Journal of Economic Behavior & Organization 75 (2010) 506–522

Contents lists available at ScienceDirect

Journal of Economic Behavior & Organization

journal homepage: www.elsevier.com/locate/jebo

Digital options and efficiency in experimental asset markets

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ARTICLE INFO

Article history:
Received 20 February 2009
Received in revised form 31 March 2010
Accepted 11 May 2010
Available online 4 June 2010

JEL classification:
G01
D01
D02

Keywords:
Asset market
Digital option
Experimental economics
Bubble
Efficiency

ABSTRACT

In asset markets, extraordinary price run-ups (bubbles) followed by crashes back to levels closer to fundamental values have been shown to adversely affect the real economy, leading to inefficient resource allocation and underinvestment. Conversely, derivative markets contribute to price discovery and lead to informationally more efficient prices in the market for the underlying asset. We combine these observations and test experimentally whether digital options – a type of derivative that has recently been introduced to a wider audience via online prediction markets – can reduce price bubbles in a laboratory setting. We find that subjects do not use the derivative market to improve their expectations of future asset prices and analyze this result.

The research question underlying this article is motivated by three loosely related topics in financial economics. The first of them is the propensity of market prices to sometimes exhibit extraordinary run-ups (bubbles) followed by crashes back to levels closer to fundamental values. This phenomenon has been documented as early as after the disintegration of the tulip price bubble in the Netherlands in 1637 or the plunge in stock prices of the South Sea Company in the UK in 1720. In the last century, the Great Depression in the 1930s clearly demonstrated the danger that spillover effects from price bubbles in financial markets pose for the underlying real economy. The global financial crisis following the crash of a price bubble in U.S. real estate prices in 2007 forms another example that is and will continue to be subject to intense analysis in the coming years.

Bubble-and-crash patterns in financial market prices are widely considered harmful to economic activity in general, since they cause a misallocation of available resources to non-optimal uses. As a case in point, Gan (2007) documents how the adverse liquidity shock experienced by Japanese banks in the early 1990s led to reduced lending, which in turn had significant repercussions on both the real investments and the performance of capital-deprived Japanese firms. His study showcases an indirect transmission channel from asset market bubbles to the real economy, underlining the possible efficiency gains to be had from a better understanding of the bubble phenomenon.

The second strand of research impacting on our work saw its beginnings in the 1970s. Cox (1976) was one of the earliest articles to model the link between futures trading and the information processing taking place in the formation of spot market prices. Since then, an extensive branch of literature has been devoted to the connection between the trading of forwards, futures and options, and its impact on the informational efficiency of the market price of the underlying

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doi:10.1016/j.jebo.2010.05.011

asset. Both theoretical and empirical studies have shown that derivative markets generally process information earlier and faster than spot markets and that the creation of a derivative market to accompany a spot market usually leads to higher price efficiency in the latter.[1] One explanation for this effect is proposed by Figlewski and Webb (1993), who reason that options give traders who cannot or will not engage in short sales due to e.g. transaction costs, an opportunity to sell short indirectly.

The final component motivating our research is the emergence of a new type of online marketplace permitting the trading in digital options. Prediction markets and online betting sites like betonmarkets.com, binarybet.com, intrade.com, ladbrokes.com, and mybet.com (among others) are relatively new ventures which allow investors to trade cash-or-nothing (digital) options on financial market prices. A cash-or-nothing option returns a fixed cash amount in the case that it expires in the money and nothing if it expires out of the money. These options are sometimes referred to as 'binary bets' in markets outside the lab and are being marketed as being easier to understand than conventional bets (cp. Oliver, 2007). The sites mentioned above have in common that there are low barriers to entry and that trades can be initiated with relatively small investment volumes and transaction costs.

Our article brings together the above three pieces of motivation. It aims at providing evidence regarding the question of whether the adverse effects of price bubbles in financial markets can be reduced if markets are provided with the forward-looking price information from digital option markets. We attempt to uncover the effects of giving traders an opportunity to trade digital options under the controlled conditions of a laboratory experiment. The design we employ is a modification of the experimental double auction asset market introduced in Smith et al. (1988).

