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A robust reference-dependent model for speculative bubbles☆

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ABSTRACT

We present a robust model of speculative bubbles by introducing loss-averse reference-dependent preferences by Koszegi and Rabin (2006) into the framework of Allen et al. (1993), where in equilibrium, asymmetrically-informed rational investors buy overvalued assets, hoping to sell them to less informed agents before the crash occurs. With reference-dependent preferences, the asset price may not necessarily be observable to agents when there is no trade. However, this is never the case with classical preferences, as shown in the paper. Incorporating the classical model as a special case, we generalize the notion of bubbles to allow for the analysis in the case of a silent market with unobservable prices, and our model is able to generate strong bubbles robust to moderate perturbations in parameters without the need for stronger conditions as suggested in previous literature. Assuming for simplicity that dividends can only take on two values, we construct an example of a robust reference-dependent bubble which is not robust in the classical setting, and we also show that the positive results regarding the limit of the bubble size and bubble frequency in the classical setting are preserved in our framework. Our main results and economic implications remain valid in more general settings.

Normally sensible people drift into behavior akin to that of Cinderella at the ball. They know that overstaying the festivals will eventually bring on pumpkins and mice... participants all plan to leave just seconds before midnight... (But) they are dancing in a room in which the clocks have no hands.

Warren Buffett

1. Introduction

The last two decades have witnessed at least two dramatic boom-and-bust episodes – the dot-com bubble (Ofek and Richardson, 2003) and the subprime crisis (Varadarajan, Christiano and Keho, 2008), which seem like replications of the stories in Kindleberger and Aliber (2011), including the Dutch tulip mania (1634–1637), the Mississippi bubble (1719–1720)

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and the South Sea bubble (1720).[1] Similar phenomena have also been observed in the laboratory environment (Dufwenberg et al., 2005; Moinas and Pouget, 2013; Lugovskyy et al., 2014; Bao et al., 2017, among others) where bubbles occur with asymmetrically informed agents aware of the possibilities of both riding the bubble and getting stuck, or bubbles are robustly generated in markets with positive expectation feedback.

Despite its nearly unambiguous existence and prevalence in empirical studies, the phenomena of bubbles seem difficult to explain using classical economic theory. There is a large strand of literature trying to introduce the ideas of overlapping generations to rationalize bubbles (Tirole, 1985; Farhi and Tirole, 2011; Martin and Ventura, 2012). We refer to this type of bubble as an "investment bubble" in the sense that the asset serves as a store of value and may grow slowly without bursting, or alternatively may burst because of the insufficiency of cash (Caginalp and Ilieva, 2008). This can be regarded as a type of moderate-scale bubbles from the long-term perspective. However, the bubbles mentioned in the beginning of the paper typically involve an intense crash, calling for a distinct definition of bubbles from the short-term perspective. Following Conlon (2004) and Doblas-Madrid (2012), we characterize this type of bubble as a "speculative bubble" where rational agents consciously buy the over-valued assets in the hope of selling them to a greater fool before the assets crash. In this paper we narrow our focus to speculative bubbles.

Tirole (1982) has shown that with a homogeneous setup, rational expectations equilibrium is incompatible with speculative bubbles. In this sense, it is necessary to introduce some form of heterogeneity in order to generate bubbles, the idea of which is aptly captured by the opening quotation by Warren Buffet: Investors hold the over-priced asset in the expectation of getting a higher payoff by selling it to a "greater fool" and quitting the market just before the bubble bursts, but at the same time it is possible that they may stay too long to actually successfully sell the asset. Allen et al. (1993, henceforth referred to as AMP) precisely captured this intuition in their finite-horizon bubble model with asymmetric information and short sale constraint. By their notion of "strong bubbles", every trader knows that the asset is over-priced with certainty, however, they still would like to hold the asset because there is uncertainty about other traders' knowledge of this over-pricing phenomenon. The AMP framework has been well adopted in the literature on rational bubbles, given its success in explaining the existence of bubbles from the perspective of information economics (Conlon, 2004, 2015; Zheng, 2014; Lien et al., 2015, among others). However, it has also been shown that the bubble equilibria in AMP model are fragile and not very robust to small perturbations in payoff or belief parameters (Zheng, 2014; Conlon and Zheng, 2013). Intuitively, to support rational bubbles, public signals (prices) should not reveal too much information; that is, certain states of the world need to be indistinguishable from one another in observing the market price. Also, with risk neutrality and competitive markets, players should be indifferent between selling or buying an additional unit of the asset in equilibrium. This necessary condition translates into a system of equalities for parameters under the classical AMP setup, and thus fails to hold when there are small asymmetric perturbations in the values of parameters such as priors or dividends, since the players may find it strictly better off to trade and force the equilibrium prices to vary in previously indistinguishable states, which in turn ruins the proposed information structure that supports the rational bubble.

In order to take into account the main concern of the bubbles' robustness issue, we extend the AMP framework to allow for a more general type of utility – reference-dependent loss-averse utility in this paper, and show that the bubbles are no longer fragile when agents have such preferences.[2] The ideas of reference dependence was first observed and formulated in the Kahneman and Tversky's seminal paper on prospect theory (1979) and has been studied in various fields (for example, Ericson and Fuster, 2011; Eil and Lien, 2014; Humphreys and Zhou, 2015; Lien and Zheng, 2015, among many others). Koszegi and Rabin (2006, 2007) study the loss aversion feature of reference-dependent preferences by introducing an extra gain-loss utility term into the traditional consumption utility function and set a consumer's recent rational expectations about outcomes as her reference point. As for empirical justifications of using expectations as the reference point, it has been well observed that expectations influence the trading behavior in general (for example, List, 2003; Ericson and Fuster, 2011) and the bubble formation in particular (Hommes et al., 2008; Hsler et al., 2013; Bao et al., 2017, among others) in the lab environment.[3] Convinced by the empirical and experimental evidence, we follow Koszegi and Rabin (2006, 2007), adopt the loss aversion type of reference-dependent preferences, and assume rational expectations as the reference point for every trader in our model. Henceforth, for convenience, we refer to such a behavioral approach to modeling preferences as the KR approach and the relevant preferences as the KR preferences.

In this paper, we present a robust model of speculative bubbles by introducing the KR preferences into the AMP framework, where in equilibrium, asymmetrically-informed rational investors buy overvalued assets, hoping to sell them to less-informed investors before the crash occurs. Incorporating the classical model as a special case, our model is able to

[1] Other examples may include the 2005–2007 and 2008–2009 Chinese stock market bubbles (Jiang et al., 2010). However, there is still some controversy about whether these can be classified as strong bubbles.

[2] Since the classical reference-independent preferences are only a special case in the class of reference-dependent preferences, the nonbusiness issue for bubbles in AMP framework will no longer be too much of a concern, as long as it can be shown that with reference-dependent preferences bubbles are in general robust. This approach of extending an existing classical model to incorporate realistic behavioral features, to provide new insights and different results under different scenarios, is named as "Portable Extensions of Existing Models" ("PEEMs") by behavioral economist Matthew Rabin (Rabin, 2013).

[3] Among others, Kahneman (2011)'s observation that "no endowment effect is expected when owners view their goods as carriers of value for future exchanges, a widespread attitude in routine commerce and in financial markets" also supports the idea that in a trading scenario, expectations, instead of the status quo, can serve as an appropriate reference point – that is, a trader does not suffer from selling if she expects to sell, as suggested by the results of experiments in Ericson and Fuster (2011).