholders. Debt contracts usually will set some restrictions on the using of cash by managers. Therefore, free cash flow problem could be minimized by debts. Figure 1 below illustrates the curve of optimum capital structure as the implication of the trade-off between net present value (NPV) costs of financial distress and NPV of interest tax shields.

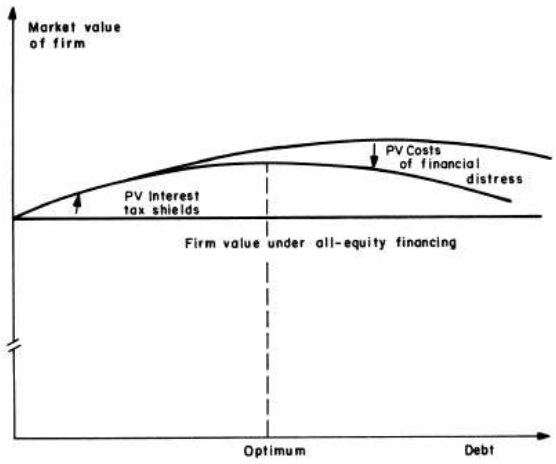

Figure 1. The static trade-off hypothesis (source: Myers 1984)

One of important implications of the static trade-off analysis is that firms may have a target debt. They will always adjust their leverage towards the target leverage. The phenomenon is well-known as the mean reversion process. Other implications are related with taxes and the potential costs of financial distress. Tax status will directly affect the leverage. Profitable firms, for instance, will have the higher trade-off curve rather than unprofitable firms because the financial distress in the profitable firms will be lower than that in their counterpart. Growth opportunity is also related with financial distress because it may damage growth opportunities (as intangible assets). Tangible assets, on the other hand, are

usually an evidence for large and safe firms which has relatively low financial distress. Financial distress is also correlated with business risks (as volatility): the riskier (the more volatile) the business, the higher financial distress.

The empirical testing on the static trade-off hypothesis is basically aimed at finding the statistical evidence on the mean reversion process and statistical relationship between leverage and its determinants discussed above. The empirical testing on the mean reversion or adjustment process toward debt targets, among others, are Taggart (1977), Marsh (1982), Auerbach (1985), Jalilvand & Harris (1984), Shyam-Sunder & Myers (1999), and Hovakimian *et al.* (2001). Meanwhile, the empirical testing on the statistical relationship betwen leverage and its determinants usually use either cross-section or panel regresion models such as in Schwartz & Aronson (1967), Bradley *et al.* (1984), Long & Malitz (1985), Titman & Wessel (1988), and Smitt & Watts (1992). Harris & Raviv (1991) summarised these theoretical implications of the static trade-off hypothesis as follows: while leverage is positively correlated with fixed assets, non-debt tax shields, growth opportunities, and firm size, leverage is negatively related with volatility, advertising and R&D expenditures (as a measure of growth opportunities), bankruptcy probability, profitability and uniqueness of product.

III. The Pecking Order Hypothesis

In the pecking-order hypothesis framework (Myers 1984; Myers & Majluf 1984), firms do not have either a target or debt ratio. This hypothesis stresses the existence of the priority lists (order) on how a firm finances its business. Myers (1983) and Brealey *et al.* (2003) summarized and restated that the pecking order theory results in the following order: (1) firms prefer internal finance; (2) firms' sticky target dividend payout ratio is subject to their investment opportunities; (3) internally-generated cash flow may be less than the investment outlays due to unpredictable fluctuation in profitability and investment opportunities, hence the firm draws down its cash balance and marketable securities portfolio; and (4) if external finance is required, the firm will issue the safest security first, e.g. (straight) debt, followed by hybrid securities such as convertible debt and equity as the last resort. This order is based on two key points: the cost of external financing and the advantages of debt to equity financing (Myer 1984). Issuing new securities is costly, in terms of underwriting costs and underpriced securities. Asymmetric information between managers and shareholders, in terms of the firm prospects and the value of securities the firm would like to issue, also force the firm to use internal funds in first priority. In short, capital structure changes when there is an imbalance

of internal cash flow, net of dividends and real investment opportunities (Myers 1984; Fama & French 2002).

