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Insider trading and information revelation with the introduction of futures markets

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ABSTRACT

We establish a theoretical model with informed trading in which both of individual stock futures and its underlying stock are traded in the market. With the introduction of the futures, the paper shows that an informed trader's position of futures usually motivates him or her to trade more aggressively in the stock market at the expiration day. This also worsens the adverse selection problem and makes the stock market become less liquid. Moreover, the increase of the informed trading accelerates the information revelation and improves market efficiency on the expiration date. Finally, our results suggest that price manipulation could be one factor that affects the market liquidity and market efficiency when the futures are introduced into the market.

1. Introduction

Price discovery is one of the most important functions of the financial derivatives such as futures. Traditional financial theory argues that futures markets provide venues for investors to buy or sell an asset which will be delivered in the future, so futures prices usually reflect the fundamental values of securities and improve market efficiency. On the other hand, the introduction of financial derivatives also creates additional opportunities for strategic speculation or manipulation. The manipulation behaviors usually disturb the information environment and weaken the price discovery function of the markets. Because of the complexity of the trading strategies in derivatives markets, the impact of derivatives introduction on the market efficiency is debatable.

This paper theoretically investigates the impact of the introduction of futures on the informed trader's trading strategy and the spot and futures prices dynamic. We consider a model in which a trader with private information simultaneously trades both a risky security and its corresponding futures, and discuss the equilibrium characteristics. Compared to past research that focuses on the hedging function of futures or on the low margin for speculation, this study is different as our multi-market setting pays attention to how an informed trader optimally exploits the private information in the two markets, and, furthermore, how the information reveals to the markets.

The main contribution of this paper is twofold. First, we study how an informed trader optimally exploits his information to profit from an economy with both stock and its corresponding futures markets. Prior research, such as Stoll and Whaley (1987, 1991), suggests that the prices of futures and its underlying stocks move abnormally at the expiration date of the futures, because many arbitragers liquidate their holdings at that time. Karolyi (1996), Stoll and Whaley (1997) and Hsieh (2009) also provide evidences to show that the spot markets are associated with abnormally large volume and high price volatility at the time immediately prior to the derivatives expiration date. Most of them attribute the results to the investors' unwinding trading of their arbitrage positions. Surprisingly, only few papers discuss this issue from a manipulation perspective although "marking the close (open)" is a common technique for derivatives investors in practice.[1] Our study, therefore, attempts to discuss this phenomenon, the so called expiration day effect in a price manipulation approach.

The second contribution of our study is to investigate the impact of informed manipulation in our setting on the information revelation and market efficiency. Despite the lack of consensus, several empirical evidences study the effect the futures trading on market efficiency and information transmission. Cox (1976), Brorsen (1991) and Merton (1995) claim that the introduction of derivatives can improve market efficiency because derivatives provide opportunities for risk sharing with lower costs. Debasish (2009) provides empirical evidence to show that the introduction of Indian index futures results in less efficient spot market. However, none of these papers examine the behavior of manipulators and their impact on information environment. As we know, market manipulation disturbs information revelation and

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[1] Kumar and Seppi (1992) is one example who argues that traders can benefit from establishing futures positions and then manipulating the price of the underlying asset to accrue profits. While Kumar and Seppi (1992) suggest that the introduction of futures makes uninformed traders profitable from strategically manipulating the spot price at delivery, our study is devoted to the discussion of the trading strategy of a monopoly informed trader.

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worsens the market efficiency. Consequently, our paper tries to answer whether the introduction of futures can improve efficiency even in the appearance of manipulation.

Based on the framework of Kyle (1985) and Chowdhry and Nanda (1991), we construct a two-period two-market economy with a monopolistic strategic informed trader, many noise traders, and a competitive risk-neutral market maker. The unique linear equilibrium can be found and the informed trader's optimal trading strategy is discussed. In our setting, on the expiration date, the informed trader trades more aggressively in the spot market and it reveals more information relative to the single security model. The result supports the existence of expiration-day effect in a theoretical approach and implies that the introduction of futures improves market efficiency.[2] On the other hand, our results also suggest that the introduction of the futures may worsen market efficiency prior to expiration day. In some situations, futures could attract discretionary liquidity traders who originally trade in spot markets. It results in an illiquid spot market and the informed traders will trade less aggressively. Therefore, the speed of information revelation slows down and market efficiency becomes worse.

This study explains the expiration-day effect in the approach from informed speculation and price manipulation. Intuitively, after taking a position in the futures markets, the informed trader will trade more aggressively and manipulate the stock price to move rapidly because it increases the profits in futures markets. Our model theoretically explains that the aggressive trading intensity of informed traders in underlying asset could be due to great position holding in the futures contracts.