The rest of this article is structured as follows: Section 1 discusses some background issues and develops our hypotheses. Section 2 then introduces our experimental design. Section 3 reports the results of our experiments and provides a brief comparison with previous results from the literature. Section 4 concludes the paper and proposes possible future research questions. An appendix is provided in Appendix A.

1. Background and hypothesis

Our experiment is modeled after the seminal contribution of Smith et al. (1988). They find that although the possible dividend draws in their laboratory markets are common information and every trader has all the information required to derive the fundamental value of the stock in every period, there is a persistent pattern across inexperienced subjects: the stock price starts out below its fundamental value in period 1. Over the course of the experiment, the stock price then rises above its fundamental value, creating a bubble. During the final periods, the price crashes down to levels close to its fundamental (intrinsic dividend) value.

These results have in the past 20 years been replicated numerous times, with a wide array of variations, and have been found to be remarkably robust.[2] The only variable that has been widely observed to reliably lead to a disappearance of the observed bubbles is experience. Subjects who have played the same experiment once or twice before produce a price series that follows the fundamental price series significantly more closely, with bubbles usually vanishing entirely by the second repetition.

While not leading to a disappearance of bubbles, the addition of a derivative market to the spot asset market has been found to cause a decline in measures of the extent of price bubbles. Forsythe et al. (1982, 1984) use a somewhat different design than that of Smith et al. (1988), but find that futures markets do accelerate convergence and that in the absence of futures markets, even experienced traders have problems overcoming the existing coordination problems. Friedman et al. (1983, 1984) conduct similar experiments and confirm the higher informational efficiency of asset market prices in the presence of a futures market. Porter and Smith (1995) introduce a futures market to the Smith et al. (1988) design, while staying true to the original institution in all other respects. They report a reduction of the amplitude of the observed price bubble in their spot-and-futures treatment relative to the spot-only treatment. In a different approach, De Jong et al. (2006) modify the Smith et al. (1988) baseline experiments both by adding an option market to the spot market, and by introducing three market makers and an insider. They find that price efficiency in the asset market is higher and the asset's price volatility

[1] O'Hara (1995) is one of the best sources for theoretical work on this topic. In an empirical study, Easley et al. (1998) show that option volumes lead stock price changes and carry information about future stock price changes. Similarly, Jayaraman et al. (2001) find that option markets lead equity markets in terms of volume. Chakravarty et al. (2004) employ an approach pioneered by Hasbrouck (1995) to measure that between a stock and an option market, on average between 17 and 18 percent of price discovery occurs in the option market.

[2] Modifications of the original Smith et al. (1988) design were made with regard to many dimensions: variations in dividends featured certain dividends (Porter and Smith, 1995), a symmetric discrete dividend distribution with unequal probabilities over outcomes (Van Boening et al., 1993), variations in the structure of dividend payments over time (Smith et al., 2000; Caginalp et al., 2001; Oechssler et al., 2007), a dividend payment date beyond subjects' investment horizon (Hirota and Sunder, 2007), a dividend regime that induced a non-monotonic fundamental value process (Noussair and Powell, 2008), and an expected dividend of zero, yielding a constant expected asset value (Caginalp et al., 2001; Noussair et al., 2001). Some studies varied the reward function by employing play money instead of real money payouts (Smith, 1962; Forsythe et al., 1982), introducing trading commissions and transaction costs (Friedman et al., 1983, 1984; King et al., 1993), or deviating from the practice of payouts being linearly related to the wealth amassed in the experiment (James and Isaac, 2000; Luckner and Weinhardt, 2007). Another class of variations targeted the ability of subjects to short-sell (King et al., 1993; Sunder, 1995; Ackert et al., 2006; Haruvy and Noussair, 2006). An important variation was preventing speculation by assigning subjects the role of either buyer or seller (Lei et al., 2001). Other modifications concerned the transaction mechanism (Van Boening et al., 1993), multiple assets (Fisher and Kelly, 2000), uninformative announcements (Corgnet et al., 2010), non-stationary repetition (Hussam et al., 2008), and computer simulation (Gode and Sunder, 1993).