If the pecking order hypothesis is valid, then one of its implications is that firms should maintain spare debt borrowing capacity. This is important because firms do not know about their future funds and investment opportunities; so if they do not have enough internal funds, they could borrow funds from external sources to finance the investment opportunities. Another implication is that high profitable firms with limited investment opportunities will have low debt ratios. On the other hand, firms who have many investment opportunities will use their internal funds to fund the opportunities and they will borrow if the internal funds are not enough. It means that the pecking order hypothesis predicts a negative relationship between debt ratio and past profitability. Fama & French (2002) summarized the relation between leverage and profitability and investment opportunities as follows: holding investment constant, leverage is lower for more profitable firms; and holding profitability constant, leverage is higher for firms with more investments. However, if firms also concern with current and future financing costs, Fama & French (2002) further more concluded that given profitability, leverage may be lower for firms with more investments. It is important to maintain debt capacity in order to anticipate the need of external funding in the future.[2] In terms of net cash flows, the pecking order hypothesis predicts that leverage is lower for firms with more volatile net cash flows.

The empirical testing on the static trade-off hypothesis is basically aimed at finding statistical relationship between leverage and its determinants, especially in terms of profitability and investment opportunities discussed above. The empirical evidence on the pecking order hypothesis, among others, are Shyam-Sunder & Myers (1999), Fama & fench (2002). Harris & Raviv (1991) summarized other several empirical evidence until 1990s, especially in their Table V panel D (page 340) and Table VII panel B (page 346).

IV. The Survey of the Proxy Variables

Leverage determinants or attributes are often in abstract terms, even for the leverage itself. There is no unique measure or representative of them. Titman & Wessels (1988) argued that this may lead to biased interpretations on empirical findings. Usually we use proxies for the variables of interest, but there are a lot of possible choices on which proxy to be used. So far there has been no consensus on which proxies are the best for measuring leverage and its determinants, or may be there will be no such consensus. However, it is important and of

[2] Fama & French (2002) referred to it as the complex version of the pecking order hypothesis.

interest to know various proxies that have ever been used in empirical studies on capital structure. This objective is straightforward. We will have alternative proxies, if we do not have a specific proxy we are looking for. This is important especially for researchers in developing countries which still have problem with limited published data and low data quality. Off course, the best judgement in choosing a proxy is the theoretical justification. The complete survey of the proxy variables is given in Appendix.

V. The Survey of the Methodologies

Based on the methodology employed, there are at least five methodologies that can be used as empirical testing on capital structure hypotheses: survey sampling, cross-section (or panel) regression models, two-step cross-section regression models, logit models, latent variable approach, and dynamic models. We will focus on a more representative and recent article to discuss the methodology employed in more detail. The logit and latent variable approach are discussed briefly because their model specifications are similar with cross-section or panel regressions. The only difference is in the type of dependent variable used: cross-section or panel regression using a continuous variable, while logit and latent variable approach use limited dependent variables.

V.1. Survey sampling

Survey sampling is a statistical technique used to select a small portion of population called a sample; from the results of sample analysis, we could infer the results about the population as a whole. The methodology issues in a survey sampling usually focus on the population frame, the sampling method, and the instrument design in which includes question designs. Here, we will focus on these issues to how existing literatures use the survey sampling to distinguish between the static trade-off hypothesis and the pecking order hypothesis such as Allen (1991) for Australia, Ang *et al.* (1997) for Indonesia, Graham & Harvey (2001) for the U.S., and Bancel & Mittoo (2003) for 16 European countries. However, this article will only focus on two articles: Allen (1991) and Ang *et al.* (1997). The reason behind the choice is that we hope that they are representative on how to conduct the survey sampling in developed and developing countries, especially in terms of their stock market development.[3] In addition, interestingly, both articles support different hypothesis: Allen (1991) argued in favour of the pecking order hypothesis, while Ang *et al.* (1997) found the evidence of the static trade-off hypothesis.

