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A Study on Optimal Capital Structure of Vietnamese Real Estate Listed Firms

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Abstract

This paper focuses on those structural models with an endogenous default barrier where firms optimally choose a default boundary so as to maximize the equity value. The analysis commences to cover avowedly theoretical frameworks from pioneering works by Black-Scholes (1973) and Merton (1974) on zero-coupon debts to later extensions of those models for a more complex debt structure to include coupon perpetual bonds (Leland, 1994) and of arbitrage maturity or rolled-over debts (Leland and Toft, 1996). Furthermore, this paper studies the empirical performance of capital structure models by testing the optimized gearing levels computed from those models with different assumptions. Parameters of these models are estimated from the firms' equity prices. The novelty of this paper lies in the fact that it is not merely a summary of static theories on capital structure but it is the first of its kind to empirically study the capital structure choices of Vietnamese real estate firms, with primary focus on static models. This research follows secondary data analysis to investigate market information of stock returns and attempts to examine the potential dissimilarity in actual and proposed optimal gearing levels for the two years 2014 and 2016.

Keywords: Geometric Brownian motion; parameters estimation; static optimal capital structure; structural approach; drift and volatility.

JEL code: C61.

1. Introduction

Capital structure is an essential part of corporate finance and has received much attention from researchers worldwide. Management is often concerned with the composition of different sources of funds (equity, debts, or hybrid securities) to finance the firm's operations and growth. In fact, firms can raise their values by taking advantage of tax benefits but otherwise hesitate to increase debt levels for fear of increasing the probability of financial distress. The appropriate mix of debts and equity, the optimized combination, therefore should be examined. According to Graham (2000), a typical firm is estimated to be able to increase its value by up to 7.3% just by issuing more debts to the point where the marginal tax benefits start to decline. This paper thus puts an emphasis on the significant role of capital structure and how firms make decisions on optimal leverage to maximize their value.

This study is conducted so as to examine the optimal leverage ratios generated by a number of structural models. The research, as a result, intends to reveal answers for the following queries: How is "endogenous default" defined? How are optimal leverage ratios for firms computed, following several well-known static capital structure models? Given common input data, what are the reasons for the differences among predictions of different models regarding optimal capital structure? And how well can these models capture actual optimal gearing levels?

Our analysis is restricted to structural models for capital structure. These models assume that the firm value changes randomly over time with known expected returns and volatility. In the endogenous default case, firms will choose to declare bankruptcy when the firm value touches an optimally-predetermined threshold that maximizes the benefits of shareholders.

2. Literature review

Capital structure has always been the main concern of both academics and corporations. The foundation of modern theories on capital structure is disputably established since the introduction of the Modigliani – Miller Irrelevance Theorem on capital structure. Modigliani and Miller (1958) stated that firms, given a set of assumptions, would be indifferent to capital structure decisions, as their value was not affected by the choice of capital structure. The theorem was initially developed in the absence of market frictions like taxes, agency costs, asymmetric information and bankruptcy costs. That is, in the presence of perfect financial markets, an unlevered firm and a geared counterpart assume the same market value and the cost of equity rises with the increase in the leverage ratio as the risk to equity holders rises accordingly. The propositions were later modified to take into account the fact that interest expenses could be deductible and that the value of the firm would increase along with an increase in debt use, thanks to the amount of tax saved (Modigliani and Miller, 1963). The modified proposition states that there exists an optimal capital structure where the firm is financed 100% by loans as WACC drops along with the increase in gearing level (as debts prove to be a cheaper source of funds). As can be easily guessed, neither of the two extreme cases should be observed in practice. In his later work, Miller (1977) concludes that in the presence of both corporate and personal taxes, an economy-wide leverage ratio can be achieved but states that individual companies are indifferent to capital structure.

Modern theories of capital structure can be categorized into two groups. The first category, including the agency theory, the trade-off theory and the free cash flow theory, acknowledges the existence of an optimal leverage level while the second group (with pecking order theory and market timing theory) contradicts the former's acknowledgement (Abdeljawad et al., 2013). The last paper also recognizes key differences between the dynamic versions of both groups of theories. While the first category realizes firms adjust their debt levels towards what they deem the target, theories in the second group fine-tune the "observed leverage" according to the factors that affect the leverage level.

The trade-off theory of capital structure argues that an optimal capital structure can be reached, taking into consideration the advantages and disadvantages associated with borrowings. In other words, the trade-off theory insists that companies look for a target debt ratio (Jalilvand and Harris, 1984). Debts can be used to cut the firm's taxable income thanks to the tax deductibility of interest payments. Meanwhile, the use of debts can surely raise the risks of bankruptcy (Warner, 1977). The balance of the costs and benefits would decide the optimal debt ratio that maximizes the value of the firm.

Structural models, allegedly initiated by Merton (1974), examine the evolution of "structural variables" of companies; for example, the asset value to quantify their default points (Benito et al., 2005). Structural models have been proved to perform quite well as a predictor of distress and ratings transitions. However, one drawback of these models is their inapplicability in private companies due to data unavailability about stock prices. Besides, many of their key assumptions are often violated, resulting in limited implementation in reality.

Structural models, like those introduced later in this essay, distinguish themselves from reduced-form approaches pioneered by Jarrow and Turnbull (1995) in the fact that the former use stock information while the latter need bond prices or credit derivative data. Moreover, in structural models, defaults are determined endogenously while reduced approaches generate defaults exogenously (Elizalde, 2006). In more detail, structural models assume that default occurs when the state variable drops below a certain default barrier, while reduced-form models accept that default is an event driven by "default intensity" and do not consider default-triggering events and/or conditions (Poulsen and Miltersen, 2014). Another difference worth noting is that in general, structural models require a larger set of information, which includes those often observed by managers/ insiders. On the whole, from this point onwards, only structural models will receive the spotlight as they prove to attentively put an emphasis on capital structure while their reduced-form counterparts are more concerned with corporate debt pricing.

While the extent to which structural models can describe practical situations remains debatable, these models undoubtedly supply important insights about the factors that drive the determination of capital structure and debt valuation (Hongkong Institute of Bankers, 2012), the target of our analysis. Besides, structural models appear to do well in many specific applications.

According to the static capital structure theory, firms could seek to figure out the best debt-to-equity ratio that helps to optimize their value, which is called the optimal capital structure level. For all-equity companies, firms' value is maximized at time 0. The static capital structure model then assumes that they can issue debts one time only, resulting in a stationary debt level. The probability of default exists and shareholders cannot refund at any rate. In fact, Myers (1993) has pointed out several flaws with the static trade-off theory and stresses that only models based on an asymmetric information problem (pecking order theory) and those rooted from the proposition that firms act in their own interests remain in the race of explaining capital structure. Hammes (2004) concludes that most capital structure studies are "static" and firms are assumed to stick with a single level of optimal capital structure for good.

Real estate firms, with their distinctive features, present "unique opportunities" to examine capital structure theories (Bond and Scott, 2006). That may explain why there are quite a number of studies with respects to capital structure in the sector of real estate, though with different aspects. Bond and Scott (2006) conducted an empirical study on a sample of 18 public firms in the UK for a period of seven years until 2004, in which they examined the two popular theories of capital structure. Specifically, they tried to develop two models of simple pecking order and trade-off to explain capital structure choices of companies under research.

Hammes (2004), meanwhile, conducted research in an approach to analyze data of Nordic (Denmark, Finland, Norway, and Sweden) real estate companies and found large differences among those countries with respect to adjustment speed towards target leverage level. Haron (2014) conducted a study to test the determinants of target capital structure in Malaysia, incorporating as many as 127 listed companies operating in the real estate sector in the country for a 10-year period from 2000. The research, published online in early 2014, finds that Malaysian real estate firms did follow what is referred to as dynamic capital structure, which is under the influence of such factors as tangibility, profitability, and non-debt tax shield as well as the size and growth opportunities of the firms themselves. It confirms that the companies' choice of capital structure is partially explained by what are deemed the most famous theories, i.e. the dynamic trade-off, the pecking order and the market timing theories.

Limited studies have been carried out with regards to capital structure in Vietnam, needless to say in the sector of real estate. Thus, this study, though preliminary, aims to test capital static structural models in the case of Vietnamese listed property companies. These models, presented with different "optimal" capital structure levels, will help to realize the differences in results obtained through different sets of assumptions, from which it is expected to add some values to current researches in such financial aspects locally. One challenge posed for this study is that given the Vietnamese market, there is yet to be a study on the variables necessary to estimate structural values. This paper, thus, handles the issue with the use of the method of parameter estimation and Black-Scholes framework, which are the core of most financial theories.

