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The forecasting ability of Internet-based virtual futures market

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ABSTRACT

Internet-based virtual futures markets (VFMs) have been used in predicting election results and movie ticket sales. We construct an Internet-based VFM to predict an underlying stock price. While the virtual futures market has received much attention, questions remain as to the ideal number of participants. Results of Granger causality tests and analysis of directional accuracy show that a VFM with only a small number of participants (75) is able to generate informative futures prices useful in the prediction of the underlying stock price. Moreover, the participants were not professional investors but merely undergraduate finance students with only a cursory introduction to futures trading. Our results provide additional evidence supporting the use of VFMs in forecasting and show that VFMs are powerful forecasting tools.

1. Introduction

The use of Internet-based virtual futures markets is a powerful and previously unexplored approach that can be used to predict movements in the stock markets. It is well known in finance literature that futures prices are powerful forecasters of spot asset prices. In fact, many popular existing financial assets (e.g. stock market index mutual funds, currency, major government bonds, etc.) have active futures markets and their futures prices are used widely by financial forecasters as inputs to their forecasting models. However, in the real world, not all financial assets have active (bricks and mortar) futures markets. For example, only in the past 2 years has the London Stock Exchange (LSE) started trading futures contracts on individual stocks, and so far, they have been limited to contracts on a select group of well-established companies.

Suppose that an investor is interested in investing money in Taiwan Semiconductors (TSM), for example. Currently, however, there is not an active futures market for TSM anywhere in the world. Is it possible to create in virtual space a feasible futures market for TSM? Would this futures market be informative like the futures prices generated by the virtual futures market? Would they, therefore, be useful in the forecasting of the underlying spot prices (in this case TSM stock prices)? Additionally, how small can the virtual futures market be without sacrificing the integrity of its information? Can an Internet-based virtual futures market with only 75 or so participants generate informative futures prices useful in predicting the underlying asset? What caliber must the futures market participants be? Do they have to be experienced futures traders? Or can they be ordinary college finance students with interest in the stock market? Also, what incentive structure should the virtual futures market use? Should it be based on real money as in the bricks and mortar futures markets where traders gain and lose real money depending on their futures positions? Or would a simple prize system of incentives suffice and produce the same results? Or can a system of punishments in a classroom setting (i.e. lower grades for poor performing students) be used and still generate informative futures prices? These questions merely provide a glimpse of the many interesting research questions that can be studied. This study should be considered preliminary and only as a first step. Further studies are planned to address related issues in more detail and with more robust research methodologies.

2. Related research and concepts

The basic concept of an Internet-based futures market involves bringing a group of traders together via the Internet and allowing them to trade shares of virtual futures contracts on an underlying asset of common interest. These futures contracts conceptually represent a bet on the future market prices of the underlying asset, while their value depends on the realized market price of the underlying asset at a fixed date in the future specified by the futures contract. In this sense, a virtual futures market (VFM) extracts and cumulates the assessments of its participants concerning the future price of the underlying asset.

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Forecasting future asset prices based on past data requires that past data contain useful extractable information about the future (Lutkepohl, 1993). In the case of financial assets, however, the usefulness of past data is of heated debate. Believers of the efficient market hypothesis (Fama, 1970, 1991) believe that current asset prices reflect nearly all useful information concerning the asset in question thereby causing asset prices to behave in a random walk fashion. This results in the assertion that asset prices cannot be predicted from past data alone. Futures prices are, however, generated by participants betting on the outcome of future market prices and are by definition not past data but instead are forward-looking information. Futures prices are therefore, in theory, feasible predictors of future asset prices. Thus, the application of Internet-based virtual futures markets is a promising approach that can be used to predict future asset prices. In the Internet virtual futures market, the applicable futures contract can be constructed to represent a bet on the outcome of the future market asset prices, and their value, therefore, will depend on the realization of these market asset prices. Once the outcome of a specific market situation is known (i.e. the future market asset price is known), each share of the virtual futures contract receives a payoff according to that specific market outcome (e.g. $1 for each unit purchased).

VFMs were first applied in the form of a political futures market to predict the outcome of the Bush versus Dukakis 1988 US Presidential Election with participation restricted to members of the University of Iowa community (Forsythe, Rietz, & Ross, 1992). Interestingly, their study found that the predictions derived from their VFM outperform opinion polls in terms of forecast accuracy. Their results also showed that their VFM performed well even though their participants are not a representative sample of the electorate.