[3] We consider Australia, the U.S., and European countries have more developed stock market than Indonesia. Another reason is personal where the author is from Indonesia.

The target population of both articles of Allen (1991) and Ang *et al.* (1997) is similar. They wanted to draw conclusion about how the listed companies in Australia and Indonesia, respectively, make decision on their capital structure policy. The sampling frame, therefore, is the list of listed companies on the Australian Stock Exchange (ASX) and the Jakarta Stock Exchange (JSX) as the population frame.[4] The sampling method in the two articles, however, is different. Allen (1991) used the Australian Graduate School of Management Centre for Research in Finance data as a filter to find listed companies that have financial data to some reasonable length. The number of companies in his sampling frame finally reached the number of 159 companies. The random sampling method then was applied to choose a sample. Ang *et al.* (1997), on the other hand, did not use any filter. They directly mailed and sent a questionnaire to all listed companies. These different approaches are straightforward and make sense. Indonesian stock market is still young so we cannot expect that the listed companies have a reasonable length on financial data. Australian stock market is, on the other hand, quite mature so there are a lot of listed companies that have a long story. The final usable samples were 48 companies in Allen (1991) and 38 companies in Ang *et al.* (1997).

While Ang *et al.* (1997) purely surveyed by mailing questionnaires, Allen (1991) followed up the process with direct interviews. Using semi-structured questionnaire, he interviewed company secretaries and senior financial personal. There are two main parts of questions addressed. The first part is regarding the attitudes on funding sources and its determinants. There are six main questions in this part: the importance of taxes in policy making on the level of leverage, the existence of a target debt, the maintenance of spare debt capacity, the willingness to borrow more under current debt level and spare debt capacity, the importance of industry debt level, and the use of off-balancing sheet financial techniques. The second part is related to the preference for internal funds, debts, and equity, the existence of an upper limit debt and the measure of financial risks. The answers from the questions in both parts are important to distinguish between the static trade-off hypothesis and the pecking-order hypothesis. Ang *et al.* (1997) relatively addressed similar questions. For instance, they also asked questions on optimal debt level, the upper limit debt and the reasons to set the upper limit whether it is due to tax considerations, financial distress, or conflict of interest. The difference was that they did sensitivity analysis by asking 'if' questions. They set three

[4] Actually, there are two stock exchanges in Indonesia; the other one is the Surabaya Stock Exchange (SSX). However, the main and more representative exchange to Indonesia is the JSX. Furthermore, a public company in Indonesia usually has it listed on both exchanges so that there is not much difference between them. In addition, both exchanges in 1997 have entered the memorandum of understanding with the ASX.

scenarios and asked what financial sources the sample companies use when the debt level were at the same, 25% higher, and 20% lower than the current level.

The findings of Allen (1991) and Ang *et al.* (1997) are different. Allen (1991) found that the majority companies in his sample consider that taxes are very important in deciding the debt level. They also have a target debt, an upper limit debt, and spare debt capacity, and are willing to borrow more under current target debt and spare debt capacity level. Further questions in the second part revealed the fact that the majority companies prefer internal funding as the first main source and the mixture of retained profit and debt funding as the second sources. None preferred equity. Their reasons were that equity financing is costly and time consuming, while debt financing is quicker. However, they will use equity financing when they have already reached unreasonable debt level, so the use of equity financing is expected to bring down leverage to more comfortable level. However, they will only issue equity when the market condition is right, and not solely based on the debt level. Based on these findings, Allen (1991) concluded that his sample support the pecking order hypothesis rather than the static trade-off hypothesis. Ang *et al.* (1997), on the other hand, argued for the static trade-off hypothesis. They found that the sample companies set their optimum debt ratio to 48%, but their actual ratio was only 41%. Indonesian listed companies preferred to use banks loans as the main source, followed by retained earning and the equity as the last source. They also found that the main reasons why the Indonesian listed companies set the upper limit debt are tax consideration, financial distress and conflict of interests. The sensitivity analysis revealed the fact that retaining earning is the most preferred source of financing, when equity financing is only preferred when the debt level is already 20% higher than the current level. They also found no evidence on underestimation problem in their sample. Therefore, they conclude that there was no evidence for the pecking order hypothesis in Indonesian listed companies.

