Full length article

Interest on cash, fundamental value process and bubble formation: An experimental study☆

Giovanni Giusti [a,b], Janet Hua Jiang [c,*], Yiping Xu [d]

[a] *Escse, Tecnocampus Mataró-Maresme, Spain*
[b] *Universitat Pompeu Fabra, Spain*
[c] *Bank of Canada, Canada*
[d] *University of International Business and Economics, China*

ABSTRACT

We explore the flexibility created by the introduction of interest payments on cash holdings to the design of asset-trading experiments along the line of Smith et al. (1988). We conduct an experiment using this framework, and find that the fundamental value generating process greatly affects trading behaviors and prices. In particular, an environment where the asset has increasing fundamental values and positive expected dividend payments is conducive to fundamental trading. In addition, we provide some evidence that increasing the opportunity cost of speculation on the asset market in the form of interest payments on cash has limited success in containing price inflation.

© 2016 Published by Elsevier B.V.

1. Introduction

The recent global financial crisis has once again demonstrated the damaging impact of collapsing asset prices following an excessive speculative frenzy. Empirical studies of asset bubbles face a challenge: it is often difficult, if not impossible, to identify the fundamental value of the asset in the field. In this paper, we follow an alternative route and study the asset bubble formation in controlled laboratory environments. Through tighter control of the trading environment and a clearer definition of the fundamental value, experimental studies constitute a good complement to the empirical research using field data.

In their seminal paper, Smith et al. (1988, hereafter SSW) find strong evidence of price bubbles in a simple experimental asset market. The setting in SSW, frequently used as the benchmark design in the literature, features a single finitely-lived asset that

pays a random dividend in each period. The dividend payment (the distribution of which is common knowledge) and a fixed terminal buyout value are the only components of the intrinsic or fundamental value of the asset.[1] Following SSW, various measures have been proposed to reduce price bubbles in experimental asset markets (see Palan, 2013, for a comprehensive survey of the literature).

In this paper, we focus on how the fundamental value generating process affects trading activities and prices. Researchers have suspected that the fundamental value generating process in the SSW design, in particular, the negative time trend of the fundamental value, leads to confusion and bubble formation. As a result, several studies have been carried out to study asset trading in environments characterized by non-decreasing fundamental values. Smith et al. (2000), Noussair et al. (2001), and Stöckl et al. (2015) find that bubbles are greatly reduced if the fundamental value of the asset is constant. Noussair and Tucker (2016) find that bubbles continue to exist in such an environment if subjects are endowed

---

[1] In the experimental literature, the fundamental value is usually calculated under the assumption of risk neutrality. If agents are risk averse, then the fundamental value will be lower than that implied by risk neutrality, which makes the observation of price bubbles (relative to risk-neutral fundamental values) even more striking.

with high levels of cash before trading starts. Stöckl et al. (2015) also study the case with increasing fundamental values and find underpricing in that environment. Noussair and Powell (2010) and Breaban and Noussair (2014) find that when the fundamental value changes in a non-monotonic way, bubbles continue to exist.[2] These studies are conducted in environments without interest payments on cash. This framework imposes a rigid structure on the fundamental value generating process in the sense that the only way to control the time trend of the fundamental value is by changing the sign of the expected dividend payment. To generate decreasing, flat, or increasing fundamental values, the expected dividend must be positive, zero or negative, respectively. As a result, the effects of the time trend and the sign of the dividend payment are inevitably entangled together.

Our design deviates from those in the above studies along one important dimension: cash earns interest. The introduction of interest payments on cash allows us to maneuver the fundamental value generating process in a more flexible way by breaking the tight relation between the time trend of the fundamental value and the sign of the expected dividend payment. For example, it is possible to have either increasing or decreasing fundamental values with a positive dividend payment.

Using this new framework, we design three treatments with interest payments on cash, characterized by different combinations of the sign of the expected dividend payment and the sign of the time slope of the fundamental value. In the first two treatments (treatments F and R), cash earns positive interest and stocks pay positive expected dividends. The difference lies in the dynamics of the fundamental value: the fundamental value decreases in treatment F and increases in treatment R. Comparing the two treatments enables us to identify the effect of an increasing (versus a decreasing) trend, while eliminating the contamination caused by a simultaneous change of the sign of the dividend payment. Our experimental results suggest that the upward trend in the fundamental value is effective in suppressing price inflation: in treatment R, the trading price follows the fundamental value very closely. Combining our results from treatments F and R with those from other studies that investigate the effect of the fundamental value generating process, we suggest the sign of the expected dividend payments as another important factor in determining the trading price beside the time trend of the fundamental value. To evaluate the effect of the dividend payment, we exploit the flexibility of the new framework to conduct a third treatment (treatment N), where the expected dividend is negative and the fundamental value decreases. In treatment N, the decreasing fundamental value leads to overvaluation but the negative dividend causes undervaluation, and these two forces offset each other, inducing only mild mispricing.