3. Static structural models of capital structure

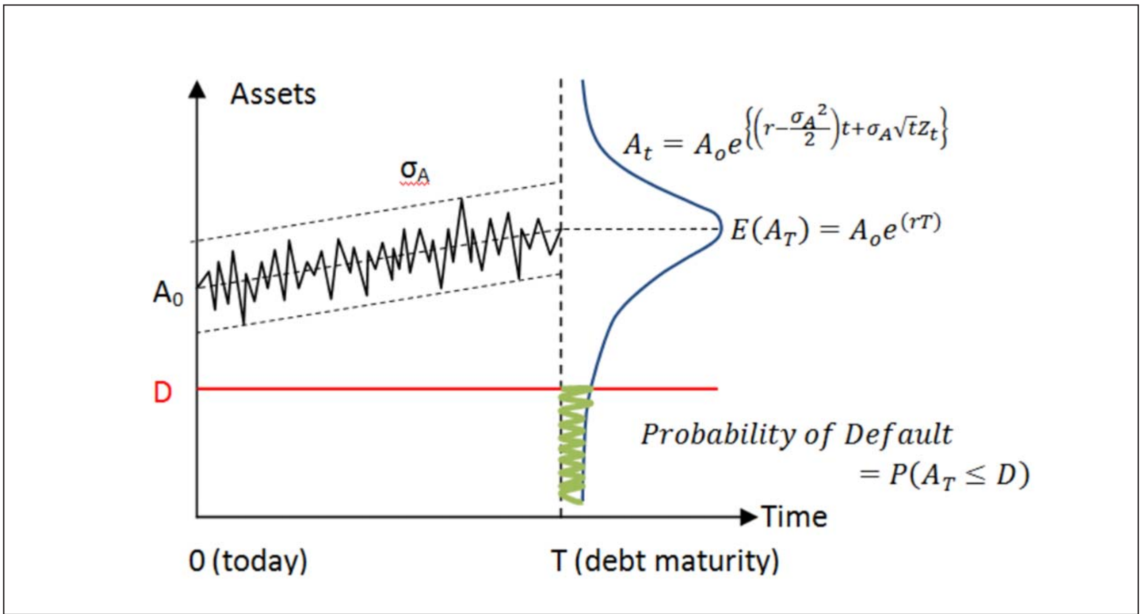
In structural models, both equity and debt are regarded as "contingent claims" on the asset value of the firm; and as a consequence, option pricing theories can be applied (Suo and Wang, 2005).

3.1. The Merton (1974) model

Merton's (1974) paper on the valuation of corporate debts, since its publication, has received a vast amount of attention from financial economists for its insights into the design of a firm's capital structure. His paper presented an option-theoretic approach, developed from implicit ideas of Black and Scholes (1973) with as many as eight assumptions, some of which about the perfect market can be relaxed. The two "critical" assumptions, according to the author, are: (1) continuous trading in assets; and (2) the asset value of the firm evolves a diffusion stochastic process, i.e. a geometric Brownian motion.

The model introduced by Merton (1974) is applicable to firms with infinite zero-coupon debts. It assumes that the firm's capital structure only consists of equity and a single issue of zero-coupon bonds whose maturity is denoted as *T* and face value is *D*. With this assumption, equity is considered as a European call option on assets with maturity *T* and strike price *D,* and thus Merton's model permits the straightforward application of Black-Scholes' pricing theory to value risky debts. According to Benito et al. (2005), a firm would declare

Figure 1: Basic concepts of the Merton model



Source: Zieliński (2013)

bankruptcy if its asset value could not service its outstanding debts when payments come due, which indicates that default can only occur at maturity. In case of default, debt holders will receive random *VT* while shareholders will be left with nothing. Default under Merton's approach is illustrated in Figure 1.

The asset value of the firm follows a geometric Brownian motion (GBM) process, given by $dV_t = \mu V_t dt + \sigma V_t dW_t$. The payoff to shareholders at the maturity of the zero-coupon debts is then *max{Vt-D, 0}* while that to bond-holders is V_T-E_T. The equity value at time *t* $(0 \leq t \leq T)$ is quantified with the use of Black-Scholes formula as follows:

$$E_t(V_t,\sigma_V,T\text{-}t) = e^{-(r(T-t)}[e^{(r(T-t)}V_t N(d_1) - DN(d_2)]$$

where: *N(.)* is referred to as the cumulative distribution function of a standard normal random variable and d_1, d_2 are calculated by

$$d_1 = \frac{\ln\left(\frac{e^{r(T-t)}V_t}{D}\right) + \frac{1}{2}\sigma_V^2\left(T-t\right)}{\sigma_V\sqrt{T-t}}$$

and $d_2 = d_1 - \sigma_V\sqrt{T-t}$

The model considers only the case when the firm has only one issue of zero-coupon bonds, while in reality the firm's debt structure can be much more complex with various issues of different maturities, coupons, etc. One practical solution to relax this assumption is introduced in the KMV model, which seeks to replace a complex debt structure with an equivalent zero-coupon one. The KMV model states that the equivalent zero-coupon debt structure consists of all short-term liabilities and half the face value of long-term liabilities after witnessing that more often than not, firms would not declare bankruptcy when their market value of assets falls to book value of all liabilities, but to a lower critical point being above the book value of short-term debts (Lu, 2008). As the popular KMV model appears to do well in practice, we decide to apply the model to quantify the level of debts D_0.

3.2. The Leland (1994) model

Leland (1994) extended the works by Merton (1974) and Black and Cox (1976) and also spared space in an attempt to tackle issues stated in Brennan and Schwartz (1978) to derive a model to determine the optimal capital structure with the introduction of corporate taxes and deadweight bankruptcy costs.

The Leland (1994) model introduced closed-form solutions to derive the optimal gearing levels for firms issuing securities that are contingent on the value of the firm but independent of time. Time independence means either sufficiently long maturity debts or finite debts rolled over at a fixed rate (much resembling revolving credit agreements). This is an important assumption that enables the construction of an analytical framework to derive closed form solutions to the problem raised. Besides, the face value of debts remains unchanged over time. Researches show that as supplementary debt issuance upsets debt holders (and thus it is part of bond covenants) while debt repurchase hurts shareholders (although it can be otherwise beneficial), it is uncommon that firms will be discouraged to change the debts' principal. In another note, firms' debts are coupon-bearing and firms will always benefit fully from the tax deductibility of coupon payments as long as the firm remains solvent. In case bankruptcy occurs, bondholders, for this model, are assumed to receive a level of asset value V_B less a fraction lost due to default costs. Shareholders, like the previous model by Merton (1974), get nothing in the extreme case.

The assumption that securities have time independent cash-flows and valuation is considered a key element for Leland (1994) to come up with a closed form solution for optimal leverage. The author states that why unprotected debts resemble perpetual coupon debts, protected debts are treated as rolled over short term (finite) loans. We first examine the optimal leverage for unprotected debts. Here, Leland introduced the concept of endogenous defaults, i.e. shareholders will try to set a boundary at which firms will optimally default and the firm's value is maximized (optimal decision). The model introduces α ($0 \leq \alpha \leq 1$), a fraction of the firm's value that is lost due to costs in the case of default and corporate taxes, The functional form: $F(V) = A_0 + A_1V + A_2V^{-X}$ with $X = 2r/\sigma^2$ can be applied to quantify time-independent debts with non-negative coupons that are financed through equity. We have:

At $V = V_B$, $D(V) = (1-\alpha)V_B$

As $V \to \infty$, $D(V) \to C/r$

Substituting the above boundary conditions into the functional form gives the value of debts equaling

$$D(V) = C/r + [(1-\alpha)V_B - C/r][V/V_B]^{-X}$$

In reality, firms are encouraged to issue debts to take advantage of the tax deductibility on interest expenses. Moreover, firms have to face a positive bankruptcy cost, which is ignored in the Merton model. As bankruptcy costs *BC(V)* and tax benefits *TB(V)* are introduced, the value of the firm follows:

$$F(V) = V + TB(V) - BC(V)$$

The stream of tax savings bears a resemblance to a security offering a perpetual payment of $\tau_c C$ as long as the firm remains solvent and it benefits fully from the tax deductibility. We have:

At $V = V_B$, $TB(V) = 0$

As $V \to \infty$, $TB(V) \to \tau_c C/r$

and thus

$$TB(V) = \frac{\tau_c}{r} - \frac{\tau_c}{r}[V / V_B]^{-X}$$

Bankruptcy costs, meanwhile, can be viewed as a security with a payoff at default and zero in case the firm remains solvent. This brings us the boundary conditions:

At V = VB, BC(V) = αVB

As $V \to \infty$, $BC(V) \to 0$

and hence $BC(V) = \alpha VBV/V_B]^{-X}$. The value of α is expected to be constant across all bankruptcy threshold levels (Leland, 2004). Leland noted that α included both direct and indirect costs of bankruptcy, suggesting that the latter (consisting of the loss of value from the leave of employees or potential growth opportunities, etc.) is often much more severe than the former expenses. The parameter α should be determined based on empirical estimates of recovery rates.