V.2. Cross-section or panel regression models

Based on the type of data used, a linear regression model can be classified into three types: a cross-section regression model, a time-series regression model, and a panel or a pooled cross-section time-series regression model (Wooldridge 2000). Cross-section data are those taken across firms or countries data at a particular time, while time-series data are over time data on a particular firm or country. The panel data are the combination of both cross-section and time-series data. As discussed in Section III, empirical testings on the static trade-off hypothesis have been done by using both mean reversion (adjustment process toward debt

targets) models and cross-section or panel regression models. In fact, the mean reversion models also use cross-section data, so we also classified them as cross-section or panel regression models. However, in the following subsection we will separate them into two groups: pure cross-section regression models and mean reversion models. The former are the models that do not accommodate the adjustment process toward debt targets, while the latter are the models that accommodate the adjustment process. We will illustrate how the models are used in more details in the third subsection (V.2.3) that combine pure cross-section regression model and mean reversion model by using the article of Shyam-Sunder & Myers (1999).

V.2.1. Pure cross-section or panel regression models

We can classify such following articles Schwartz & Aronson (1967), Bradley *et al.* (1984), Long & Malitz (1985), Smitt & Watts (1992), and Rajan & Zingales (1995) into pure cross-section regression models. The general representation model with cross-section data is as follows:

$$[1] \qquad y_{it} = \alpha + \sum_{j=1}^{p} \beta_j x_{ijt} + \varepsilon_{it}$$

Where y_{it} is a leverage of firm-i at year-t, α is a constant, β_j is a j^{th}-parameter, x_{ijt} is a j^{th}-leverage determinant for firm-i at year-t, and ε_{ij} is a disturbance or errors term, and p is the number of leverage determinants. The number of leverage determinants is chosen according to some theoretical justification. However, some articles have used different determinants. Harris & Raviv (1991) in their Table IV page 336 reviewed some determinants of leverage (volatility, bankruptcy probability, fixed assets, non-debt tax shields, advertising, R&D expenditures, profitability, growth opportunities, size, free cash flow and uniqueness) and summarized the empirical findings on the relationship between leverage and its determinants.

Technically, to test if a firm financing decision follows either the static trade-off hypothesis or the pecking order hypothesis, we test if a specific parameter (or test some parameters jointly) is statistically significant and agrees with the sign and magnitude predicted by a specific hypothesis.

V.2.2. Mean reversion models.

A mean reversion model tries to examine whether there is an evidence of the adjustment process or mechanism towards the target leverage. There are two keys here: the target debt and the actual ones. Taggart (1977), Auerbach (1985), Jalilvand & Harris (1984), and Shyam-

Sunder & Myers (1999), are examples of articles that use the mean reversion models. The mean reversion model is generally represented by the following model:

$$[2] \qquad y_{it} - y_{it-1} = \Delta y_{it} = \alpha + \delta(y_i^* - y_{it}) + \varepsilon_{it}$$

Where δ is the speed of adjustment coefficient, y_i^* is the target leverage for firm-i. Technically, to test if a firm financing decision follows either the static trade-off hypothesis or the pecking order hypothesis, we test if δ is statistically significant different from zero. If it is insignificantly different from zero, we may suspect that the firm financing decision follows the pecking order hypothesis; otherwise we have a reason to argue for the static trade-off hypothesis.

