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Dynamic agency and investment theory with time-inconsistent preferences

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ABSTRACT

We incorporate managers' time-inconsistent preferences into the DeMarzo et al. (2012) model of dynamic agency and the q theory of investment. Our model provides an alternative explanation for underinvestment from the perspective of managers' time inconsistency. It also shows that firms prefer delaying a cash payout due to managers' time-inconsistent preferences, and the corresponding distorted investment and payout decisions significantly decrease a firm's average q and marginal q.

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1. Introduction

In general, many studies of corporate decisions assume that managers are homogeneous, which implies that managers' personality traits are not relevant for the financial decisions within a firm. However, in psychology, it is well known that individuals generally differ in factors such as time preferences and beliefs. Bertrand and Schoar (2003) empirically document that a major portion of heterogeneity in firms' investment and organizational practices is explained by the presence of manager fixed effects. Therefore, in this paper, we incorporate time-inconsistent preferences, an important aspect of humans' personalities, into the DeMarzo et al. (2012) model. Thus, we are able to link managers' personal characteristics with corporate investment decisions and to investigate their effects on firm value and corporate investment behavior.

For simplicity, only the manager has time-inconsistent preferences, an assumption that arises from psychological research and is supported by empirical studies such as those by Thaler (1981); Ainslie (1992); Loewenstein and Prelec (1992). The key issue involved in such time preferences is that they vary over time. Laibson (1997) models such time-varying preferences using quasi-hyperbolic discount functions in which the discount rate decreases over the horizon. As is standard in models

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of time-inconsistent decision making, such problems are generally addressed as the outcome of an intra-personal game in which the manager is represented by different players (called selves) at a future time. In other words, the current self makes decision by taking into account its future selves' decisions.

In this article, we follow Grenadier and Wang (2007), Harris and Laibson (2013), and Chen et al. (2014) in employing a continuous-time model with quasi-hyperbolic discount functions. The standard protocol for studying time-inconsistent preferences makes two different assumptions about the actions taken by future selves. One is that the manager is naive because he assumes that all future selves act according to the current self's preferences and believes that the current self can commit all future selves to act in a time-consistent way. The other is that the manager is sophisticated because he correctly anticipates time-varying impatience and assumes that all future selves make decisions that are optimal for the future selves, despite being suboptimal for the current self. However, in our scenario, the current self maximizes his total expected payoff by discounting the current payoff by a constant rate and future selves' by an additional discounting factor, and he accepts the incentive-compatible contract at the time that the contract is initiated. However, the contract stipulates the recommended actions for all selves, which implies that all future selves have to fulfill the contract until it is terminated. Thus, in the following discussion, we do not distinguish between the naive manager and the sophisticated one.

In this paper, we assume that the manager has time-inconsistent preferences but that investors are time consistent, which is the main difference between our model and that of DeMarzo et al. (2012), who assume that the investors and the manager both possess time consistent preferences. With time-inconsistent preferences, the manager discounts his payoff by a discount rate that is adjusted by the degree of his time inconsistency rather than only by a static rate, which implies that a time-inconsistent manager requires a higher rate of return for participation than do his time-consistent peers. In an optimal contract between the investors and the time-inconsistent manager, investors delay the manager's compensation in order to optimally share the risk resulting from the manager's personality traits, which means that investors detain a larger share of the time-inconsistent manager's stake in the firm. As the degree of time inconsistency increases, investors delay the manager's compensation further.

By comparing our conclusions with those of DeMarzo et al. (2012), our paper can characterize the net effect of the manager's time-inconsistent preferences on the firm's value, marginal q and average q, as well as on the optimal investment policies. We find that the manager's time inconsistency not only results in a loss in total firm value but also distorts the optimal investment policies of the firm. For the former, the existing literature regarding corporate finance provides several explanations, such as agency costs. However, by incorporating the manager's time inconsistency, this paper relates this loss to the personal characteristics of the manager and explains it from a different perspective. For the latter, there are two traditional explanations. One is misalignment between managerial and shareholder interests and the other is the existence of asymmetric information between corporate insiders and outsiders. By linking corporate investment strategies to the manager's personality traits, in this paper, we propose an alternative explanation for suboptimal firm investment behavior.

Our article is connected to a growing body of literature on principal-agency problems and dynamic contracting, such as DeMarzo and Sannikov (2006), DeMarzo and Fishman (2007a), Marzo and Fishman (2007b), and Sannikov (2008). However, our paper differs from these studies because we consider a manager with time-inconsistent rather time-consistent preferences. Moreover, our paper differs from Malmendier and Tate (2005), Hackbarth (2008), and Gervais et al. (2011) because we examine the effect of the manager's time-inconsistent preferences on firm value and corporate investment policies rather than the effect of his optimism and/or overconfidence.

Our article is closely related to work by Li et al. (2016), although they focus on the effect of the manager's time-inconsistent preferences on the optimal contract and the optimal capital structure. This article is also related to work such as Biais et al. (2010) and Hoffmann and Pfeil (2010), among others. Biais et al. (2010) use a Poisson process to capture large risks, while Hoffmann and Pfeil (2010) employ a Poisson process to describe the manager's "luck". However, we use a Poisson process to capture variation in the manager's time preferences over time.

The remainder of the paper is organized as follows: Section 2 describes the model, which includes the firm's production technology, the agency problem, the manager's preferences and the time-consistent contract. The solution to the model is derived in Section 3. In Section 4, some economic implications are provided based on the optimal contract. Finally, Section 5 concludes the paper.

2. The model

2.1. Production technology

The firm employs physical capital for production. The price of capital is normalized to unity. Denote the level of capital stock and gross investment as K and I, respectively. As is standard in investment models, the evolution of K is governed by

$$dK_t = (I_t - \delta K_t)dt, \tag{1}$$

where $\delta \geq 0$ represents the depreciation rate.

It is well known that investment entails adjustment costs. As in the literature on neoclassical investment with adjustment costs, we denote the adjustment cost as $G(I, K)$, which satisfies $G(0, K) = 0$, is smooth and convex in I and is homogeneous of degree one in both arguments. With the homogeneity of $G(I, K)$, the total investment costs can be written as

$$I + G(I, K) \ \equiv c(i)K, \tag{2}$$

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