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journal homepage: www.elsevier.com/locate/jbfCorporate liquidity and dividend policy under uncertainty[☆]Nicos Koussis^{a,*}, Spiros H. Martzoukos^b, Lenos Trigeorgis^c^a Department of Economics, Finance and Accounting, Frederick University Cyprus, 7 Frederickou Street, Nicosia 1036, Cyprus^b Department of Accounting and Finance, University of Cyprus, P.O. Box 20537, CY 1678 Nicosia, Cyprus^c Department of Accounting and Finance, University of Cyprus, P.O. Box 20537, CY 1678 Nicosia, Cyprus; School of Management and Business, King's College London; and Sloan School of Management, MIT

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ABSTRACT

We examine optimal liquidity (retained earnings) and dividend choice incorporating debt financing with risk of default and bankruptcy costs as well as growth options under revenue uncertainty. We revisit the conditions for dividend policy irrelevancy and the broader role of retained earnings and dividends. Retained earnings have a net positive impact on firm value in the presence of growth options, high external financing costs and low default risk. High levels of retained earnings enhance debt capacity but have a negative effect on equity value due to the likelihood of losing accumulated cash balances in case of default, unless offset by high external financing costs. Opposite directional effects of retained earnings on equity and debt create a U-shaped relation with firm value. The framework is extended to analyze management-shareholder conflicts, demonstrating that managers accumulate higher than optimal cash.

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1. Introduction

Miller and Modigliani (1961) established that dividend policy is irrelevant in frictionless markets. In real markets, dividend irrelevancy does not hold in the presence of costly external financing, default risk, bankruptcy costs and growth option opportunities. Developments using contingent claims analysis or real options provide a framework for an integrated analysis of the firm's interrelated investment, capital structure and dividend policies incorporating both default risk and growth option considerations. A key advantage of the real options approach is the explicit incorporation of uncertainty and managerial or shareholder flexibility to make decisions depending on the future realization of stochastic revenues (see Dixit and Pindyck, 1994; Trigeorgis, 1996). This important strand of literature (e.g., Leland, 1994; Mauer and Triantis, 1994; Childs et al., 2005; Mauer and Sarkar, 2005; Sundaresan and Wang, 2015; Liu and Mauer, 2011) has, however, largely

ignored corporate liquidity and dividend policy. Contingent-based models typically assume that any excess cash is distributed in the form of dividends, while in periods of negative cash flow the firm resorts to external financing to finance the shortfall. One notable difficulty in incorporating liquidity choice in a real options framework is dealing with path-dependency arising from the need to keep track of the history of cash balances retained (e.g., Acharya et al., 2000, p. 14). In this paper, we develop a theoretical framework to investigate these issues in a real options setting. We present a number of propositions based on a simple analytical setup and then obtain further insights using a more comprehensive numerical model that incorporates revenue uncertainty, path-dependent liquidity (retained earnings) choice, debt financing with risk of default and costly external financing, as well as future growth options. In our model, retained earnings are held in the form of liquid assets that earn a specified per-period interest. This serves as a substitute to reduce future external financing and the risk of costly default and incurrence of bankruptcy costs. Our main contribution is highlighting the negative incentive to save as cumulated cash savings would be lost at default due to limited liability (and absolute priority rule) and quantifying the tradeoff between the default cost of savings and other important offsetting benefits. We obtain a number of related specific results.

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First, we confirm that irrelevancy of retained earnings and dividend policy holds in the absence of default risk, provided retained earnings in the form of liquid assets earn the risk-free rate and there are no external financing costs. Default risk can induce a negative impact of retained earnings on unlevered firm (equity) value because accumulated cash holdings may be lost if the firm cannot make the debt payment and goes bankrupt.

Second, the role of retained earnings is more important the higher the expected benefits from growth options and the greater the external financing costs. External financing costs have a lesser impact on firm value when their only role is to finance liquidity shortages to avoid default. Lins et al. (2010), surveying CFOs from 29 countries, show that the main driver of holding liquidity is the financing of future investment growth opportunities. Brown and Petersen (2011) further suggest that cash balances enable a firm to smooth R&D spending. Riddick and Whited (2009) (see also Milne and Robertson, 1996) put forth a precautionary saving motive of holding cash, while Palazzo (2009) argues that cash-rich firms earn superior returns due to precautionary motives. Our analysis highlights the offsetting role of the risk of default, i.e., the risk of lost cash holdings in case of default offsets the precautionary motive of accumulated cash.