The main problem with the mean reversion model is how to estimate the target leverage. This target is unobservable in practice. There are at least three approaches to estimate the unobservable debt target level by using (1) historical mean, (2) moving average,[5] and (3) historical firm's characteristics information. The latter is quite similar with the model [3] described above:

$$[3] \qquad y_i^* = \alpha + \sum_{j=1}^{p} \beta_j x_{ijt} + \varepsilon_{it}$$

V.2.3. An illustration

We use the article Shyam-Sunder & Myers (1999) to illustrate the use of the cross-section or panel regression model. We choose their article because of these following reasons: (1) they test both hypothesis jointly when other articles test the hypothesis separately, and (2) they show how to examine the statistical power of the test against alternative hypotheses; this is important to decide whether the findings are valid or not. They argued that if actual financing follows the static trade-off hypothesis, the pecking order hypothesis can be rejected. On the other hand, if the actual financing follows the pecking order hypothesis, the static trade-off hypothesis cannot be rejected (it works) because of time patterns of capital expenditure and operating income which create mean-reverting leverage.

Let the funds flow deficit of firm *i* be defined as follows:

$$[4] \qquad DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} + R_{it} - C_{it}$$

[5] Jalilvand & Harris (1984) used a three-year moving average.

Where C_{it} is operating cash flows after interest and taxes, DIV_{it} is dividend payments, X_{it} is capital expenditure, ΔW_{it} is net increase in working capital, R_{it} is current portion of long-term debt at the start of period that has to be repaid during period *t*. According to pecking order hypothesis, the amount of debt issue, ΔD_{it} (the net increase in long-term debt outstanding D_{it}),[6] will be affected by the deficit. This relationship is represented in the following simple regression model:

$$[5] \qquad \Delta D_{it} = \alpha_0 + \alpha_1 DEF_{it} + \varepsilon_{it}$$

We expect that if the firm's actual financing follows the pecking order hypothesis, then $\alpha_0 = 0$ and $\alpha_1 = 1$.[7] In contrast, if the firm's actual financing follows the static trade-off hypothesis, the amount of debt issue will be affected by the deviation of the current amount of debt from the debt target (D_{it}^*). The representation of the static trade-off hypothesis is as follows:

$$[6] \qquad \Delta D_{it} = \beta_0 + \beta_1 (D_{it}^* - D_{it}) + \varepsilon_{it}$$

We expect that if the firm's actual financing follows the static trade-off hypothesis, then $\beta_1 \neq 0$. The slope is called as the target-adjustment coefficient and it depends on how quick the firm adjust its current amount of debt toward the target level. Both models may be estimated by the ordinary least square (OLS) method. Interestingly, we could combine the two models into one model. The results will be virtually identical.

As an alternative of average debts, Shyam-Sunder & Myers (1999) proposed to use fixed assets, growth opportunities, tax-paying status and profitability to estimate the target debt. Denoting each firm characteristic above by *Plant*, *R&D*, *Tax*, and *Earning*, respectively, the debt target can be estimated by the following regression model:[8]

$$[7] \qquad D_{it}^* = \phi_0 + \phi_1 Plant_{it} + \phi_2 R\&D_{it} + \phi_3 Tax_{it} + \phi_4 Earning_{it} + \varepsilon_{it}$$

The findings of Shyam-Sunder & Myers (1999) are as follows. By using 157 firms in the period 1971, 1981, and 1989, they found evidence that support the pecking order hypothesis. The speed of adjustment coefficient was significant when they use average debts

[6] We replace the notation y_{it} here to distinguish that the notation refers to general terms of leverage.

[7] The sign of the slope is not considered in this article because a firm may have a surplus $DEF_t < 0$ or a deficit $DEF_t > 0$.

