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Investor sentiment, heterogeneous agents and asset pricing model

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ABSTRACT

This paper presents a sentiment asset pricing model with heterogeneous agents. In the model, the sentiment equilibrium prices have a number proportion-weighted average structure among heterogeneous investors, and idiosyncratic sentiments can have a significant impact on the equilibrium price at the aggregate level because the demand function is nonlinear in the sentiment. Moreover, we also find that even if the individual sentiment affects the demand in a linear way, the sentiment may still has a significant effect on the equilibrium price in the aggregate due to the fluctuation of the number distribution of investors. The model could offer a partial explanation to the financial anomaly of overreaction.

1. Introduction

One conventional argument suggests that if the irrational investors are independent of each other, they should not have a significant impact on equilibrium prices since their trading would cancel out by aggregation (Friedman, 1953; Fama, 1965). More interestingly, the emerging behavioral asset pricing theory argues that individual irrational investors tend to be correlated and that their impacts on equilibrium can't be cancelled out at the aggregate level (e.g., Shleifer, 2000; Hirshleifer, 2001). The aggregation argument has been taken for granted by both the traditional asset pricing theory and the growing behavioral finance. The contribution of the current paper is to analyze the models with heterogeneous agents and demonstrate that idiosyncratic sentiments can have a significant impact on the equilibrium price even if they are independent across individual irrational investors. First, in the case with optimistic investors and pessimistic investors, the idiosyncratic sentiments affect the equilibrium price if the demand for the risky asset is a nonlinear function of investor sentiment. Second, in the case with many types of sentiment investors, even if the demand function is linear in individual investor sentiments, the idiosyncratic sentiments may still have a significant impact on the equilibrium price in the aggregate due to the fluctuation of the number distribution of investors.

The irrational investors may be affected by noise (Black, 1986; De Long, Shleifer, Summers, & Waldmann, 1990), cognitive bias (Daniel, Hirshleifer, & Subrahmanyam, 1998; Yan, 2010), or investor sentiment in the actual financial market. Compared with the noise pricing theory and the psychological bias pricing theory, one advantage of the related sentiment research is

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that investor sentiment could be quantitatively measured. Thus, the corresponding empirical analysis can be carried on (Baker & Wurgler, 2006, 2007). Baker and Wurgler (2006) employ principal component analysis to construct a composite market sentiment index based on six underlying proxies for sentiment. In addition, their results suggest that descriptively accurate models of prices need to incorporate a prominent role for investor sentiment in asset pricing. Recently, a number of empirical studies have shown that investor sentiment has a systematic effect on asset prices and therefore that financial asset pricing is much higher with optimistic sentiment and vice versa (see, e.g., Baker & Wurgler, 2006, 2007; Baker, Wurgler, & Yuan, 2012; Kumar & Lee, 2006; Lee, Jiang, & Indro, 2002; Brown & Cliff, 2004; Brown & Cliff, 2005; Yu & Yuan, 2011; Seybert & Yang, 2012; Stambaugh, Yu, & Yuan, 2012, 2014, 2015; Kim, Ryu, & Seo, 2014; Li, 2015; Yang & Zhou, 2015, 2016; Li & Yang, 2017). In particular, the related empirical results are supported by some experimental evidences that investors with high sentiment would make optimistic judgments and decisions so that they increase the perceived asset value, and vice versa (e.g., Ganzach, 2000; Statman, Fisher, & Anginer, 2008; Kempf, Merkle, & Niessen, 2014).