Third, the incentive to maintain high retained earnings (low dividends) is moderated by firm profitability and available cash balances. For firms with low profitability and low initial cash balances, retaining earnings may not be sufficient to avoid default; in this case, it may be better for shareholders to reduce cash balances and pay higher dividends, resorting to external financing in the future if needed. Conversely, for firms with high profitability and high initial cash balances the negative role of retained earnings is mitigated as the risk of default decreases; in this case, retaining earnings may play a positive role for shareholders because the accumulation of cash balances can be used to finance growth options and reduce costly external financing. This non-linear role of profitability and initial cash balances highlights important differences regarding the behaviour of early-stage firms having low profitability and cash balances vs. more mature firms with higher profitability and accumulated cash.

Fourth, we show that higher revenue uncertainty increases default risk, thereby reducing the role and importance of retained earnings because equityholders may lose any accumulated cash balances in case of firm default. In the presence of growth options and debt, however, higher retained earnings may be beneficial when volatility is high (despite the higher default risk) because they enhance the value of the growth options and reduce external financing needs for funding valuable growth options while maintaining a high level of debt capacity.

Fifth, higher retained earnings enhance debt capacity as the risk of default is reduced. Unless the firm has valuable growth options or high external financing costs, higher levels of retained earnings have a negative impact on equity value. The opposite directional effects of retained earnings on equity and debt values may have a U-shaped effect on firm value. Firm value maximization in this case favours high retained earnings and plowback when the risk of default is low (for firms with high profitability and low volatility) and when growth options and external financing costs are high. A low plowback instead is preferred under high default risk and when the value of growth options and external financing costs is low.

Sixth, in terms of investment timing, when there is low profitability (and low accumulated cash holdings from earlier periods), the firm delays exercising its growth option to avoid incurring high external financing costs. When the firm faces high profitability (and high accumulated holdings), early investment exercise is more appealing as it can enhance revenues early on without the need to incur high external financing costs.

Finally, we address managerial-shareholder conflicts by conducting an analysis of optimal payout policy based on managerial instead of shareholder optimization objectives when there are costs of collective action by shareholders. Such managerial-based policies result in sub-optimally high cumulated cash balances, sub-optimal early exercise of growth options and delayed default. This results in significant agency costs which are more severe in the presence of growth options.

We proceed as follows. Section 2 presents a literature review. Section 3 shows the theoretical framework based on an analytical solution with comparative statics. Section 4 presents numerical sensitivity results based on an extended numerical model. Appendix A proves a key result used in the derivation of analytic comparative statics while Appendix B describes in detail the extended numerical model.

2. Review of literature

Early dividend policy theories have focused on dividend irrelevancy in frictionless markets (Miller and Modigliani, 1961), the effect of corporate and personal taxes (Brennan, 1970; Miller and Scholes, 1978) and the use of dividends as a signalling device for future growth prospects (e.g., Miller and Rock, 1985). As an alternative to an optimal capital structure, pecking order theory (Myers, 1984) motivated by asymmetric information posited that retained earnings should be the first source of financing, followed by external debt issuance, and only in last resort by equity. In our model we examine a complementary relation between retained earnings and debt capacity mostly ignored by the pecking order and previous theories on dividend policy. We abstract from asymmetric information (which would increase the costs of external financing in our context) and signalling considerations and set aside the effects of personal taxes.

Agency-based theories have provided prominent explanations of firm dividend decisions. Easterbrook (1984) suggests that paying higher dividends provides a disciplinary mechanism reducing manager-shareholder conflicts; the firm should thus resort to external markets for financing any future investment opportunities. Analogously, Jensen's (1986) "free-cash flow" theory posits that larger dividends reduce the incentives of managers to expropriate value via large accumulated cash balances. Lambrecht and Myers (2008) analyze capital investment policies for a firm facing management-shareholder conflicts and show how bankruptcy costs can distort investment and disinvestment decisions. Our findings provide complementary evidence that managers have strong incentives for maintaining high levels of cash balances to ensure their own benefits. We further show that managers may choose cash-holding policies sub-optimally investing in growth options and leading to high agency costs.¹ Similarly to Lambrecht and Myers (2008), managers may sub-optimally delay default. Dittmar et al. (2003) find that firms in countries with poor shareholder protection hold more cash since shareholders cannot force managers to disgorge excessive cash balances. Dittmar and Maht-Smith (2007) further show that poor governance mechanisms lead to suboptimal use of cash balances.

Agency conflicts among equity and debt holders over dividend policy are analyzed in Hirth and Uhrig-Homburg (2010), who fo-

¹ In our model, agency conflicts of this sort can be implicitly captured by reducing the return earned on accumulated cash balances (see also Asvanunt et al., 2010), reflecting increasing agency costs of maintaining high cash balances. A recent article in *Economist* (2013), highlights that many firms in the US adopt structures such as Master Limited Liability (MLP) that keep no retained earnings to reduce the payment of corporate taxes and enforce market discipline on managers. Allen et al. (2000) suggest another positive side effect of paying high dividends involving an increased monitoring role by institutional investors who represent a clientele for firms paying higher dividends.

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