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Sustainable growth rate, optimal growth rate, and optimal payout ratio: A joint optimization approach ☆

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ABSTRACT

This study investigates the investment decision and dividend policy jointly from a non-steady state to a steady state. We extend Higgins' (1977, 1981, 2008) sustainable growth rate model and develop a dynamic model which jointly optimizes the growth rate and payout ratio. We optimize the firm value to obtain the optimal growth rate in terms of a logistic equation and find that the steady state growth rate can be used as the benchmark for the mean-reverting process of the optimal growth rate. We also investigate the specification error of the mean and variance of dividend per share when introducing the stochastic growth rate. Empirical results support the mean-reverting process of the growth rate and the importance of covariance between the profitability and the growth rate in determining dividend payouts. The intertemporal behavior of the covariance may shed some light on the fact of disappearing dividends over decades.

1. Introduction

The relationship between the optimal dividend policy and the growth rate has been analyzed at length by Gordon (1962), Lintner (1964), Lerner and Carleton (1966), Miller and Modigliani (1961, 1966), and others. In addition, Higgins (1977, 1981, 2008) derives a sustainable growth rate assuming that a firm can use retained earnings and issue new debt to finance the growth opportunities of the firm. Furthermore, a growing body of empirical literature focuses on the relationship between the optimal dividend payout policy and the growth rate. For example, Rozeff (1982) showed that the optimal dividend payout is related to the fraction of insider holdings, the growth of the firm, and the firm's beta coefficient. Grullon et al. (2002, 2006), and DeAngelo and DeAngelo (2006) suggest that increases in dividends convey information about changes in a firm's life cycle from a higher growth phase to a lower growth phase. Benartzi et al. (1997) and Grullon et al. (2002) show that dividend changes are related to the change in the growth rate and the change in the rate of return on assets. Fama and French (2001) use a free cash flow hypothesis to find that firms tend to pay dividends when they experience high profitability and low growth rates. Finally, DeAngelo and DeAngelo (2006), Blau and Fuller (2008), and Lee et al. (2011) reexamine issues of dividend policy based upon the dividend flexibility hypothesis. Although pioneering in their efforts, these authors focus their analyses at the equilibrium point, but not on the time path that leads to the equilibrium. More importantly, these authors do not jointly consider the investment decision and finance decision at the same time.

This study attempts to provide a way of jointly finding the optimal investment and payout decisions from a non-steady state to a steady state. We start by extending Higgins' (1977, 1981, 2008) sustainable growth rate model by allowing new equity to be issued. Under this framework, the new assets of a firm can be

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financed by new debt, external equity, and internal equity through retained earnings. We also assume that the growth rate varies over time and profitability follows a stochastic process. A dynamic model is then developed expressing a firm's risk-adjusted stock price. Under this dynamic model, a firm's investment decision and financing decision will interact with each other and the time path of the optimal growth rate is traced and analyzed. By maximizing the current stock price, we derive closed forms of the optimal growth rate and the optimal payout ratio.

We find that the optimal growth rate is a logistic equation with characteristics of a mean-reverting process. We show that a specification error of the expected dividend per share may exist when a stochastic growth rate is introduced. The model shows that the covariance between the rate of return on equity and the total asset growth, which represents the interaction between the profitability risk and the growth risk, has a negative impact on dividend payout policy. Ignoring the covariance term may therefore result in a misspecification error in determining the dividend payout policy. Such a negative impact in the covariance between the profitability risk and the growth risk may provide an alternative explanation for the declining number of firms paying cash dividends documented by Fama and French (2001) and DeAngelo et al. (2004).[1]

We further develop three testable hypotheses and determine their implications based on our theoretical model. Hypothesis 1 investigates the nature of the mean-reverting process of the optimal growth rate of a firm. Hypothesis 2 examines whether the covariance between the profitability risk and the growth risk can be one of the key factors in determining a firm's dividend payout ratio. Hypothesis 3 examines whether the covariance term affects a firm's decision to stop or initiate a dividend payout. To tackle our research questions, we empirically test the hypotheses using 31,255 firm-years of data during the period from 1969 to 2011. We use a partial adjustment model to test the mean-reverting process of the growth rate as indicated in our theoretical model while acknowledging that the model has been used passively in testing the adjustment process of dividend policy (see Fama and Babiak, 1968; Lee et al., 1987; Andres et al., 2009) and capital structure (see Flannery and Rangan, 2006; Lemmon et al., 2008; Huang and Ritter, 2009). In addition, we use a structural change model and a probit model to examine the determinants and decisions of dividend policy. Empirical results support the mean-reverting process in total asset growth and the importance of the interaction between the profitability risk and the growth risk in determining the dividend payout ratio. We also find that a positive covariance term can increase the probability of stopping a dividend payout while a negative covariance term cannot assure an increase in the probability of initiating a dividend payout. These results may, to some extent, explain the puzzle of disappearing dividends over past decades (see Fama and French, 2001).

