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journal homepage: www.elsevier.com/locate/jfecMarket timing, investment, and risk management[☆]Patrick Bolton^{a,c,d}, Hui Chen^{b,c}, Neng Wang^{a,c,*}^a Columbia University, New York, NY 10027, USA^b MIT Sloan School of Management, Cambridge, MA 02142, USA^c National Bureau of Economic Research, USA^d Center for Economic Policy Research, UK

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ABSTRACT

The 2008 financial crisis exemplifies significant uncertainties in corporate financing conditions. We develop a unified dynamic *q*-theoretic framework where firms have both a precautionary-savings motive and a market-timing motive for external financing and payout decisions, induced by stochastic financing conditions. The model predicts (1) cuts in investment and payouts in bad times and equity issues in good times even without immediate financing needs; (2) a positive correlation between equity issuance and stock repurchase waves. We show quantitatively that real effects of financing shocks may be substantially smoothed out as a result of firms' adjustments in anticipation of future financial crises.

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1. Introduction

The financial crisis of 2008 and the European debt crisis of 2011 are fresh reminders that corporations at times face substantial uncertainties about their external financing conditions. Recent studies show dramatic changes in firms' financing and investment behaviors during these crises. For example, Ivashina and Scharfstein (2010) find aggressive credit line drawdowns by firms for precautionary reasons. Campello, Graham, and Harvey (2010) and Campello, Giambona, Graham, and Harvey (2011) show that more financially constrained firms planned deeper cuts in investment and spending, burned more cash, drew more credit from banks, and engaged in more asset sales during the crisis.

Rational firms could plausibly adapt to fluctuations in financing conditions by hoarding cash, postponing or

bringing forward investments, timing favorable market conditions to raise more funds than they really need, or hedging against unfavorable market conditions. Recently, there has been much empirical work on the corporation's cash holdings.¹ Yet, very little theoretical research tries to answer the following related questions. How should firms change their financing, investment, and risk management policies during a period of severe financial constraints? How should firms behave when facing the threat of a future financial crisis? What are the overall real effects of changes in financing conditions when firms can prepare for future shocks through cash and risk management policies?

We address these questions in a quantitative model of corporate investment, financing, and risk management for firms facing stochastic conditions. Our model builds on the recent dynamic frameworks by [Decamps, Mariotti, Rochet, and Villeneuve \(2011\)](#) and [Bolton, Chen, and Wang \(2011, henceforth BCW\)](#), mainly by adding stochastic financing opportunities. The five main building blocks of the model are (1) a constant returns-to-scale production function with independently and identically distributed (i.i.d.) productivity shocks and convex capital adjustment costs as in [Hayashi \(1982\)](#), (2) stochastic external financing costs, (3) constant cash-carrying costs, (4) risk premia for productivity and financing shocks, and (5) dynamic hedging opportunities. The firm optimally manages its cash reserves, financing, and payout decisions by following a state-dependent optimal double-barrier policy for issuance and payout, combined with continuous adjustments of investment, cash accumulation, and hedging between the issuance and payout barriers.

The main results of our analysis are as follows. First, during a financial crisis, to avoid extremely high external financing costs, the firm optimally cuts back on investment, delays payout, and, if needed, engages in asset sales, even if the productivity of its capital remains unaffected. This is especially true when the firm enters the crisis with low cash reserves. These predictions are consistent with the stylized facts about firm behavior during the recent financial crisis.

Second, during favorable market conditions (a period of low external financing costs), the firm could time the market and issue equity even when no immediate need exists for external funds. Such behavior is consistent with the findings in [Baker and Wurgler \(2002\)](#), [DeAngelo, DeAngelo, and Stulz \(2010\)](#), [Fama and French \(2005\)](#), and [Huang and Ritter \(2009\)](#). We thus explain firms' investment, saving, and financing decisions through a combination of stochastic variations in the supply of external financing and firms' precautionary demand for liquidity. We also show that, due to market timing, investment can be decreasing in the firm's cash reserves. The reason is that the market timing option together with the fixed external financing costs can cause firm value to become locally convex in financial slack. This local

convexity also implies that it could be optimal for the firm to engage in speculation rather than hedging to increase the value of the market timing option.

Third, along with the timing of equity issues by firms with low cash holdings, our model predicts the timing of cash payouts and stock repurchases by firms with high cash holdings. Just as firms with low cash holdings seek to take advantage of low costs of external financing to raise more funds, firms with high cash holdings are inclined to disburse their cash through stock repurchases when financing conditions improve. This result is consistent with the finding of [Dittmar and Dittmar \(2008\)](#) that aggregate equity issuances and stock repurchases are positively correlated. They point out that the finding that increases in stock repurchases tend to follow increases in stock market valuations contradicts the received wisdom that firms engage in stock repurchases because of the belief that their shares are undervalued. Our model provides a simple and plausible explanation for their finding: improved financing conditions raises stock prices and lowers the precautionary demand for cash buffers, which in turn can result in more stock repurchases by cash-rich firms.

Fourth, we show that a greater likelihood of deterioration in the financing conditions leads to stronger cash hoarding incentives. With a higher probability of a crisis occurring, firms invest more conservatively, issue equity sooner, and delay payouts to shareholders in good times. Consequently, firms' cash inventories rise, investment becomes less sensitive to changes in cash holdings, and the ex post impact of financing shocks on investment is much weaker. This effect is quantitatively significant. When we raise the probability of a financial crisis within a year from 1% to 10%, the average reduction in a firm's investment-capital ratio following the realization of the shock drops from 6.6% to 1.8%. Furthermore, this reduced investment response is in large part due to the firm cutting back investment in the good state in preparation for the crisis. These findings provide important new insights on the transmission mechanism of financial shocks to the real sector and helps us interpret empirical measures of the real effects of financing shocks. In particular, it shows that judging the real effect of financial crisis by measuring the changes of investment following the crisis can be misguided.

Fifth, due to the presence of aggregate financing shocks, the firm's risk premium in our model has two components: a productivity risk premium and a financing risk premium. Both risk premia change substantially with the firm's cash holdings, especially when external financing conditions are poor. Quantitatively, the financing risk premium is significant for firms with low cash holdings, especially in a financial crisis, or when the probability of a financial crisis is high. However, due to firms' precautionary savings, the financing risk premium is low for the majority of firms as they are able to avoid falling into a low cash trap. Moreover, our model predicts that idiosyncratic cashflow risk affects a firm's cost of capital. Firms facing higher idiosyncratic risk optimally hold more cash on average, which lowers their beta and expected returns. This result highlights that the endogeneity of cash

¹ See [Almeida, Campello, and Weisbach \(2004\)](#), [Dittmar and Mahrt-Smith \(2007\)](#), [Dittmar and Dittmar \(2008\)](#), [Bates, Kahle, and Stulz \(2009\)](#), [Riddick and Whited \(2009\)](#), among many others, on the empirical relevance and potential explanations of corporate cash holding policies.

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