Now we can obtain the value of assets as the sum of unlevered firm value and the benefits of tax deductibility less the costs related to bankruptcy:

$$F(V) = V + \frac{\tau_c C}{r} - \left(\frac{\tau_c C}{r} + \alpha V_B\right)\left[\frac{V}{V_B}\right]^{-X}$$

It should be noted here that when $V = V_B$, the bankruptcy triggering level, the debt holders will take over the firm and the value of the company becomes the asset value minus the default costs since the tax benefits of debts are lost. The equity value is computed as the residual of asset and debt values:

$$(V) = V + \frac{\tau_c C}{r} - \left(\frac{\tau_c C}{r} + \alpha V_B\right)\left[\frac{V}{V_B}\right]^{-X} -$$

$$-\frac{C}{r} + \left[(1-\alpha)V_B - \frac{C}{r}\right]\left[\frac{V}{V_B}\right]^{-X}$$

$$= V - \frac{(1-\tau_C)C}{r} + \left[\frac{(1-\tau_C)C}{r} - V_B\right]\left[\frac{V}{V_B}\right]^{-X}$$

The model assumes that firms can optimally choose a boundary for defaults so that the value of equity is maximized. The default barrier is determined not only by the principal of debts, but also by the debt maturity, the riskiness of the firm, the pay-out rate, the costs of bankruptcy and the corporate tax rate (Leland, 2004). Defaults will be triggered when firms are no longer able to issue more equity to pay due coupons. As a result, equity value will be equal to 0 in case the firm value falls below the bankruptcy level and firms will have positive equity when their value is higher than V_B, implying a standard smooth-pasting condition, which stipulates that the equity value as a function of V is continuously differentiable at the default threshold:

$$\left.\frac{\partial E(V)}{\partial V}\right|_{V=V_B} = 0$$

The endogenous optimal bankruptcy level V_B^* can be derived by

$$V_B^* = \frac{(1-\tau_c)C}{r + \frac{1}{2}\sigma^2}$$

At this threshold, the value of equity goes to zero. With a view to determining the value of debts that maximize the total firm value, we have to optimize the coupon *C*. With the first order condition $\partial F/\partial C = 0$, the optimal coupons can be found by

$$C^* = \frac{\left(r + \frac{1}{2}\sigma^2\right)Vs}{1-\tau_c}$$

where $s = \left(\frac{\tau_c \sigma^2}{d}\right)^{\frac{\sigma^2}{2r}}$ and $d = 2\tau_c r + \tau_c \sigma_2 + 2r\alpha - \tau_c 2r\alpha$

As can be clearly seen, C* is a function of V and other constant parameters, which means that one can easily find the optimal capital structure, just by knowing a firm's current assets' value. Substituting C* into equations yields optimal values of debts and assets as follows:

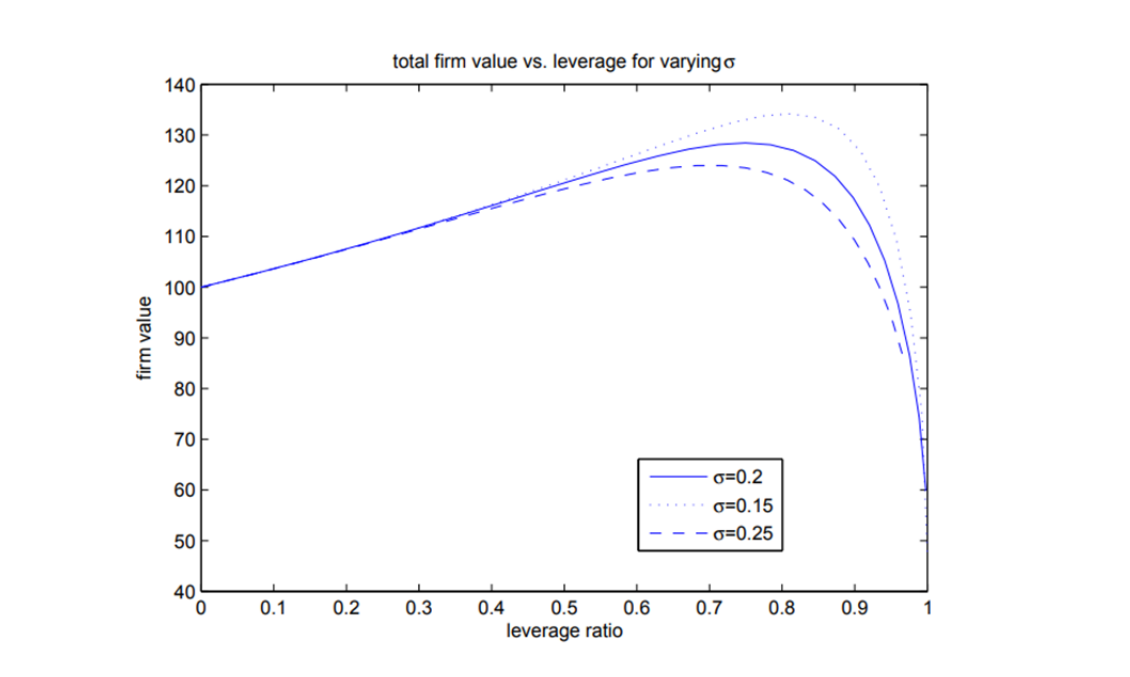
$$D^* = \frac{C^*}{r} + \left[(1\text{-}\alpha)Vs - \frac{C^*}{r}\right]s^{\frac{2r}{\sigma^2}}$$

$$V^* = V + \frac{\tau_c C^*}{r} - \left[\frac{\tau_c C^*}{r} + \alpha Vs\right]s^{\frac{2r}{\sigma^2}}$$

Being equipped with these two optimal values, it is now straightforward to find the optimal leverage, given by D*/V*.

Leland (1994) also attempted finding an optimal capital structure for the case of protected debts, assuming that the principal and market value of debts when they are issued acquire the same value, resulting in $D_0 = V_B$. Protected debts means that there is a covenant specifying that the firm must declare bankruptcy in case its assets fall beneath the principal value, denoted as *P* (positive net worth covenants). The opti-

Figure 2: Total value of firms as a function of leverage with different volatility



Source: Huttner (2014)

mal bankruptcy level V_B^* is the same for both protected and unprotected debts.

With $D_0 = V_B$ and $\boldsymbol{\alpha} = \mathbf{0}$, the optimal value for protected debts can be implied as

$$D_0^*(V_0) = V_B^*(V_0) = V_0(m/h)^{1/X}$$

And it follows that

$$C^*(V_0) = rD_0^*(V_0) = rV_B^*(V_0) = V_0(m/h)^{1/X}$$

$$v^*(V_0) = V_0 + \left[\tau C^*(V_0)/r\right]\left\{1 - \left[C^*(V_0)/V_0\right]^X h\right\}$$

where

$m = [(1 - \tau)X/r(1 + X)]^X/(1 + X)$

$h = [1 + X + \alpha(1-\tau)X/\tau]m$

given that $v(V) = V + TB(V) - BC(V) = V + (\tau C/r)[1 - (V/V_B)^{-X}] - \alpha V_B(V/V_B)^{-X}$

Plugging in the formula, we obtained the results summarized in Table 1.

The model only presents closed-form formula to exogenously determined bankruptcy when bankruptcy costs are zero; no solutions have been found for cases where α is positive and the optimal capital structure may change remarkably. Furthermore, its application to infinite debt life is obviously restrictive. Thus, in the next part, Leland and Toft (1996) developed a new model with more realistic assumptions about the debt structure to better determine the optimal debt level.

3.3. The Leland and Toft (1996) model

Leland and Toft (1996) further extended the Merton model with an endogenous default boundary (where shareholders want to maximize their benefits by optimally deciding a de-

Table 1: Comparative statics of variables at optimal leverage

		Sign of change in variable for an increase in:			
Variable	**Shape**	σ^2	r	α	τ
C*	Linear in V	$< 0^b$	> 0	< 0	$> 0^a$
D*	Linear in V	< 0	> 0	< 0	$> 0^a$
L*	Invariant in V	< 0	> 0	< 0	< 0, α small^b; > 0, α large

Note: [a]No effect if α = 0; [b]Represents different behavior from unprotected debt.

fault point) through the analysis of debts with arbitrary maturity. Their paper has had a substantial impact on subsequent studies on capital structure and the pricing of debts.

The model presumes a "stationary" capital structure so as to have a constant *VB*. Debts of finite maturity *T* are continuously rolled over at maturity with new debts of the same face value and maturity so that the total principal value of all outstanding debts *P* is constant with a constant total coupon *C* paid on all outstanding debts annually. New debts will be issued at the rate $p = P/T$; thus, the firm will have a portfolio of bonds with a uniform distribution of remaining time-to-maturity within the interval of *(s, s+T)*, implying the average maturity of outstanding debts of *T/2*. Bonds with principal p bear a constant coupon rate of $c = C/T$ per unit time until maturity or default. Coupon level *C* is determined such that the debts are sold initially at par. If the firm remains solvent at maturity, the debts will also be redeemed at par.

This model differentiates itself from the previous model by Leland (1994) by the fact that the former assumes a firm with perpetual debts whereas the latter analyses a company with finite maturity. As a consequence, bonds in Leland (1994) are identical in every aspect, while those in Leland and Toft (1996) are not the same in terms of remaining time to maturity.