The present study deviates from earlier studies in two major aspects. First, this study presents a fully dynamic model for determining the optimal growth rate and the optimal dividend policy under stochastic conditions. Second, the focus is on tracing the time optimal path of the relevant decision variables and exploring their inter-temporal dependencies. The entire analysis in this paper is under the joint consideration of the investment and finance decisions, and is carried out in the stochastic control theory framework. The implications induced from our theoretical model are confirmed by the empirical work. We believe that this study is the first of its kind to provide a theoretical basis for combining the investment decision and the finance decision under uncertainties.

The paper is organized as follows. In Section 2, we develop a theoretical model jointly considering the investment decision and the finance decision. The optimal growth rate is obtained and analyzed. In Section 3, we present the optimal dividend payouts under conditions of a static growth rate and a dynamic growth rate. In Section 4, we develop three hypotheses and discuss the empirical results of optimal growth rate and dividend payout policy. The conclusion is in Section 5.

2. The model

2.1. Sustainable growth rate with new equity allowed

This section is to generalize Higgins' (1977) sustainable growth rate with the issuance of new equity allowed. To explore the relationship between the payout policy and the growth rate, we allow that a firm can finance growth by new debt, external equity, and internal equity through retained earnings, and thus leave new investments unconstrained by retained earnings. Our model operates under the usual assumptions of rational investor behavior, zero transactions costs, and the absence of tax differentials between dividends and capital gains and between distributed and undistributed profits. We further assume that the rate of return on equity is nonstationarily distributed and the growth rate varies over time.

A model to maximize price is developed under stochastic growth rate assumptions, but first we present a simplified case under a deterministic time variant growth rate. Under this specification neither the growth rate nor the level of assets are predetermined in any time interval. Thus, the asset size at time t is

$$A(t) = A(0)e^{\int_0^t g(s)ds}, \tag{1}$$

where

$A(0)$ = initial total asset,
$A(t)$ = total assets at time t,
$g(t)$ = time variant growth rate, and
s = the proxy of time in the integration.

Assuming a constant leverage ratio exists for a firm, the firm's earnings can also be defined as a stochastic variable that is the product of the rate of return on equity and the total equity.

$$\begin{aligned}\widetilde{Y}(t) &= R\widetilde{O}A(t)A(0)e^{\int_0^t g(s)ds} = \frac{R\widetilde{O}A(t)}{1-L}A(0)(1-L)e^{\int_0^t g(s)ds}\\ &= \tilde{r}(t)A'(0)e^{\int_0^t g(s)ds},\end{aligned} \tag{2}$$

where

$\widetilde{Y}(t)$ = earnings of the leveraged firm at time t,
$R\widetilde{O}A(t)$ = the rate of return on total asset for a leverage firm at time t,
$\tilde{r}(t) = \frac{R\widetilde{O}A(t)}{1-L}$ = the rate of return on total equity at time t, normally distributed with mean $\bar{r}(t)$ and variance $\sigma^2(t)$,
$A'(0) = (1-L)A(0)$ = the total equity at time 0, and
L = the debt to total assets ratio.

In the rest of this study we express the firm's earnings in terms of the rate of return on equity and total equity.

[1] Explanations of diminishing cash dividends are documented in the following. Grullon et al. (2002) and DeAngelo et al. (2004) find a substitution of share repurchases for dividends in both the United States and Europe. According to Dittmar and Dittmar (2008), the annual aggregate volume of repurchases has surpassed that of cash dividends. Another explanation for disappearing dividends is the catering theory of dividends proposed by Baker and Wurgler (2004a). This theory suggests that the decision to pay dividend is driven by investor demand for dividends. Baker and Wurgler (2004b) further find that the propensity to pay dividends is associated with the catering incentives.