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Futures markets, cognitive ability, and mispricing in experimental asset markets☆

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ABSTRACT

We study the effect of a futures market, in which contracts maturing in the last period of the life of the asset can be traded. Our experiment has two treatments, one in which a spot market operates on its own, and a second treatment, in which a spot and a futures market are active simultaneously. Futures markets lower spot prices, but increase price volatility. The futures markets themselves exhibit considerable overpricing. Individuals with higher cognitive reflection test (CRT) scores achieve greater earnings, and tend to sell in the overpriced futures market, while traders with lower CRT scores make purchases in the futures market. Greater average CRT score among a group of traders is associated with better price discovery when no futures market is present but there is no such relationship in the presence of a futures market. Modified measures of CRT, which take into account different types of incorrect responses, are introduced.

1. Introduction

Futures markets are thought to aid in the effective functioning of spot asset markets. For instance, Cox (1976) argues that the existence of futures markets may attract additional traders to participate in spot markets. Futures prices provide an aggregated measure of traders' expectations about prospective spot prices. This can harmonize beliefs about future prices, which may in turn help price discovery in the spot market. Indeed, as Grossman (1977) points out, it is impossible for a spot market on its own to incorporate all relevant information about the future.

Empirically, how well futures markets aid price discovery may be measured by the lead-lag relationship between futures and spot markets. Garbade and Silber (1983) estimate that about 75 percent of new information is incorporated in futures prices first. Chan (1992), among others, reports that futures market price indices tend to lead their counterpart spot indices.[1] Moreover, Antoniou and Holmes (1995) suggest that the introduction of futures for the FTSE-100 index has improved the functioning of the spot market.

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[1] The intraday lead–lag relationship between index futures and spot prices has also been studied with econometric techniques that allow for high frequency data, see e.g., de Jong and Nijman (1997).

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The effects of futures markets on spot market price discovery have also been studied in controlled laboratory environments (see Noussair and Tucker (2013), for a survey). In markets for short-lived (2- or 3-period) assets, it has been shown that the existence of a futures market fosters information transmission among traders and thereby accelerates the convergence of prices to the rational expectations equilibrium level (Forsythe et al., 1982; Friedman et al., 1984). This suggests that a futures market creates common rational expectations about future prices for traders. This in turn leads spot markets to converge to rational expectations prices.

The most commonly studied asset market paradigm in experimental economics is that introduced by Smith et al. (1988). Under this setup, asset prices tend to exhibit a pattern of bubbles and crashes (see Palan (2013) for a recent overview) in the absence of futures markets. In this setting, the asset has a relatively long life, typically 15 periods. Each unit of the asset pays a per-unit dividend at the end of each period. The dividend distribution and process are common knowledge. Since the only source of intrinsic value for the asset is the dividend, and the time horizon is finite, the fundamental value at any point in time can be calculated. The fundamental value declines each period by the amount of the expected per-period dividend, as the remaining number of future dividend payments declines. However, instead of tracking fundamental values, market prices typically greatly exceed fundamental values for a prolonged time interval, and then often rapidly drop to fundamental value as the end of the life of the asset approaches.

Would the presence of a futures market aid price discovery in the spot market? Porter and Smith (1995) consider the effects of the inclusion of a market for futures contracts maturing half-way through the life of the asset, namely in period eight of a 15-period horizon. They find that the futures market exerts at best a very modest dampening effect on price bubbles. Noussair and Tucker (2006) find that the addition of a complete set of futures markets, one maturing in every period, serves to eliminate spot market price bubbles. However, they also observe widespread mispricing in the futures markets themselves. The research question we ask in this paper is how effective one futures market, for contracts maturing in the final period of the asset's life, is in reducing price bubbles. Our view before undertaking this study was that the futures market maturing in the last period might be especially important in improving price discovery, because it provides an aggregate measure of price expectations for the final period, and thus the appropriate starting point for a process of backward reasoning from the end of the life of the asset to the present about the appropriate price trajectory.

Our experiment has two treatments, one in which a spot market operates on its own, and a second treatment in which a spot and futures market are active simultaneously. The experiment is conducted in two different locations: at Tilburg University in the Netherlands, and at the University of Waikato in New Zealand. We conducted 25 sessions, of which 13 took place at Waikato.

The main conclusions of our study are that one futures market, for contracts maturing in the last period of the life of the asset, reduces price level, but increases price volatility. The two subject pools display some differences. In the Waikato sample, futures markets reduce prices. In the Tilburg sample, characterized by considerably smaller bubbles when no futures market is present, the futures market increases price volatility.

The fact that the two subject pools behave differently, suggests that they may differ in one or more key characteristics that affect market outcomes. Other authors (Corgnet et al., 2014; Charness and Neugebauer, 2014; Breaban and Noussair, 2015; Bosch-Rosa et al., 2015) have noted that average score of a trader cohort on the Cognitive Reflection Test (CRT), developed by Frederick (2005), is correlated with mispricing. Higher average scores among traders are associated with closer adherence to fundamentals. The CRT, which measures ability/willingness to reflect on a logical problem, and is therefore interpretable as a measure of sophistication, is administered to all traders before the market is introduced to them. We explore the relationship between CRT scores at the individual and cohort level and the market data.

CRT measures were originally intended to distinguish system 1 from system 2 thinking (Stanovich and West, 2000; Kahneman and Frederick, 2002; Frederick, 2005). Many other authors in the experimental economic community have used them as an index of cognitive ability, with the number of correct responses as a measure. This ignores what we believe is useful information contained in incorrect responses. We develop two extended CRT measures, called ECRT1 and ECRT2, which take into account the type of mistake that is made. ECRT 1 penalizes the system 1, the intuitive but incorrect answer, but does not penalize other incorrect answers. Low scores on ECRT1 result from quick decisions that reflect the engagement of system 1. ECRT2 does not penalize the intuitive incorrect answer, but does penalize all other incorrect answers. Low scores on ECRT2 reflect a tendency to make errors for reasons other than the engagement of system 1.

Barberis et al. (2014) identify three behaviors as consistent with system 1 thinking in financial markets: (1) a focus on the past, (2) basing decisions on the prospect theory value of the past return distribution, and (3) narrow framing of risks. While these specific behaviors are difficult to isolate in our data, all of them typically lead to poor decisions and thus lower earnings. If system 1 thinking is the principal driver of poor decisions, then ECRT1 would presumably correlate negatively with earnings, while ECRT2 would correlate less strongly. If low cognitive ability, and not system 1 reasoning, is the main factor behind poor decisions in our markets, ECRT2 would exhibit a negative correlation with earnings, while ECRT1 may not. If system 1 decisions distort market behavior, then the average ECRT1 score of a trader cohort would correlate negatively with deviations from fundamental values. If other errors affect the market, the cohort's average ECRT2 score would be negatively correlated with our measures of mispricing.

Our analysis reveals that the average score of a trader cohort on each measure is significantly negatively correlated with the magnitude of mispricing when no futures market is present. Individually, higher sophistication scores are associated with greater earnings, a result consistent with Corgnet et al. (2014), Breaban and Noussair (2015), and Charness and Neugebauer (2014). However, the presence of a futures market generates a different pattern. In the futures markets, traders with relatively