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Decision Support

A jump model for fads in asset prices under asymmetric information

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ABSTRACT

This paper addresses how asymmetric information, fads and Lévy jumps in the price of an asset affect the optimal portfolio strategies and maximum expected utilities of two distinct classes of rational investors in a financial market. We obtain the investors' optimal portfolios and maximum expected logarithmic utilities and show that the optimal portfolio of each investor is more or less than its Merton optimal. Our approximation results suggest that jumps reduce the excess asymptotic utility of the informed investor relative to that of uninformed investor, and hence jump risk could be helpful for market efficiency as an indirect reducer of information asymmetry. Our study also suggests that investors should pay more attention to the overall variance of the asset pricing process when jumps exist in fads models. Moreover, if there are very little or too much fads, then the informed investor has no utility advantage in the long run.

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1. Introduction

Asset pricing and portfolio selection problems are central issues in financial engineering. In an efficient market, it is assumed that asset prices always fully reflect available information, and all investors have the same amount of information to utilize for portfolio selection. However, one of the most striking developments of the last few decades was how the most dearly held notions of market efficiency, the positive relationship between return and non-diversifiable risk, and dividend discount models were put into question. This was due to the strong unanticipated price volatility in asset markets such as stock, bond, currency and real estate markets. Empirical studies in LeRoy and Porter (1981) and Shiller (1981) were among the first to assert that there are many market anomalies including excess volatility caused by investor overreaction and under-reaction, fashions and fads (mispricing). More recent behavioral finance articles such as Easley, Hvidkjaer, and O'Hara (2002), Yuan (2005), Easley, Engle, O'Hara, and Wu (2008), Bharath, Pasquariello, and Wu (2009), Caskey (2009), Biais, Bossaerts, and Spatt (2010), Hayunga and Lung (2011), Kelly and Ljungqvist (2012), Serrano-Padial (2012), Vayanos and Wang (2012) and Mendel and Shleifer (2012) also argued for the existence of these market anomalies. Consequently, it is a fact that the asset pricing and portfolio selection should be studied in an inefficient framework.

According to Kelly and Ljungqvist (2012), information asymmetry has a substantial effect on asset prices and demands which affects assets through a liquidity channel. Asset pricing models under asymmetric information rely on a noisy rational expectation equilibrium in which prices partially reveal the better informed investors' information due to randomness in the assets supply. Examples of such studies are Grossman and Stiglitz (1980), Admati (1985), Wang (1993) and Easley and O'Hara (2004) who show that increases in information asymmetry lead to a fall in share prices and a reduction in uninformed investors' demand for the risky asset. Thus, asymmetric information plays an important role in asset pricing models when it exists.

The link between asset mispricing and asymmetric information was first studied by Shiller (1981) and Summers (1986) in a purely deterministic and discrete setting, and later extended by Wang (1993), Guasoni (2006) and Buckley, Brown, and Marshall (2012) to the purely continuous random environment. In this framework, it is assumed that the asset has both the fundamental value and market value, and there are two types of investors: informed investors (i.e., institutional investors with internal research capabilities), who observe both fundamental and market values, and uninformed investors (i.e., retail investors who rely on public information in order to make investment choices), who only observe market values. The difference between the market value and the fundamental value represents the current mispricing of the asset.

It is well known that asset return distributions are heavy tailed and skewed, which are at odds with the classical geometric Brownian motion models. Lévy models are among the most

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popular alternative models proposed to address this issue. Jumps in asset prices can have a very big impact on returns and mispricing. According to Summers (1986), asset prices can have large jumps away from their fundamental values. This leads to potentially large increases in fads. Consequently, the impact of fads may be more significant in affecting investment strategies and expected utility when asset prices jump. In this spirit, we propose a mispricing model under asymmetric information in a Lévy market where asset price jumps, while the mispricing is modeled by a continuous Ornstein–Uhlenbeck process and utility is logarithmic. We obtain explicit formulas for optimal portfolios and maximum expected logarithmic utilities for both the informed and uninformed investors, and prove that the optimal portfolio of each investor is more or less than its Merton optimal.

Under quadratic approximation of the portfolios, we show that the investors hold excess risky asset if and only if the ratio of first and second instantaneous centralized moments of return is greater than the Merton optimal. We also show that the excess asymptotic utility of the informed investor has an identical structure to continuous market counterpart, except that it is much less as a result of having a smaller adjusted mean reversion speed, which has a dampening effect on the excess utility. This adjusted mean-reversion speed, is a fraction of the original reversion speed of the mispricing process that has been reduced by the extra volatility arising from the jumps in the asset price. Notwithstanding the presence of asymmetric information, mispricing and jumps, our model shows that it pays to be more informed in the long run. However, if there is no mispricing, the informed investor has no utility advantage in the long run. Our study also shows that the overall variance of the asset process becomes more important for investors when jumps exist in the asset market.