In order to show the background of this study and to identify how it will contribute, we briefly discuss prior research that investigates the effect of derivatives on the spot market before introducing our construction of the model.

Previous theoretical research discusses the impact of the introduction of derivatives on the information environment of the economy. Most of them emphasize the issues regarding market liquidity, price volatility, and other important properties. One stream of these studies focus on discussing the investment decision of the market participants. Kumar and Seppi (1992) construct a model with the presence of cash-settled futures contract and show that investors who hold positions in cash-settled futures can increase the value of these positions by "punching the settlement price".[3] Subramanyam (1991) demonstrates the effects of the introduction of index futures and discusses price relationship between the basket and its underlying portfolio. The author concluded that this market structure allows liquidity traders to realize their trades more efficiently because their losses to the informed traders are usually lower in baskets than in individual securities. That is, the adverse selection costs are lower in these markets. This also explains the immense liquidity and popularity of markets for stock index futures.

Another stream of the research focuses on derivatives pricing. Detemple and Selden (1993) show that if the market is incomplete, the options price cannot be set by arbitrage because the options and the underlying asset would interact. Instead, by an equilibrium approach, they conclude that the prices of option and its underlying asset should be decided simultaneously. To discuss the role of options when the information among traders are asymmetric, Back (1993) finds that even if the option is redundant, it is impossible to price it by arbitrage because it makes the volatility of the asset become stochastic.

Other theoretical articles which discuss the interaction between multiple related securities include Bhushan (1991), Cuny and Stoughton (1991), Kumar and Seppi (1994) and Caballe and Krishnan (1994). Most of these theoretical articles examined how the market participants' portfolio choice and the asset prices change with the introduction of the derivatives assets. To the best of our knowledge, however, few papers focus on the information content of the derivatives. Although Back's (1993) finding implies that the introduction of derivatives could transmit available information and change the price process, how the information is revealed is neglected in his discussions. Cox (1976) suggests that low transaction costs of futures can attract investors to invest futures and cause the futures price more informational. The introduction of futures, consequently, accelerates information transmission and improves market efficiency. This finding is support by Merton (1995). Fremault (1991) develops a rational expectation model to discuss the impact of futures on spot prices and price volatilities, and shows that the information transmits across spot and futures markets because of index arbitrage. Both Cox (1976) and Merton (1995) only consider the hedging function for the futures while Fremault (1991) restricts the study to discuss the arbitrager's trading strategy. In the real economy, however, the futures are also important trading instruments for speculators and manipulators. Therefore, in addition to discussing how the futures prices provide information on the pricing of the underlying asset, this study also examines the impact of the futures on information revelation and market efficiency from a perspective with manipulation and speculation.

The remainder of this article is organized as follows. Section 2 describes an intertemporal model in which one stock and its corresponding futures are traded simultaneously in an economy with asymmetric information. The numerical analysis of the model and some related properties, including trading strategy, information revelation and market efficiency, are discussed in Section 3. Section 4 concludes.

2. The model

We consider a two-period model with one security and its corresponding futures contract trading in the market. For expositional convenience, the security is a stock. There are two types of traders: a monopolistic informed trader and many noise traders. The informed trader attempts to maximize his expected profits based on the private information which perfectly identifies the true value of the stock. On the other hand, the noise traders are assumed to trade randomly for exogenous reasons such as those selected by Kyle (1985). There is a risk-neutral market maker in each of the stock and the futures markets. As in Kyle (1985) and Admati and Pfleiderer (1988), the market makers, in a Bertrand competition, are able to observe only the net order flow of their own markets and have to absorb any order imbalances in a fair price.[4]

Fig. 1 briefly describes the timing of the trading game. The *ex post* liquidation value of the stock is denoted by $\tilde{v}$, which is normally distributed with mean p_0 and variance Σ_0. The stock market is open at period 1 and period 2. The order flows of the stock by noise traders at period 1 and period 2 are denoted by $\tilde{q}_1^n$ and $\tilde{q}_2^n$, respectively. We also assume $\tilde{q}_1^n$ and $\tilde{q}_2^n$ to be independent-normally distributed with mean zero and variance ${\sigma_1}^2$ and ${\sigma_2}^2$,

[2] The expiration day effect is still debatable. In recent studies, for example, Chow et al. (2013) show the existence of the effect by using the Taiwan data, while Xu (2014) shows no significant evidence with abnormal volume, volatility, or price distortion effect due to the expiration of the index derivatives in Sweden.

[3] For example, an investor with a short position in the index futures market can sell the stock underlying the index to enhance the value of the index futures position.

[4] The market maker can infer the past order flows of the other market after the price is announced.