[8] Actually, Shyam-Sunder & Myers (1999) used the debt book ratio, d_{it}^*, and all other explanatory variables are in portion of sales or assets. Theoretically, however, the OLS estimate will be the same. The proxy variables for each firm characteristic can be seen in Section IV.

as the target debt, but the coefficient was insignificant when they use 3- and 5-year moving average. The estimate of α_0 and α_1 are 0 and 0.85, respectively. In order to check the statistical power of the hypotheses, their simulation results in that it consistently supports the pecking order hypothesis. They used a Monte Carlo simulation technique to check the statistical power of the test against alternative hypotheses. The first step is to start with firm characteristics and simulate them under the hypotheses to determine the target debt. The second step is then to test whether each hypothesis could be rejected if financing were generated by an alternative.

V.3. Two-step cross-section models

The use cross-section or panel regression model above is criticized by Fama & French (2002). They argued that standard errors of the estimated parameters are invalid, so the inference based on these standard errors will be misleading. The problem on the standard errors is due to correlation in the residuals across firms and serial correlation in the residuals across the year. While cross-section regression models only suffer from the former, the panel regression models suffer from both types of correlations.

Fama & French (2002) proposed to use two-step cross-section models that based on Fama & MacBeth (1973)'s article. Principally, the models run separate regressions with cross-section data and regressions with time-series data. In the first step, we run cross-section regressions for each year and get the average slopes (estimated parameters). In the second step, we use the average slopes in a time-series regression. The standard errors that we use are the standard errors that we get from the second step. Fama & MacBeth argued that the average slopes in their approach will contend the same information as that in panel regression, but the standard errors are more valid and more robust.

The model used in Fama & French (2002) was principally similar to [1], [2] and [3] above, except that they put together [1] and [2] into a single model which is representated as follows:

$$[8] \qquad y_t / A_t - y_{t-1} / A_{t-1} = \alpha + \delta(y_t^* / A_t - y_{t-1} / A_{t-1}) + \beta_1 E_t + \beta_2 E_{t-1} + \beta_3 I_t + \beta_4 I_{t-1} + \varepsilon_t$$

Where A_t is assets, E_t is earnings and I_t is investment. They argued that there are only two main determinants of leverage, i.e. earnings and investments. The other variables are considered as determinants of target leverage as in the model below:

$$[9] \qquad y_t / A_t = \phi_0 + \phi_1 V_t / A_t + \phi_2 ET_t / A_t + \phi_3 Dp_t / A_t + \phi_4 RDD_t / A_t + \phi_5 RD_t / A_t + \phi_6 \ln(A_t) + \phi_7 TP_t + \varepsilon_t$$

Where V_t is the firm's market value, ET_t is earning before tax, Dp_t is the depreciation expenses, RDD_t is the a dummy variable whose value is 1 if firms with zero or no reported R&D and 0 otherwise, RD_t is the R&D expenses, and TP_t is the target payout.[9] The fitted value of [9] is the estimated target leverage needed in [8].

The findings of Fama & French are as follows. Using annual samples over the period 1965-1999, they found mixed evidence on both hypothesis. While the adjusment coefficient was statistically significant, the relationship between leverage and its determinants was slightly similar to that predicted by the pecking order hypothesis.

V.4. Logit model and latent variabe approach

Rather than using a measure of leverage in a continuous variable, Marsh (1982) and Hovakimian *et al.* (2001) used a measure of leverage in form of limited (binary) variables. Hovakimian *et al.* (2001), for example, used the financial choice of either debt or equity issue, and either debt reduction or equity repurchases rather than the actual level of leverage. When the dependent variable is binary, the linear cross-section or panel regression models described above cannot be used anymore because some assumptions behinds the models are violated. An alternative model to accommodate a binary dependent variable is a logit model. We will not discuss the details of the models here.[10] The model specifications are similar to cross-section or panel regression models and mean reversion models discussed earlier; the only difference is the logit models replace leverage with financial choice as a dependent variable. Other explanatory variables and mean reversion process are similar. When a firm is facing a problem in choosing equity repurchase and debt retirements, Hovakimian *et al.* (2001) found that the firm tends to adjust their leverage towards the target leverage. This, according to them, was consistent with the static trade-off hypothesis.