More recently, Spann and Skiera (2003) applies the concept of VFMs to solve short- and medium-term business-forecasting problems. These business-forecasting problems differ from those taken into consideration by political futures markets in aspects of complexity, information availability, incentive structure, and prediction frequency. Elberse and Anand (2007) use online market simulation to study the impact of movie advertising. Pothoff (2007) examines the use of prediction markets to obtain prior distributions for Bayesian inference. Jones (2008) compares different methods of U.S. presidential election forecasting and finds political futures markets provides the most accurate popular-vote forecasts. Berg, Nelson, and Rietz (2008), using data from 1988 through 2004 U.S. Presidential elections, present evidence that VFMs outperform polls for longer horizons.

Compared to bricks and mortar futures markets, Internet-based VFMs provide many advantages. Participants can conveniently access the VFM from almost anywhere in the world at any time. This means the Internet increases the pool of possible participants and allows, if necessary, the anonymity of traders on the VFM. VFMs also allow for almost real-time reaction to futures prices to additional information and, hence, a quick prediction of the impact of that information on future market situations. Using VFMs for research frees the researcher from the burden of weighing and aggregating different expert opinions as this is achieved by the trading mechanism of the VFM. This is because participants (traders) of the VFM weigh their assessments by the volume and the price of the purchase or sale order they place or accept. VFMs also provide participants with a natural incentive to reveal their true assessments (Forsythe, Rietz, & Ross, 1999) if an adequate remuneration is properly linked to the participants' performance on the VFM. That is, in a VFM, the losers in effect provide the remuneration for the winners. This means the price of collecting this information concerning the future is virtually zero once the VFM is established in cyberspace. Compared with consumer surveys that remunerate consumers for their participation in a survey, a VFM is obviously much more cost effective in terms of information extraction. Wertenbroch and Skierra (2002) show, for example, that consumers' willingness to pay differs significantly according to the incentive structure being provided.

3. Theoretical foundations

Futures are contracts to perform a certain action at a later date. The obligation of the buyer and seller are defined in the contract. Only the price and number of contracts are negotiated at the time of transaction. The fact that futures prices can be useful in forecasting is based on well-established economic rationale. The theoretical foundations are the Hayek Hypothesis (Hayek, 1945) and the efficient market hypothesis (Fama, 1970, 1991). According to the efficient market hypothesis, a market is efficient if all available information is always reflected in the prices. Therefore, as long as the futures market is efficient, the traded price of the futures contract should reflect information concerning the future and, thus, be useful for forecasting. The Hayek hypothesis states that the price mechanism in a competitive market is the most efficient instrument to aggregate the asymmetrically dispersed information of market participants. This being the case, it provides a rationale for why the VFM, in providing a trading mechanism and market to aggregate and display individual assessments in futures contracts, should be efficient. In a VFM, individual assessments of future outcomes are tradable contracts and participants compete on the basis of their individual assessments. VFMs therefore create a market for generating information useful for forecasting by aggregating information that is then reflected in the futures prices.

Conceptually, VFMs allow future market situations to be expressible and tradable through virtual futures contracts. These futures contracts intermediate between the present and the future. That is, futures prices are observed today but refer to transactions to be carried out in the future. As such, futures prices must reflect expectations about the future. The payoff of such futures contracts depends on the actual outcome of a specified event at some future point in time and can be expressed as

$$d_{i,T} = \psi(\Xi_{i,T}) \quad (i \in I) \tag{1}$$

where $d_{i,T}$, is the payoff from a futures position on the outcome of the ith event at time T, $\psi(\bullet)$ is the transformation function, $\Xi_{i,T}$ is the outcome of the ith event at time T, I denotes the index set of events, and T is the point in time corresponding to the expiration of the futures contract.

Eq. (1) shows that futures contracts are securities whose terminal values are contingent upon the outcome of an uncertain event. The transformation function ψ can have different forms but needs to be invertible. For our constructed VFM, the transformation function giving the payoff at expiration is:

(*price of TSM stock at time T – price at which you took a long position on the TSM futures contract*)
if you are long the futures contract
(*price at which you took a short position on the TSM futures contract – price of TSM stock at time T*)
if you are short the futures contract

The choice of transformation function depends on the purpose of the VFM and whether it is set up for forecasting. For example, in the case of political futures markets, the most commonly used method is to pay a cash dividend of $1 multiplied by the fraction of votes the particular candidate receives. Another possibility [for political futures markets (i.e. Forsythe et al., 1999)] is to construct the transformation function to pay a cash dividend of $1 if the candidate is elected and $0 otherwise. The theoretical value of one fu-