# Price bubbles, gender, and expectations in experimental asset markets[☆]

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## ARTICLE INFO

## ABSTRACT

This paper reports results of laboratory markets for a risky asset with a "flat" fundamental value that equates expected dividends to the return on a safe asset. Subjects were sorted by gender in an unobtrusive manner, and bubbles in this setting are pervasive and of comparable magnitude for both genders. In contrast, a robustness check done with a declining fundamental value did generate larger bubbles for groups of males. Elicited price forecasts tend to trail share prices as they rise and exceed prices as they fall, a pattern that is tracked by a "double adaptive" forecasting model.

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Eugene Fama once quipped: "The word 'bubble' drives me nuts."[1] He went on to suggest that high valuations of technology stocks during the "internet bubble" could have been justified by 1.4 firms of the same size as Microsoft. Obviously, it is difficult to distinguish speculation fueled by overoptimistic expectations from increases in fundamental values due to structural change or small probabilities of potentially large returns. Laboratory experiments provide a method of inducing fundamental values to investigate factors that stimulate bubble formation. Moreover, it is possible to consider the effects of treatments, e.g. single-gender groups of traders, that do not arise in the field.

[1] *The Region*, D. Clement, ed., Federal Reserve Bank of Minneapolis, December 2007 (Interview with Eugene Fama 2007).

Asset markets in the lab are typically run for a short duration with a declining fundamental value that equals the sum of expected dividends in the remaining periods. With a zero redemption value for shares held at the end of the final period, the expected share value is the expected dividend in the final period, double the expected dividend in the second-to-last period, etc. This marvelously simple declining-value design, introduced by Smith et al. (1988), has been used extensively to document factors that promote or impede bubble formation.[2] Some of the most interesting recent contributions to this literature pertain to gender effects, e.g. Eckel and Füllbrunn (2015) and Cueva and Rustichini (2015). The former paper, with a declining asset value, reports robust bubbles with groups of male traders but not with groups of females. No such gender differences are reported in the later paper, which uses a combination of positive and negative dividends to maintain a flat value. This paper is primarily motivated by 1) a consideration of asset markets with a flat present value induced by interest paid on a safe asset and 2) using this framework to revisit differing gender effects.

The declining value structure, which is pervasive in this literature, may be confusing to subjects for whom backward induction reasoning does not come naturally. Corgnet et al. (2015) find that people who score low on a cognitive response test earn less and tend to be net purchasers when the share price exceeds the (declining) fundamental value. Using a questionnaire and a clever set of treatments, Kirchler et al. (2012) also argue that confusion can lead to bubbles in the declining value setup, since people expect fundamental values to be flat and assets with declining value are not the norm. They observe lower deviations of price from fundamental value when that value is constant from period to period. Given the cognitive demands associated with backward induction and the well documented gender differences in cognitive response tests (with a key question based on backward induction), it is important to consider asset markets with a non-decreasing value structure that is more closely related to patterns encountered in typical financial markets.

In a provocative paper entitled "Searching Beyond the Lamppost: Let's Focus on Economically Relevant Questions," Jörg Oechssler (2010) makes a strong case for experiments in more realistic settings, with constant fundamental values, more assets, etc. A salient aspect of most investment decisions is the tradeoff between risk and return (Markowitz, 1952), which is the motivation for adding a second asset with a safe return that induces a natural opportunity cost for cash. The markets in this paper are structured so that the fundamental value for the risky asset is the share price that equates the expected return from random dividends to the safe return. This approach, which induces discounting to produce an asset with a constant present discounted value, was first introduced by Bostian et al. (2005).[3] More recently, this approach was used by Smith et al. (2014), to measure neural activity associated with bubbles and crashes, and by Giusti et al. (2016), who investigate asset markets with increasing and decreasing fundamental values. An alternative method of inducing a flat fundamental value without a safe asset is to use a risky asset with zero expected dividends, so the sum of remaining expected dividends is zero, which is the approach taken by Cueva and Rustichini (2015). In either case, a flat fundamental value design makes it easier to distinguish price surges driven by speculation from inertia that may produce a relatively flat price series that increasingly diverges from a declining fundamental value. Many of the price sequences reported by Eckel and Füllbrunn (2015) for all-female groups exhibited a relatively flat trajectory followed by a decline in the final periods. Those series do generate bubbles in the technical sense that the difference between the market prices and the declining fundamental value is increasing as prices remain relatively constant for many periods. Flat price trajectories, however, do not offer opportunities for speculative capital gains. In contrast, bubbles rising from a flat fundamental value (with cash increases due to interest and dividends) can generate expectation-based speculation, and this is a key motivation for reconsidering gender effects in a flat-value context. The presence of such anticipated speculative gains can be confirmed by collecting data on price forecasts.

One of the most important findings in the experimental asset literature is that "excess cash" is associated with enhanced bubbles (Caginalp et al., 2001).[4] One way to mitigate cash buildup is to use dividends with a zero expected value.[5, 6] As noted above, Cueva and Rustichini (2015) also use a zero expected dividend to achieve a flat fundamental value, and they observe no difference between all-male and all-female markets in terms of bubble amplitude. However, the price trajectories in these markets are typically flat, within 10–15% of fundamental value, so that it is difficult to make a sharp comparison of

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[2] Some of the important effects considered in this literature are trader experience (Hussam, Porter, and Smith, 2008), "excess cash" (Caginalp, Porter, and Smith, 2001), timing of dividends (Van Boening, Smith, and Wellford, 2000), futures markets (Porter and Smith, 1995 and Noussair and Tucker, 2005), group size (Cheung and Palan, 2012), speculation and probability judgment biases (Ackert, Charupat, Deaves, and Kluger, 2009), cognitive ability (Noussair, Tucker, and Xu, 2016), house money effects (Corgnet, et al. 2015), uninformative announcements (Corgnet, et al. 2010), number of trading periods (Lahav, 2011), call market clearing (Van Boening, Williams, and LaMaster, 1993), and testosterone (Nadler et al., 2015). Palan (2013) provides a recent survey of laboratory asset market experiments.

[3] The Bostian et al. (2005) approach of introducing a safe asset with a fixed rate of return provides a natural way of inducing a preference for present payments and discounting of the future. The connection to present value and opportunity costs makes this a useful way to incorporate financial markets topics into economics classes (Bostian and Holt, 2009 and Holt, 2007).

[4] In particular, delayed (positive) dividend payments have been shown to inhibit bubble formation (Van Boening, Smith, and Wellford, 2000) as compared with a situation where dividends are paid every period and cash can accumulate. In fact, Kirchler, Huber, and Stöckl (2012) show that bubbles in the declining-value setup are greatly diminished (eliminated in an average sense) when cash buildup is prevented by cash deductions and delayed dividend payments. This laboratory evidence is consistent with observations that real estate bubbles often occur in times of easy credit (e.g., Rajan and Ramcharan, 2015).

[5] However, Noussair and Tucker (2016) show that bubbles can arise even if dividends involve both positive and negative payments, as long as there are large and early cash infusions.

[6] Price bubbles may sometimes be observed with zero expected dividends (Noussair, Robin, and Ruffieux, 2001), but are often attenuated relative to those seen with a decreasing fundamental value (Kirchler, Huber, and Stöckl, 2012). Indeed, for some parameterizations, prices of an asset with a zero expected dividend track the constant value so closely that deviations are barely visible (Fig. 4 in Stöckl, Huber, and Kirchler, 2015).