The use of proxy variables in testing capital structure hypotheses were criticized by Titman & Wessel (1988). They argued that there are three weaknesses of this approach. Firstly, there is no unique representative of a proxy. Researchers will not be able to avoid the bias in choosing a proxy; therefore their interpretation about their research finding will also be biased. Secondly, usually a proxy they choose is correlated with another proxy; this will create

[9] Fama & French (2002) jointly investigated both dividend and capital structure policies. In the model of leverage, they also used the target payout.

[10] See Wooldridge (2000) and Verbeek (2004) for technical discussion on some limited dependent variables such as probit and logit models.

multicolinearity in their regression models. Thirdly, there will be a measurement error problem because they cannot measure the proxy perfectly. And finally, there is a possibility to have a spurious regression because the measurement errors in both proxy variables and disturbance terms. To overcome these weaknesses, Titman & Wessels (1988) proposed to use a latent variable approach or a linear structural modelling; they used indicator variables rather than proxy variables. An indicator variable is a function of unobservable leverage determinants. For example, as an indicator variable of growth, they used capital expenditures-to-assets and the growth of total assets. The uniqueness is measured as a function of R&D expenditures-to-sales, selling expenses-to-sales, and quit rates. However, their results were inconclusive; some supported the static trade-off hypothesis, the other supported the pecking order hypothesis.

V.5. Dynamic models

Fischer *et al.* (1989) and Graflund (2000) indicated that all models discussed above are single period models and not trying to capture dynamic behaviour of the capital structure. While Fischer *et al.* (1989) proposed a new model that is specific to the capital structure hypothesis, Graflund (2000) used the co-integration analysis that makes it possible to examine the short-run and long-run dynamics of the capital structure. The co-integration analysis has been an integral part in model econometrics and has been widely used in many applications including finance. Here, we will focus on the co-integration analysis on the capital structure proposed by Graflund (2000).

Graflund (2000) used both bivariate and multivariate models of co-integration analysis. In the bivariate models, he tested three hypotheses on the existence of equilibrium relationship between (1) agency costs and leverage, (2) bankruptcy costs and leverage, and (3) tax shields and leverage. The general representation of a bivariate model is as follows:

$$[10] \qquad y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} y_{t-i} + \sum_{j=1}^{q} \beta_{1j} x_{t-j} + \varepsilon_{1t}$$

$$[11] \qquad x_t = \beta_0 + \sum_{i=1}^{p} \alpha_{2i} y_{t-i} + \sum_{j=1}^{q} \beta_{2j} x_{t-j} + \varepsilon_{st}$$

Where x_t is a leverage determinant. To test the dynamic relationship between leverage and one of its determinants, we need to test the significance of α_1, α_2, β_1, and β_2. If all parameters are significantly different from zero, it means that both variables affect each other dynamically. In other words, a leverage determinant truly determines a level of leverage, and at the same time leverage also affects the leverage determinants. If α_1 and α_2 are insignificant, we can say that leverage is affected by its determinant, but it does not affect the determinant. However,

we have this approach requires both leverage and its determinant have a unit root and co-integrated. Using the case of Hufvudstaden, Graflund (2000) found that there is a dynamic relationship between leverage and its determinants.

Another important difference between co-integration approach of Graflund (2000) is that we can focus on a firm, rather than on several firms using cross-section data. Unfortunately, this approach, that is a pure time-series analysis, requires a long data period. If we use annual data, at least we need 30 years to be able and make a valid inference about the results. It may not be a big issue for developed countries, but it is obviously a crucial problem for developing countries.