Denote $d(V;\ V_B, t)$ as the value of a debt issue with maturity *t* periods from the present, whose principal is *p(t)* and coupon equals to *c(t)*. Denoting *F(s; V,* as the density of the first passage time to default, the value of the single debt issue can be computed from the risk-neutral valuation as follows:

$$d(V;\ V_B, t) = \int_0^t e^{-rs} c(t)[1 - F(s; V,\ V_B)]ds + e^{-rs} p(t)\left[1 - F(t; V, V_B)\right] + \int_0^t e^{-rs} \frac{(1-\alpha)V_B}{t}[1 - F(s; V,\ V_B)]ds$$

The equation can also be written as:

$$d(V;\ V_B, t) = \frac{c(t)}{r} + e^{-rt}\left(p(t) - \frac{c(t)}{r}\right)(1 - F(t) + \left(\frac{(1-\alpha)V_B}{t} - \frac{c(t)}{r}\right)G(t)$$

where *F(t)* is found in Harrison (1990) whereas *G(t)* can be obtained from Rubinstein and Reiner (1991).

$$F(t) = N\left[h_1(t)\right] + \left(\frac{V}{V_B}\right)^{-2a} N\left[h_2(t)\right]$$

$$G(t)=\left(\frac{V}{V_B}\right)^{-a+z}N\left[q_1(t)\right]+\left(\frac{V}{V_B}\right)^{-a-z}N\left[q_2(t)\right]$$

with

$$q_1(t)=\frac{\left(-b-z\sigma^2 t\right)}{\sigma\sqrt{t}};\quad q_2(t)=\frac{\left(-b+z\sigma^2 t\right)}{\sigma\sqrt{t}};$$

$$h_1(t)=\frac{\left(-b-a\sigma^2 t\right)}{\sigma\sqrt{t}};\quad h_2(t)=\frac{\left(-b+a\sigma^2 t\right)}{\sigma\sqrt{t}};$$

$$a=\frac{\left(r-\delta-\sigma^2/2\right)}{\sigma^2};\quad b=\ln\left(\frac{V}{V_B}\right);$$

$$z=\frac{\left[\left(a\sigma^2\right)^2+2r\sigma^2\right]^{1/2}}{\sigma^2}$$

It should be noted that δ is the constant payout rate to security holders and *N(.)* is the cumulative standard normal distribution. Again, σ denotes volatility of the firm's asset value. *F(t)* can be interpreted as the present value of \$1 paid at time t as long as the firm remains solvent at *t,* while *G(t)* should be understood as the present value of a claim that pays \$1 in case the firm goes into bankruptcy at any time prior to *t*. As a result, the value of a single bond issue comprises the present value of a coupon in perpetuity plus the principal paid up at maturity (in case of solvency) and recovery (in case of bankruptcy prior to maturity).

Total debts can then be interpreted as the assembly of all single debts issues, suggesting that

$$D\left(V;\ V_B,T\right)=\int_{t=0}^{T}d\left(V;\ V_B,t\right)dt=\frac{C}{r}+$$

$$\left(P-\frac{C}{r}\right)\left(\frac{1-e^{-rT}}{rT}-I_1(T)\right)+\left((1-\alpha)V_B-\frac{C}{r}\right)I_2(T)$$

with

$$I_1(T)=\frac{1}{rT}(G(T)-e^{-rT}F(T)$$

$$I_2(T)=\frac{1}{z\sigma\sqrt{T}}(-\left(\frac{V}{V_B}\right)^{-a+z}N\left[q_1(T)\right]q_1(T)+\left(\frac{V}{V_B}\right)^{-a-z}N\left[q_2(T)\right]q_2(T)$$

The total value of the firm is the sum of the asset value and the value of tax benefits less the value of default costs, over the infinite horizon. Defining $x = a + z$, the total firm value can be obtained by:

$$v\left(V;V_B\right)=V+TB\left(V;V_B\right)-BC\left(V;V_B\right)$$

$$=V+\frac{\tau C}{r}\left[1-\left(\frac{V}{V_B}\right)^{-x}-\alpha V_B\left(\frac{V}{V_B}\right)^{-x}\right]$$

Equity of the firm, thus, will take the value of:

$$E(V;V_B,T) = v(V;V_B) - D(V;V_B,T)$$

Endogenous bankruptcy barrier *VB* is determined such that it solves the following smooth-pasting condition:

$$\left.\frac{\partial \mathbf{E}\left(\mathbf{V};\mathbf{V_B},\mathbf{T}\right)}{\partial \mathbf{V}}\right|_{\mathbf{V}=\mathbf{V_B}}=0$$

And this gives us the default threshold derived as:

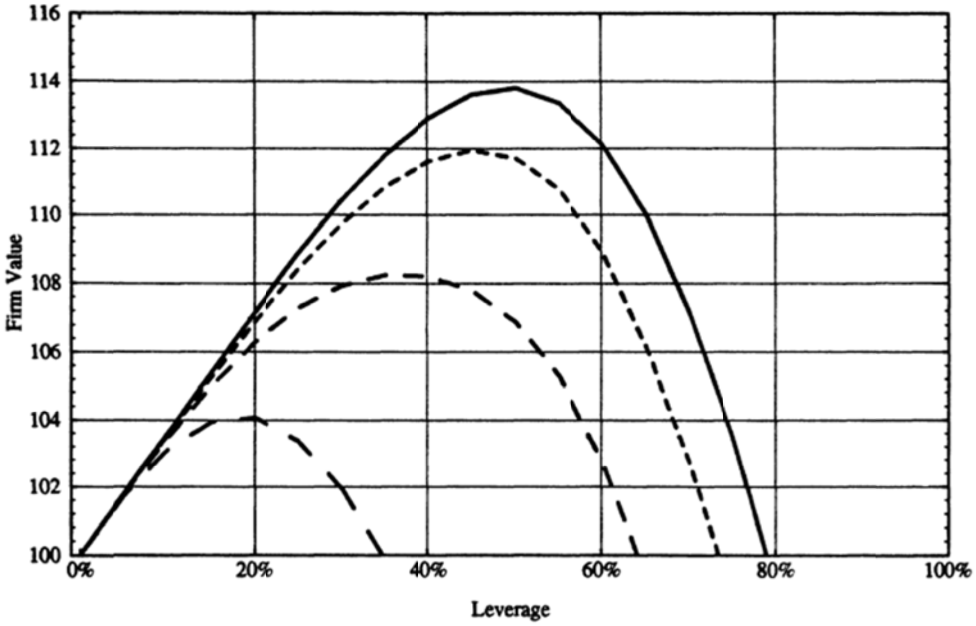
$$\mathbf{V_B}=\frac{(\mathbf{C}/\mathbf{r})(\mathbf{A}/(\mathbf{rT})-\mathbf{B})-\mathbf{AP}/(\mathbf{rT})-\boldsymbol{\tau}\mathbf{Cx}/\mathbf{r}}{1+\boldsymbol{\alpha}\mathbf{x}-(1-\boldsymbol{\alpha})\mathbf{B}}$$

where

$$\mathbf{A}=2\mathbf{a}\mathbf{e}^{-\mathbf{rT}}\mathbf{N}\left(\mathbf{a}\boldsymbol{\sigma}\sqrt{\mathbf{T}}\right)-2\mathbf{z}\mathbf{N}\left(\mathbf{z}\boldsymbol{\sigma}\sqrt{\mathbf{T}}\right)-\frac{2}{\boldsymbol{\sigma}\sqrt{\mathbf{T}}}\mathbf{n}\left(\mathbf{z}\boldsymbol{\sigma}\sqrt{\mathbf{T}}\right)+\frac{2\mathbf{e}^{-\mathbf{rT}}}{\boldsymbol{\sigma}\sqrt{\mathbf{T}}}\mathbf{n}\left(\mathbf{a}\boldsymbol{\sigma}\sqrt{\mathbf{T}}\right)+(\mathbf{z}-\mathbf{a})$$

$$\mathbf{B}=-\left(2\mathbf{z}+\frac{2}{\mathbf{z}\boldsymbol{\sigma}^2\sqrt{\mathbf{T}}}\right)\mathbf{N}\left(\mathbf{z}\boldsymbol{\sigma}\sqrt{\mathbf{T}}\right)-\frac{2}{\boldsymbol{\sigma}\sqrt{\mathbf{T}}}\mathbf{n}\left(\mathbf{z}\boldsymbol{\sigma}\sqrt{\mathbf{T}}\right)+(\mathbf{z}-\mathbf{a})+\frac{1}{\mathbf{z}\boldsymbol{\sigma}^2\sqrt{\mathbf{T}}}$$

Figure 3: Total firm value as a function of leverage



Source: Leland and Toft (1996)

and *n(.)* denotes the standard normal density function[1]**.** The default threshold, as can be seen in the solution above, moves in the opposite direction with debt maturity, asset volatility, risk-free rate and changes positively with bankruptcy costs and more than proportionately with debt principal.

Poulsen and Miltersen (2014) claim that the newly issued bonds at time $t = 0$ must be sold at face value such that $c = C/T$ is the smallest solution to:

$$D(V_0; c, p) = p$$

which implies that all bond issue with maturity t smaller than *T* will be offered at premium. Denote *P(C)* as the total principal value of debts for a given coupon paid annually *C*. At time $t = 0$, the optimal coupon that maximizes the value of the firm can be calculated numerically by:

$$C^* = \text{argmax } v(V_0; V_B^*(C), P(C), C)$$

The relationship between the total firm value and leverage with different maturities of debts is illustrated in Figure 3. The long dashed line corresponds to 6-month maturity; medium dashed line to 5 years; short-dashed line to 20 years and the solid line to debts of infinite duration.