On the other hand, some sentiment asset pricing models are gradually set up to emphasize the systematic role of investor sentiment in asset prices, such as Yang and Yan (2011), Yang, Xie, and Yan (2012), Yang and Zhang (2013), Cen, Lu, and Yang (2013), Yang and Li (2013, 2014), Li (2014), Liang, Yang, Zhang, and Cai (2017) and so on. Yang and Yan (2011) present a sentiment asset pricing model with homogenous sentiment investors. Yang et al. (2012) consider a sentiment capital asset pricing model whose results show that the optimistic investor would have high perceived price and the pessimistic investor would have low perceived price. Yang and Li (2013) set up a static sentiment asset pricing model, which focuses on the interaction between rational investors and uninformed sentiment investors and shows how this interaction could sustain incorrect prices. Yang and Li (2014) propose a two-period trading sentiment asset pricing model with information, whose results show that the equilibrium prices are two-period game results among different types of investors. Li (2014) present a multi-period trading sentiment asset pricing model with information which shows that the speed of information incorporated into price becomes faster and faster, while the speed of sentiment factored into price gets slower and slower over time. Liang et al. (2017) present a framework that incorporates an investor's limited attention and anchoring and adjustment sentiment and their joint effects on asset pricing, with endogenous cost of neglecting part of the dividends and the asymmetric rationality levels of investors.

Grossman and Stiglitz (1980) propose a noisy rational expectation model with information in which it only considers the rational investors, the informed rational investors possess valuable information, and the uninformed rational investors learn from prices to infer the fundamental information and trade rationally. Black (1986) claims that irrational noise traders are contrasted with rational information traders and argues that it makes no sense to create a model with information trading but no noise trading where traders have different beliefs. Specifically, the future is very uncertain, and forecasts are very difficult to make, so it is implausible to assume that somehow everyone makes identical estimates of the return and risk from every security. In practice, the very concept of uncertainty implies divergence of opinion (Miller, 1977; Yan, 2010).

In particular, Yang and Zhang (2013) present a dynamic asset pricing model with heterogeneous sentiments based on the framework of consumption-based model, but they merely consider a special case where investors' initial wealth is equal to the equilibrium price. Chau, Deesomsak, and Koutmos (2016) develop an intertemporal capital asset pricing model that accommodates the heterogeneous trading behavior of three distinct groups of investors: rational utility maximizers investors, positive feedback traders, and sentiment-driven investors. The demand for shares by sentiment-driven investors is a linear function of the changes of investor sentiment. Nevertheless, the previous sentiment asset pricing models don't possess the generality of analysis, which focus on homogenous sentiment investors or only consider a special case and don't involve the important factors such as the initial price.

Where this paper differs from much of previous literature is in analyzing the equilibrium prices in a generalized setting. Based on the framework of noisy rational expectation model of Grossman and Stiglitz (1980), we present a generalized asset pricing model with heterogeneous sentiment investors. We first consider a benchmark case with homogenous sentiment investors, where all sentiment investors face the same sentiment shock. Namely, individual irrational investors are fully correlated. Then, we develop the model with heterogeneous agents, where the irrational investors are independent of each other.

The paper adds to the literature in several ways. Firstly, we provide a benchmark case where all investors have homogeneous sentiments and their sentiments affect the demand in a nonlinear way. Then high sentiment increases the aggregate demand and so increases the asset price if sentiment investors face the same sentiment shock. Secondly, we consider a case with optimistic sentiment investors and pessimistic sentiment investors. Optimistic investors with high sentiment would increase the perceived value of risky asset, so optimistic investors have more demand for risky asset and increase the asset price. On the contrary, it is to pessimistic investors with depressed sentiment. Then two types of investors have a significant impact on the equilibrium when the sentiment affects the demand in a nonlinear way. Finally, we consider a case with many types of sentiment investors. Even if their sentiments affect the demand in a linear way, they may still have an important effect on the asset price at the aggregate level as each type of investor is endowed with different number share of the aggregate investors.

The rest of the paper is organized as follows. In Section 2, we spell out the economy for formal model. In Section 3, we first consider the simple situation where all investors have homogenous sentiments. This provides a benchmark case for our economy. Then we investigate the equilibrium of the economy with heterogeneous sentiment investors. Section 4 concludes the paper.