VI. Conclusion

This paper has reviewed some proxy variables and methodologies that can be used to test two competing hypotheses on capital structure, namely the static trade-off hypothesis and the pecking order hypothesis. Some leverage determinants are unobservable, so it needs to find observable variables as the proxy for them. There are a lot of alternatives of a proxy for a determinant of leverage. The leverage itself is defined differently. Therefore the choice of proxy is very important in testing capital structure hypotheses.

There are also many methodologies that can be used. Some of them are survey sampling methodology, cross-section or panel regression models, two-step cross-section regression models, co-integration models, and logit model as well as a latent variable approach. The static trade-off hypothesis may be tested by using a mean reversion model in which indicates that actual leverage of a firm continuously adjust itself toward the target leverage. The pecking order hypothesis, on the other hand, requires that the adjustment must be zero because it does not assume the existence of leverage target. The dynamic relationship between leverage and its determinants may be examined by using a dynamic model such as a co-integration analysis.

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APPENDIX

Variables	Proxies	Sources
Leverage	Net debt issued-to-assets	Shyam-Sunder & Myers (1999)
	Gross debt issued-to-assets	Shyam-Sunder & Myers (1999)
	Change in debt ratio	Shyam-Sunder & Myers (1999)
	Book debt-to-the sum of book debt and market value of equity.	Hovakimian *et al.* (2001)
	Market-to-book debts	Hovakimian *et al.* (2001); Titman & Wessel (1988)
	Debts-to-book value of equity	Graflund (2000)
	Long-term debts-to-book value of equity	Graflund (2000)
	Debts-to-market vale of equity	Graflund (2000)
	Long-term debts-to-market value of equity	Graflund (2000)
Tax status/Tax shields	Tax paid-to-sales (or assets)	Shyam-Sunder & Myers (1999)
	Investment tax credit	Graflund (2000)
Nondebt tax shields	R&D expenditures-to-assets	Fama & French (2002)
	Depreciation expenses-to-assets	Fama & French (2002)
	Investment tax credits-to-assets	Titman & Wessel (1988)
	Depreciation-to-assets	Titman & Wessel (1988)
Bankruptcy costs/ Risks/Volatility	Volatility of earning	Fama & French (2002)
	Natural logarithm of assets	Fama & French (2002)
	(fixed charges minus EBIT)-to-standard deviation of earning	Marsh (1982)
Intangible assets/ Growth/Investment opportunities	R&D expenditures-to-sales (or assets)	Shyam-Sunder & Myers (1999); Fama & French (2002); Hovakimian *et al.* (2001); Titman & Wessel (1988)
	R&D expenditures	Long & Malitz (1985)
	Change in assets-to-assets	Fama & French (2002); Titman & Wessel (1988)
	Market-to-book value of assets	Fama & French (2002)
	Book-to-market of assets	Smith & Watts (1992)
	Capital expenditures-to-assets	Titman & Wessel (1988)
Agency costs	Tobin's Q	Graflund (2000)
Costs of debts	3-month T-bills rate	Graflund (2000)
	Long-term bonds	Graflund (2000)
Profitability	Operating earning-to-sales (or assets)	Shyam-Sunder & Myers (1999)
	Preinterest, pretax earning-to-assets	Fama & French (2002)
	Preinterest, after-tax earning-to-assets	Fama & French (2002)
	Market-to-book value of assets	Fama & French (2002)
	3-year average return on assets	Hovakimian *et al.* (2001); Titman & Wessel (1988)
	ROI	Marsh (1982)

APPENDIX
(continued)

Variables	Proxies	Sources
Fixed assets	Plant and equipment-to-sales (or assets)	Shyam-Sunder & Myers (1999)
Uniqueness	Selling expenses-to-sales	Hovakimian *et al.* (2001)
Size	Natural logarithm of assets	Hovakimian *et al.* (2001), Marsh (1982)
	Median real sales	Smith & Watts (1992)