4. Optimal capital structure for real estate firms

The study makes effort in estimating the optimal leverage ratios for the local firms in accordance with their respective assumptions. All the models are set up on the assumptions of the Black-Scholes model and geometric Brownian motion. In the empirical implementation of the aforesaid models, it is required that we estimate the parameters μ and σ as well as bankruptcy costs α that define the division of values upon default and the tax rate. While the corporate tax rate and the risk-free interest rate (inferred from the riskless term structure) are readily available on the market, other parameters must be computed. As all the firms in the sample are listed, firm-specific parameters can be instantaneously derived from the times series of market prices. Accounting figures on specific reporting dates are used and market prices on such dates will also be collected.

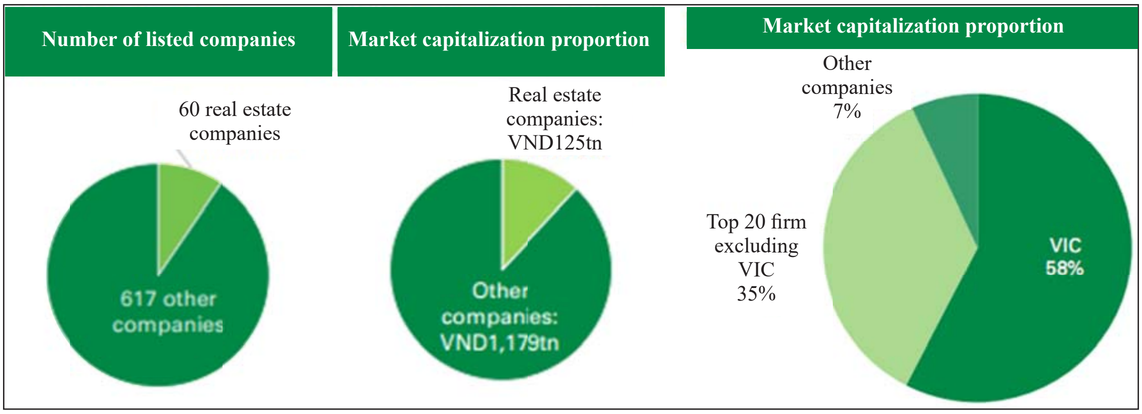
It is now worth examining the other important assumptions required for the implementation of the aforementioned models. It should be emphasized that arbitrage opportunities are eliminated due to intensive government regulations on the market. The random behaviour or the log-normal returns of stock prices must be checked to ensure the correctness of the models. In geometric Brownian motion, the drift μ and volatility σ of the security (more specifically, stocks) are assumed to be known and constant. These two parameters can firstly be drawn from the daily stock returns, from which the annualized figures are implied. For the conditions of Brownian motion, a normality test will be conducted and covered.

Data collection

For the sake of data availability, the paper only attempts to study the capital structure of publicly traded real estate companies in the two years 2014 and 2016. The paper seeks to examine the changes in optimal capital structure levels ever since the market showed signs of recovery in 2014 (CBRE, 2017). Firms are ranked by their total assets at the end of 2014 and 30 enterprises with the biggest assets are selected for the research.

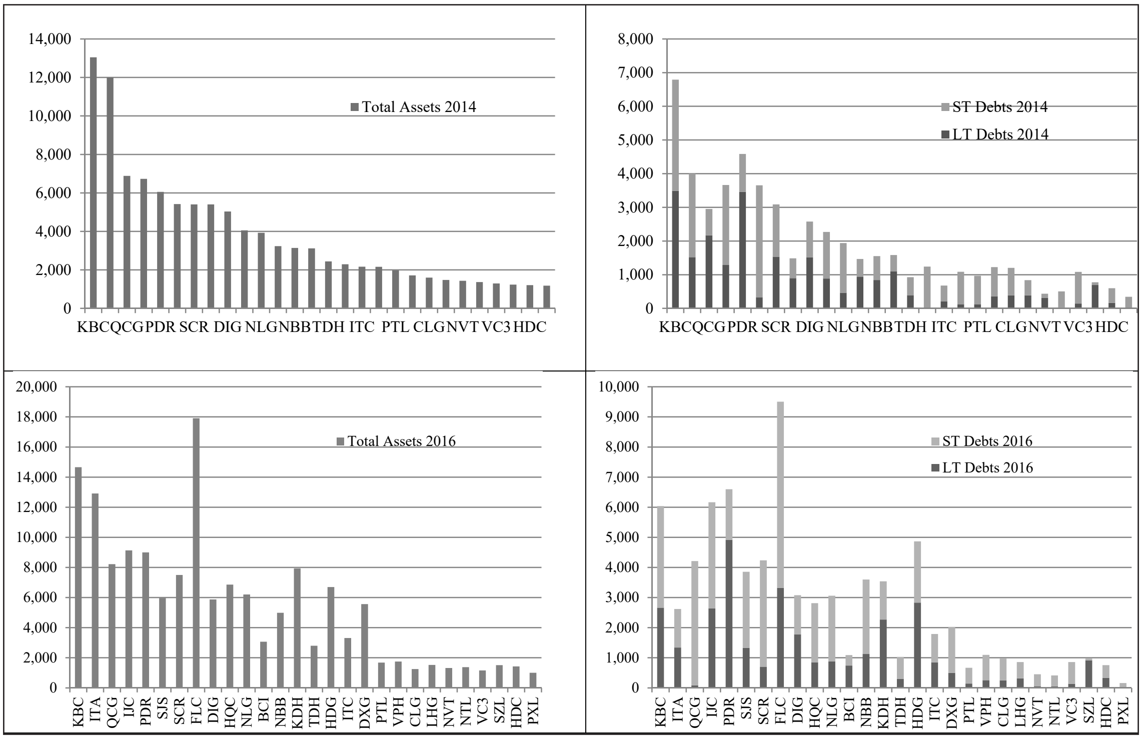
The study aims to empirically test the aforementioned models and thus, it is important to select a sample of companies with capital structures sufficiently close to the models' assumptions. Ideally, we should have firms with zero-coupon bonds when performing the Merton (1974) model, or those with perpetual debts when the Leland (1994) model is examined. However, since it is not always possible to find such "suitable" debt structures in the market, an

Figure 4: Overview of real estate market in Vietnam



Source: Bloomberg, VPBS Reports

Figure 5: Real estate firms by total assets (in billion VND, exc. VIC & HAG, 2014 vs. 2016)



approach we deem reasonable is to choose listed firms with high capitalization, vast amounts of publicly transparent information and immediate availability of stock information.

Stock prices of these firms are gathered continuously on a daily basis for the span of one year. Such stock returns will be used to work out the drift and volatility, which are the two important parameters required for computation later.

Since Vietnam's accession to the World Trade Organization (WTO), the real estate sector has become one of the fastest growing sectors in the country (Kang et al., 2013; Jehan and Luong, 2008). In 2014, total assets of listed property companies reached almost VND125 trillion, representing 10.6% of total market capitalization of the whole stock market in Vietnam (VPBS Report, 2014). Notably, the largest company by total assets, VIC, occupied more than half of the total market cap of all real estate firms.

From our sample's financial information, it is obvious that firms in the real estate sector had much bigger total assets as compared to other industries with high debt levels. VIC remained the largest property firm by total assets in 2016, more than three times as big as the second rank, HAG. Data about other firms are graphically summarized above. Regarding stock prices, VIC. SZL and VC3 exhibited relatively high prices whereas PXL, NVT, PTL and HQC prices were modestly low.

The stock returns, expressed in percentages

Table 2: Estimated drift and stock volatility

No	Stock	Standard Deviation of Returns	Annualized Stock Volatility	Daily Returns	Drift
1	VIC	2.03%	32.12%	-0.05%	-7.20%
2	HAG	3.06%	48.43%	-0.25%	-52.07%
3	KBC	1.92%	30.41%	0.03%	12.54%
4	ITA	2.50%	39.54%	-0.17%	-34.70%
5	QCG	2.53%	40.04%	-0.09%	-15.75%
6	IJC	2.16%	34.16%	0.02%	11.65%
7	PDR	1.74%	27.63%	-0.02%	-0.75%
8	SJS	2.02%	31.94%	0.00%	5.33%
9	SCR	1.85%	29.01%	0.00%	3.05%
10	FLC	2.94%	46.62%	-0.17%	-32.75%
11	DIG	2.24%	35.41%	-0.05%	-7.43%
12	HQC	2.47%	39.06%	-0.37%	-84.57%
13	NLG	1.26%	19.90%	-0.01%	-0.95%
14	BCI	1.20%	19.01%	-0.02%	-2.08%
15	NBB	2.01%	31.87%	-0.05%	-8.01%
16	KDH	1.90%	30.09%	-0.03%	-3.73%
17	TDH	1.87%	29.57%	-0.10%	-21.88%
18	HDG	2.83%	44.86%	-0.07%	-6.74%
19	ITC	2.83%	44.86%	-0.07%	-6.74%
20	DXG	2.32%	36.78%	-0.19%	-39.75%
21	PTL	3.42%	54.25%	0.18%	59.87%
22	VPH	2.58%	40.95%	-0.17%	-35.11%
23	CLG	2.85%	45.15%	-0.03%	2.40%
24	LHG	2.75%	43.53%	-0.01%	7.00%
25	NVT	2.98%	47.17%	-0.19%	-35.34%
26	NTL	2.00%	31.76%	-0.10%	-18.94%
27	VC3	1.96%	31.02%	0.17%	47.26%
28	SZL	2.13%	33.70%	0.21%	59.41%
29	HDC	1.67%	26.39%	-0.09%	-20.21%
30	PXL	4.31%	67.42%	-0.09%	0.32%

on a daily basis, illustrated the returns on 247 business working days in 2014 and 251 days in 2016. Histograms were drawn to check the normality of the distribution of the returns of these 30 stocks, which is one of the key assumptions for the application of capital structure models. In general, stock returns seem to be approximately normally distributed with some stocks experiencing quite large standard deviations. As the data are collected daily, it can be assumed that observations are continuously selected.