Besides providing a flexible framework to study the effect of the fundamental value generating process, our framework can also be used to study whether the presence of an alternative risk-free investment in the form of an interest-bearing saving account can prevent overpricing. Our treatment F is similar to the classic design in SSW in terms of dividend payments and the time trend of the fundamental value, with one major difference: cash earns interest. Our experimental results indicate that increasing the opportunity cost of speculation on the asset market in the form of interest payments on cash has limited success in containing price inflation. This conclusion seems to be consistent with the findings in other studies featuring interest payments on cash. The study by Bostian et al. (2005) is carried out in a setting where the asset's fundamental value is constant and they find substantial overpricing; the result is confirmed by Bostian and Holt (2009) in a non-incentivized classroom experiment. Fischbacher et al. (2013) examine the effect of counter-bubble interest rate policies, raising (cutting) interest rate when the trading price is high (low), and find that these policies have only a small impact on price inflation.

The rest of the paper is organized as follows. We lay out the experimental design and hypotheses in Section 2. Section 3 presents the experimental results. Section 4 concludes.

2. Experimental design and hypotheses

In this section, we first define the fundamental value of the asset in the setup where cash earns interest and demonstrate that it offers a flexible environment for studying how the trading price is affected by different fundamental value generating processes. We then describe the main features of our treatments and state our hypotheses, followed by a discussion on other design parameters, such as the cash/asset ratio, the trading mechanism, etc.[3]

2.1. The fundamental value

Subjects trade a single asset, called "shares". Shares have a finite life of T periods. Each share pays a random dividend at the end of each period from time 1 to T, plus a fixed buyout value, K, at the end of period T. The distribution of the dividend is *i.i.d.* over time. The dividend payment has four possible realizations, 0, 8, 28, and 60, with equal probabilities, which implies an expected dividend payment of $d = 24$. These settings are similar to SSW. Unlike in SSW, cash is parked in an interest-bearing savings account and earns interest at the net rate of $r = 10\%$ or 15%.[4] Subjects can use money from their savings account to purchase shares. Revenues from share sales and interest payments are automatically deposited into the savings account.

Following the usual practice in the literature, we define the fundamental value as the holding value of the asset for a risk-neutral agent. The fundamental value of the asset at the beginning of period t is calculated as the net present value of all remaining dividend payments and the buyout value at the end of T, discounted by the interest rate; i.e.,

$$FV_t = d \left[\sum_{\tau=1}^{T-t+1} (1+r)^{-\tau} \right] + K (1+r)^{-(T-t+1)}$$

$$= \begin{cases} d(T-t+1) + K & \text{if } r = 0, \\ \dfrac{d}{r} + \left(K - \dfrac{d}{r} \right) (1+r)^{-(T-t+1)} & \text{if } r \neq 0. \end{cases}$$

The time trend of the fundamental value is given by:

$$\frac{d(FV_t)}{dt} = \begin{cases} -d & \text{if } r = 0, \\ \left(K - \dfrac{d}{r} \right) [\ln(1+r)] (1+r)^{-(T-t+1)} & \text{if } r \neq 0. \end{cases}$$

---

[2] Noussair and Powell (2010) and Breaban and Noussair (2014) examine environments where the fundamental values experience different time trends during the trading game. Noussair and Powell (2010) conduct two sets of experiments. In the "peak" treatment, fundamentals first rise and then fall, while in the "valley" treatment fundamentals first fall and then recover. They find that bubbles still occur in both treatments, but in smaller magnitudes in the peak treatment. Breaban and Noussair (2014) study markets in which a trend in fundamentals sets in after an interval of constant value. They find that prices tend to track fundamentals more closely when the trend is decreasing than when it is increasing. Breaban and Noussair (2014) conclude that the contrast between their results and those from previous studies indicate that the timing of the onset of a trend in fundamentals is an important feature influencing how the trend affects the price discovery process.

[3] See Appendix B for the experimental instructions.

[4] For reference, the interest rate is 10% or 20% in Bostian et al. (2005), 10% in Bostian and Holt (2009), and ranges from 1% to 21% in Fischbacher et al. (2013).