The rest of the paper is organized as follows. In Section 2, we review the related literature. Section 3 presents the model, which includes filtrations and price dynamics of informed and uninformed investors. In Section 4, we consider the maximization problem of logarithmic utilities and obtain the optimal portfolios for informed and uninformed investors. Asymptotic results and quadratic approximations of logarithmic utilities and optimal portfolios are presented in Section 5. Section 6 concludes the paper. All the proofs and additional results are given in the Appendix.

2. Related literature

Discrete-time mispricing (fads) models for stocks under asymmetric information were first introduced by Shiller (1981) and Summers (1986), as plausible alternatives to the efficient market or constant expected returns assumption (cf Fama, 1970). Brunnermeier (2001) presented an extensive review of asset pricing under asymmetric information mainly in the discrete setting. He showed how information affects trading activity, and that expected return depends on the information set or filtration of the investor. These models show that past prices still carry valuable information, which can be exploited using technical (chart) analysis that uses part or all of past prices to predict future prices.

Wang (1993) presented the first continuous-time asset pricing model under asymmetric information, and obtained optimal portfolios for both the informed and uninformed investors. In this paper, investors have different information concerning the future growth rate of dividends, which satisfies a mean-reverting Ornstein–Uhlenbeck process. Informed investors know the future dividend growth rate, while the uninformed investors do not. All investors observe current dividend payments and stock prices. The growth rate of dividends determines the rate of appreciation of stock prices, and stock price changes provide signals about the future growth of dividends. Uninformed investors rationally extract information about the economy from prices, as well as dividends. Hence, in this paper, the fundamental value of the asset at any point is a function of stock price, dividend stream and dividend growth rate while mispricing is a function of dividend growth rate only.

Guasoni (2006) extends Shiller (1981) and Summers (1986) models to the purely continuous random setting. He studies a continuous-time version of these models both from the point of view of informed investor, who observe both fundamental and market values, and from that of uninformed investor, who only observe market prices. He specifies the asset price in the larger filtration of the informed investor, and then derive its decomposition in the smaller filtration of the uninformed investor using the Hitsuda representation of Gaussian processes. Uninformed investors, have a non-Markovian dynamics, which justifies the use of technical analysis in optimal trading strategies. For both types of investors, he solves the problem of maximization of expected logarithmic utility from terminal wealth, and obtain an explicit formula for the additional logarithmic utility of informed agents. He also applies the decomposition result to the problem of testing the presence of fads from market data. An application to the NYSE-AMEX indices from the CRSP database shows that, if the fads component prevails, then the mean-reversion speed must be slow.

Buckley et al. (2012) extended Guasoni's model for stocks following geometric Brownian motion to constant relative risk averse investors when mispricing follows a continuous mean-reverting Ornstein–Uhlenbeck process. They obtained analogous but more general results which nests those of Guasoni (2006) as a special case of the relative risk aversion being one. Even though the notions of asymmetric information and fads in our model is analogous to Guasoni (2006), Buckley et al. (2012) and Wang (1993), we model the asset dynamics using a Lévy process motivated by Schoutens (2003), Cont and Tankov (2004), Kyprianou, Schoutens, and Wilmott (2005), Singleton (2006), Kou (2007), Øksendal and Sulem (2007) and Wu (2007). Our model applies to any asset that has a fundamental value and the mispricing is simply the difference between the fundamental value and the observed value of the asset. Hence, our model is applicable to broader class of assets such as stock, bond, currency and real estate. Furthermore, we obtain the maximum expected utilities for both the informed and uninformed investors in a Lévy jump market. Hence, our model is more general and applicable, since it captures jumps, and as such, practically different from the extant literature.

It is also worth noting that our specification of the information asymmetry is different from that of the insider trading models such as Karatzas and Pikovsky (1996) and Amendinger, Imkeller, and Schweizer (1998). Like Guasoni (2006), we specify the price dynamic in the larger filtration of the informed investor, and then obtain the dynamic for the uninformed investor by contracting the larger filtration using the Hitsuda representation. In contrast, insider trading models specify the asset price dynamic of the smaller filtration of the uninformed investor. The novel information available to the insider (informed) investor is then added to the filtration of the uninformed to create the filtration of the insider investor by enlargement.

3. The model

The model consists of two assets, namely a riskless asset B called bond, bank account or money market, with price $B_t = \exp\left(\int_0^t r_s\,ds\right)$, and a risky asset S, called *asset* in the sequel for simplicity. The bond earns a continuously compounded risk-free interest rate r_t, while the continuous component of asset's percentage appreciation rate or expected return is μ_t, at time $t \in [0, T]$.