Parameter estimation: return and volatility

The stock volatility σ and the expected annual rate of returns or the drift μ are important inputs for calculation. In this section, they

Table 3: Descriptive analysis of drift and stock volatility

	Drift	Stock Volatility
Mean	-0.0753	0.3709
Median	-0.0753	0.3709
Minimum	-0.0753	0.3709
Maximum	-0.0753	0.3709
Std. Dev.	-0.0753	0.3709

are empirically estimated from historical stock prices for a period of one year. Specifically, the implied stock volatility and drift for 30 previously-chosen real estate stocks were obtained with respect to the time interval of corresponding years. The estimates for 2016 are shown in Table 2.

Among this group of 30 real estate firms, PTL, SZL and VC3 are expected to grow exponentially with an annual rate of return as high as 59.87%, 59.41% and 47.26%, respectively. VC3 was the only firm that remained in the top three performers, offering investors 63.75% rate of returns in 2014. Meanwhile, there were other firms who are forecast to be poor performers, offering negative returns to investors with -84.57% (HQC), -52.07% (HAG) and -39.75% (DXG) (2014: -10.97% (NVT), -18.92% (CLG) and -29.2% (VIC)). Their low returns are also accompanied by quite high risks with the standard deviation of such stocks ranging from 37% to 48%. As shown in Table 2, the coefficient of variation, the ratio of the stock's volatility over its mean, belongs to a quite large range of values. There are even stocks with negative or extremely high coefficients, implying that some stocks considered very risky offer low returns. A descriptive summary of firms' drift and volatility is presented in Table 3.

In addition, Figure 6 compares stock returns of firms in the sample in the two years examined. It appears that firms saw lower returns and standard deviations in 2016 as compared to two years earlier (2014).

The parameter estimation, which is critical

Figure 6: Sampled firms' stock returns and volatility (2014 vs 2016)

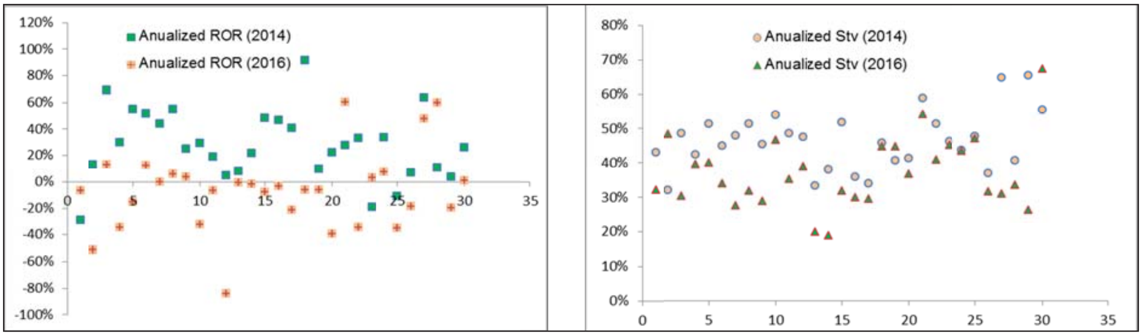


Table 4: Implied asset volatility from KMV model

Stock	Asset Volatility (2014)	Asset Volatility (2016)	Stock	Asset Volatility (2014)	Asset Volatility (2016)
VIC	0.2694	0.1600	KDH	0.2595	0.2016
HAG	0.1763	0.0751	TDH	0.1839	0.1367
KBC	0.2954	0.1796	HDG	0.2981	0.1591
ITA	0.2904	0.2637	ITC	0.1976	0.2494
QCG	0.3082	0.0833	DXG	0.2495	0.2390
IJC	0.2533	0.0639	PTL	0.1589	0.1705
PDR	0.2616	0.1105	VPH	0.1255	0.1085
SJS	0.1167	0.1380	CLG	0.0601	0.0457
SCR	0.1965	0.1001	LHG	0.1559	0.1801
FLC	0.4345	0.1434	NVT	0.3053	0.1297
DIG	0.2793	0.1646	NTL	0.2817	0.1919
HQC	0.2179	0.1166	VC3	0.0808	0.1755
NLG	0.1977	0.1108	SZL	0.1835	0.1843
BCI	0.2392	0.1411	HDC	0.3651	0.1199
NBB	0.2808	0.0938	PXL	0.2805	0.3535

for running the models, is now used to predict the optimal level of capital structure.

Optimal capital structure

With the availability of data and estimated parameters, it is now possible to construct a model to estimate the optimal capital structure. In the static world, the assumption that firms only finance one time is unrealistic; however, it should be acceptable as the differential condition is used in a short period of time. Based on the KMV model, the asset volatility can be solved for optimal capital structure calculation. As can be deduced from Table 4, volatility was lower for most stocks over the 2-year period.

The Merton model, as indicated in the previous section, does not construct a solution for optimal capital structure. As a result, it is not the focus of the analysis here. In a similar mode, as the assumption about the non-existence of bankruptcy costs does not seem to hold in reality, we make a decision to ignore the involvement of the Leland model for protected debts. This gap will be analyzed with the Leland-Toft model, for the reason that protected debts and rolled-over debts are in compatibility in various aspects that have been mentioned before.

The Leland (1994) model

The required value is $\frac{D^*(V)}{A^*(V)}$ where $D*$ is value of debts in the levered firm and $A*$ the value of total assets (which equals the equity value plus the value of debt claims). Table 5 shows different optimal leverage ratios for real estate firms with the average being 66.8% in 2014 and 73.26% in 2016.

Overall, the optimal capital structure mostly ranges from 60% to over 80% in 2016, with the lowest value of 52.7% (PXL). Relatively high optimal leverage is largely attributable to the high entry costs to the industry (Staiger, 2015). Besides, the existence of significantly levered real estate firms can be partly explained by

Table 5: Optimal capital structure by Leland (1994) model

Stock	D*(V)/A*(V) 2014	D*(V)/A*(V) 2016	Stock	D*(V)/A*(V) 2014	D*(V)/A*(V) 2016	Stock	D*(V)/A*(V) 2014	D*(V)/A*(V) 2016
VIC	61.90%	71.43%	DIG	61.10%	70.73%	PTL	74.17%	69.85%
HAG	71.75%	87.29%	HQC	66.76%	78.88%	VPH	79.39%	80.43%
KBC	59.88%	68.55%	NLG	69.05%	79.99%	CLG	91.49%	93.49%
ITA	60.25%	59.11%	BCI	64.58%	74.50%	LHG	74.60%	68.49%
QCG	58.98%	85.56%	NBB	60.98%	83.37%	NVT	59.18%	76.47%
IJC	63.28%	89.66%	KDH	62.73%	65.67%	NTL	60.91%	66.90%
PDR	62.55%	80.04%	TDH	70.75%	75.25%	VC3	87.51%	69.14%
SJS	80.89%	75.02%	HDG	59.69%	71.57%	SZL	70.81%	67.91%
SCR	69.19%	82.10%	ITC	69.06%	60.43%	HDC	55.62%	78.26%
FLC	52.56%	74.11%	DXG	63.62%	61.46%	PXL	61.00%	52.70%

the fact that they might seek to intensively use debts to cover their projects whose construction costs, most of the time, are huge. This represents an increase from the common scale of 50-70% in 2014, which can be reasoned by the recovery (albeit slow) of the market since early 2014.

The model suggests that the largest firm by total assets, VIC, makes use of a leverage ratio of modestly 62% in 2014 and raises the percentage to 71.42% two years later. Meanwhile, in both periods, CLG remains the most heavily debt-financed (more than 90%) as recommended by the model. With the exclusion of HNX-listed stocks VC3 and SCR, the optimal debt ratio for HSX-traded companies, on average, stays at 73.83% in 2016, up from 65.98% in 2014. Meanwhile, the appearance of only two firms listed on HNX in the list makes it impossible to generalize the findings for firms of the same sector trading on the exchange.

One point should be noted that almost all estimated figures are higher than the actual capital structure. This can be partly attributable to notable weakness, not only of the Leland's but also of most static capital structure models, which do not allow firms to refinance more than one time. More specifically, it can be seen that only two out of 30 firms in 2014 (VIC & PDR) and three firms in 2016 (VIC, HDG, VC3) have current leverage ratios higher than predicted, meaning that such companies are overleveraged as suggested by the model.

Stimulatingly, the volatility of firms' assets moves in the same direction with the optimal coupon rates, contrary to Leland's (1994) note that the optimal coupon is a U-shaped function of risks where firms of immediate risks pay smaller coupons than low and high-risk companies. There is nothing irrational about such findings as borrowings are expected to cost more when a higher level of uncertainty is associated with firms' asset values. Notably, leverage also appears to be a decreasing function of firms' risks, indicated by lower gearing levels attached with higher volatility. A latter

Table 6: Leverage as a function of firms' volatility (2014 & 2016)

2014				2016			
Low-risk Firms				**Low-risk Firms**			
Stock	**Sigma**	**C%**	**L***	**Stock**	**Sigma**	**C%**	**L***
CLG	0.06	5.04%	91.49%	CLG	0.05	4.52%	93.49%
VC3	0.08	5.08%	87.51%	IJC	0.06	4.54%	89.66%
Medium-risk Firms				**Medium-risk Firms**			
Stock	**Sigma**	**C%**	**L***	**Stock**	**Sigma**	**C%**	**L***
NLG	0.20	5.54%	69.05%	BCI	0.14	4.73%	74.50%
BCI	0.24	5.83%	64.58%	FLC	0.14	4.74%	74.11%
High-risk Firms				**High-risk Firms**			
Stock	**Sigma**	**C%**	**L***	**Stock**	**Sigma**	**C%**	**L***
HDC	0.37	7.15%	55.62%	ITA	0.26	5.47%	59.11%
FLC	0.43	8.16%	52.56%	PXL	0.35	6.39%	52.70%

hypothesis test also confirms this reversed relationship.

It is apparent from the model setup that other things held constant, higher sigma (riskier firms) is accompanied with lower amount of debts and bankruptcy levels. That means less risky firms will choose to optimally declare bankruptcy at a higher level of asset values and their leveraging is more aggressive as it is less likely that their asset value will drop to the default boundary. Due to the limited liability of shareholders, equity value will rise with increasing volatility and it is straightforward that shareholders of risky companies will decide to extend firms' activities for a longer period (default at lower asset value) than the seemingly identical but less risky counterparts. Furthermore, as equity is a call option on the underlying of firms' assets, and given that the value of the call option rises with volatility, equity holders are ready to raise capital to fulfill debt obligations to maintain firms' operations for a longer period of time. The following table summarizes changes in the optimal debt value and bankruptcy threshold for a particular company in response to an increase in its volatility.

Other things held constant, the optimal debt ratio rises in conjunction with increasing corporate tax rates. The rationale is quite straightforward; as firms are able to exploit more benefits from the tax deductibility of interest payments, companies optimally raise the amount of outstanding debts to take advantage of larger tax shields. Analyzed in a similar mode, increased costs associated with defaults result in lower bankruptcy thresholds and optimal coupons, leading to a smaller probability of defaults. The optimal level of debts rises with an increase in a risk-free interest rate, which is quite surprising as greater costs of debts diminish firms' incentives to borrow more. However, it may be that higher price of debt financing is compensated

Table 7: Scenario analysis for sigma changes for VIC (2014)

Unit: Million VND

Stock	Sigma	D*(V)	V*d
VIC	0.27	76,095,919.37	41,836,004.82
	0.30	72,577,735.87	38,023,930.32
	0.40	64,465,177.66	29,526,594.86

by larger taxes saved.

As inferred from the analysis, firms can "gain" from leveraging to the optimal debt levels. In more detail, real estate companies under examination can potentially raise their values over their current worth through levering/de-levering to the optimal levels by 7-24.4% in 2014 and 6-22% in 2016. A summary of optimal leverage proposed by the model can be found in Table 8.

It should be noted that in this analysis, the plugged-in firm value is its current value, rather than the required unlevered figure. However, it is inferred from the analysis that although the all-equity value of firms (i.e. charter capital) are a critical component of the computation, such values have no effect on the optimal leverage ratios obtained, mainly because both optimal debts and assets' values move proportionally with the change in the value of assets plugged in at the beginning for calculation. This justifies our use of current firm value as a proxy for the needed parameter of unlevered firm values.

Hypothesis testing: Leverage versus parameters

The equation expressing the relationship between capital structure and input parameters can be written as: $OptLev = \beta_1 + \beta_2\mu + \beta_3\sigma + \varepsilon$ where: OptLev denotes optimal capital structure in the form of *D*/A**, μ and σ are the drift and assets volatility, respectively. β_1, β_2, β_3 are the estimators of the least squared line, and ε is regarded as the error term. The results are as follows.

$$\widehat{\text{OptLev}_{2014}} = 0.9188 - 0.0015\mu - 1.0725\sigma$$
$$(0.0000)\ (0.9304)\ (0.0000)$$
$$\widehat{\text{OptLev}_{2016}} = 0.9635 - 0.0099\mu - 1.4038\sigma$$
$$(0.0000)\ (0.4521)\ (0.0000)$$

Both variables are negatively related to the dependent variable and the R^2 values are around 94%, expressing a high probability that the equation fits the model. However, it should be noted that even though the asset volatility is implied from the annualized drift, the regression demonstrates that the coefficient for volatility is statistically significant while that for drift is extremely insignificant. Previous empirical studies show that high volatility and low recovery rates upon default result in low leverage ratios (Bradley et al., 1984; Titman and Wessels, 1988).

Too high R^2 coupled with insignificant coefficients for drift may indicate two things. Firstly, optimal capital structure is particularly dependent on the volatility of firms' assets, which is understandable as sigma is an important input of the model. Secondly, the regression may suggest that heteroscedasticity exists, which

Table 8: Descriptive analysis of optimal leverage - Leland (1994) model

2016		2014	
Mean	0.7395	Mean	0.6681
Median	0.7430	Median	0.6345
Standard Deviation	0.0938	Standard Deviation	0.0908
Kurtosis	-0.0719	Kurtosis	1.0518
Skewness	-0.0610	Skewness	1.1110
Range	0.4079	Range	0.3893
Minimum	0.5270	Minimum	0.5256
Maximum	0.9349	Maximum	0.9149

we subsequently prove through the White test.

In short, it can be concluded that the static structural approaches take advantage of the straightforward formulas to estimate drift and volatility. Nevertheless, the optimal capital structure not only depends on drift and volatility but also relies on other variables, which are not a subject of the model analysed above. As an additional note, structural approaches do not centre on direct relation and some limitations do exist. One of the key weaknesses of the model is the assumption of parameter estimation where drift and volatility are assumed to be constant. In very short periods, they are likely to be constant; however, financial researchers claim that drift and volatility vary with time.

The Leland-Toft (1996) model

In a similar style as the Leland (1994) model, the Leland-Toft model considers optimal capital structure under endogenous conditions that allow firms to declare defaults at the maximum interests of equity holders. The analysis uses

Table 9: Optimal capital structure by Leland-Toft (1996) model

Stock	L* (2014)	L* (2016)	Stock	L* (2014)	L* (2016)	Stock	L* (2014)	L* (2016)
VIC	61.57%	70.50%	DIG	63.01%	74.83%	PTL	78.51%	74.68%
HAG	70.75%	100.00%	HQC	67.94%	88.19%	VPH	89.80%	91.41%
KBC	60.47%	66.35%	NLG	63.43%	82.12%	CLG	93.30%	93.85%
ITA	56.63%	59.76%	BCI	63.06%	68.94%	LHG	80.59%	72.03%
QCG	63.11%	102.38%	NBB	63.76%	97.96%	NVT	61.23%	82.46%
IJC	61.83%	116.77%	KDH	58.60%	63.37%	NTL	57.99%	62.14%
PDR	67.19%	94.32%	TDH	68.47%	76.46%	VC3	100.00%	65.26%
SJS	90.02%	77.75%	HDG	55.37%	80.28%	SZL	80.65%	75.28%
SCR	72.14%	91.85%	ITC	67.70%	64.11%	HDC	59.11%	83.36%
FLC	51.88%	81.07%	DXG	58.78%	59.00%	PXL	60.00%	59.47%

the same volatility of the firm's assets computed above as an important input.

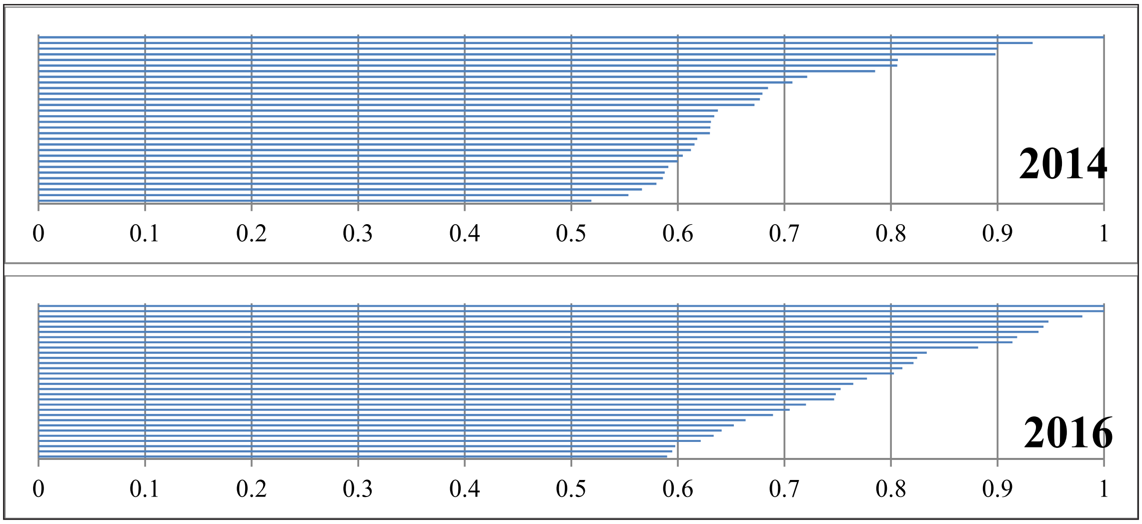
The required value is $\frac{D^*(V)}{A^*(V)}$ where *D*(V)* is value of debts in the levered firm and *A*(V)* the value of total assets (which equals to the equity value plus the value of debt claims). With a different debt structure, it can be seen that the optimal leverage ratios for real estate firms in the list change significantly as shown in Table 9.

Generally in 2014, optimal debt ratios are mostly in the range of 50-70%. FLC is recommended to borrow the least of all, with a debt ratio at roughly 52% (maybe because of its significantly high level of asset volatility) while VC3 is suggested to finance up to 100% through debts. After VC3 and SCR are taken out, the average leverage ratio for firms trading on the HSX is 67%. In 2016, the suggested optimal gearing levels are, in general, higher with more than one firm being proposed to raise their capital structure to 100% (HAG and IJC)! It should be noted that the Leland-Toft (1996)'s model commonly proposed higher debt levels than the Leland (1994) model. Despite inconsistencies in predictions, the two models suggest most companies be underleveraged. A graphical summary of optimal leverage proposed by the model can be found Figure 7.

The Leland-Toft (1996) model introduces a new variable in the analysis of capital structure choices of firms, i.e. the payout ratio. Although the payout ratio is assumed to be constant and unaffected by capital structure, it is worth studying the effects of this new input parameter on the capital structure decisions of real estate companies under examination.

We find that optimal leverage is sensitive to changes in the payout level with small variations of the payout rate strongly influencing the optimal debt level. In 2014, an increase of 1% to 4% in the payout ratio may result in a reduction in the optimally computed leverage for the vast majority of firms in both years studied. Specifically, effects of the 1% increase in the payout rate on the capital structure are reversely related to asset volatility. In more detail, the

Figure 7: Optimal leverage range - Leland-Toft (1996) model



impact of payout ratio changes is more noticeable for firms with lower risks (smaller sigma) than those with higher volatility. In 2016, our findings confirm that given an upward change in the payout ratio, most firms also saw a dwindle in optimal leverages computed by the model; albeit the impact of change on leverage seems unrelated to their asset volatility. The effects of payout change on default barriers are mixed so no valid conclusion can be made.

Taxes are an important element of the model and it has been a common consensus in structural models that the corporate tax rate is assumed to be constant. However, as indicated earlier, the tax code was altered at the beginning of 2016, when the corporate tax rate was trimmed down to 20%. We test the tax effect on the sample in 2014 and find that optimal leverage, in compatibility with most empirical studies earlier, responds positively with the lower tax rate. We draw from the data analysis that a lower tax rate results in the loss of tax benefits and lowers both debt and firm values. As the downward changes in the value of debts are more pronounced than in the asset values, the optimal leverage declines accordingly. The tax effect can be the source of differences in the optimal leverage ratios of companies facing different tax code provisions.

It should be noted that the asset value of firms and optimal leverages generally decline with longer debt maturities, indicating that shorter term debts are preferred. Leland justifies firms' use of short-term debts by addressing the problem of asset substitution. We acknowledge this as one of the drawbacks of our analysis since the issue of asset substitution is out of the scope of our study.

Bankruptcy costs obviously have a negative impact on a firm's value, as management is motivated to cut down debts and lower coupons for fear of higher expenses related to default. The downward movement of a firm's asset value, nonetheless, can somehow be offset. For firms deciding to take fewer debts, the bankruptcy threshold drops accordingly and firms remain in operation for longer. As a result, firm value may rise as firms can keep exploiting the tax benefits of debts and enjoy lower discounted default costs over longer periods of time. However, as the former effect overshadows the latter in this case, we find that the value of firms decline as α increases.

In a similar approach to the Leland (1994) model, an increase in the volatility of firms' assets will raise the likelihood of defaults, and in turn firm value drops as a result of higher bankruptcy costs and lower tax benefits (due to lower debt capacity). As a direct consequence, the optimal leverage ratios fall. Hypothesis testing conducted also verifies this relationship.

In this analysis, all firms are expected to optimally declare bankruptcy at V^*B less than the amount of the debt principal P, given the debt maturity of 10 years. However, Leland and Toft (1996) also add that if the debts are short-term, defaults may occur even when the value of assets is higher than the endogenous default triggering value with concern over "anticipated equity appreciation".

As is clearly indicated, few firms currently employ higher leverage than indicated by the model, implying that they are operating sub-optimally; maybe because firms wish to spare room for raising capital potentially required in the future. It is evident that the majority of firms in the Leland-Toft model use higher leverage than in the model of Leland (1994), suggesting that the latter better reflects the complexity of firms' debt structure in reality and supply values that are closer to practical norms.

To summarize, the two models analysed above fail to precisely describe the debt ratios observed in the market for real parameter values. According to Bruche (2006), the estimation of structural models is rarely straightforward and in this part, some of the values cannot be determined or unrealistic. Another possible reason for this drawback rests on the ignorance of some market frictions. Simplified assumptions do make the application of these models less applicable in the market; however, the analysis still serves well as a foundation for more comprehensive study.

5. Conclusion

This paper solely focuses on the investigation of capital structure in its relation with taxes and default costs. These simple trade-off static models can be easily made use of by firms to determine their theoretical optimal capital structure, depending on how complex firms' debts are. As indicated, the optimal debt values move in the same direction with corporate income tax thanks to the deductibility of interest charges and changes negatively with default costs, mainly because of the increasing chance of bankruptcy. Nonetheless, it can be argued that the optimal sizes of debt and equity computed are not always compatible with those observed in practice, partly due to a number of unrealistic assumptions and other driving forces in the practical world. Besides, the restriction that firms can only lever one time results in higher borrowings than the actual figures are in reality; firms can proactively redeem or take more debts as many times as they want. Therefore, firms could use the quantitative results obtained from those models to reasonably adjust their capital structure levels or investigate and conduct deeper researches for financial decisions. As the analysis illustrates, there are, obviously, discrepancies between the leverage ratios observed in the market and those calculated from the models, suggesting that a more in-depth study is needed to gain an insight into the relationships among various determinants of capital structure, especially those specifically associated with the real estate sector.

Although the paper only emphasizes the application of structural models to determine the optimal capital structure, its implications can be much broader. Credit spreads, which are obviously not the focus of this study, can be inferred from the value of optimal debt values. Besides, despite the fact that we concentrate more on the methodology than the empirical results of these models, this paper has provided guidance for more precisely-done researches and the optimal debt levels found in the analysis can serve as references for banks when they make lending decisions to real estate firms. Undoubtedly, banks should not be and are not advised to make more loans to companies that are close or even exceeding their optimal gearing levels.

The findings do not clearly signpost the differences in capital structure choices between large and small firms, mainly because the sample consists of the largest players in the market by total assets. Nonetheless, previous studies suggest that bigger firms are likely to finance more via debts thanks to their flexibility in financing sources and their ability to solve temporary liquidity problems. In contrast, small firms, with low cash flows level, are discouraged to take on debts for fear of failure to service due obligations.

The models imply a relationship between firms' capital structure choices and primitive variables. More specifically, firms' optimal capital structure will undoubtedly be of different levels once the risk-free interest rate is adjusted by the government. However, the effect is mixed between the two models, depending on the assumptions about the complexity of debt structure. While an increase in the risk-free rate would urge firms in the Leland (1994) model to finance more through debts, the impacts of interest rate changes on firms' financial gearing as indicated by the Leland-Toft (1996) model were quite mixed. The tax rate levied on corporate income also has a direct influence on firms' capital structure decisions. Studies show that firms tend to increase borrowings if the corporate tax rate is to rise.

Notes:

1. Standard normal cumulative function at Z = 1.333333: N(1.333333) = 0.9087. Standard normal density function at Z = 1.333333: n(1.333333) = 0.16401.

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