1. Introduction

Simulations and games are widely accepted as a powerful mode of teaching and learning. This is especially so in the field of finance in teaching students the intricacies of stock market trading. Stock market simulations complement more traditional methods of teaching finance by encouraging learning by doing, by generating motivation and enjoyment, and by engaging the business student in a simulated experience resembling the "real world." Although there exist numerous stock market simulation games on the Web, they are all "secondary simulations" in that the players cannot affect the prices of the traded securities but must take the security prices "as given" and base the trading simulation on these given prices. Such secondary simulations, however, lose an important dimension of market realism in that in the real stock market, players, especially "big" players such as major banks and large institutional investors, can influence the price of the traded securities. Secondly, being secondary simulations, existing internet stock market simulation games focus almost exclusively on stock trading and cannot realistically simulate the trading of derivatives. Compared to stock trading the trading of derivatives is a lot more complex both conceptually and from a teaching point of view. In this study, we leverage the power of internet technology and design a fully functional internet futures exchange. In our internet futures exchange, the prices of the futures contracts being traded is directly determined by the market participants (players). Additionally, our designed website tackles the difficult task of teaching derivative (futures) trading via learning by doing in a realistic trading environment with realtime feedback where traders can influence the price. Conceptually, this is superior to the use of secondary simulators (existing web market simulation games) where players must take the security prices as given and cannot influence its value through strategic behaviors. This is especially of importance for the teaching of derivative trading in as much as in the real world, powerhouses (large institutional traders) often exert significant influence on the observed derivative prices.

With respect to academic research, we provide an example of the use of our internet futures exchange as a research platform to address the issue of market transparency and front runners. This, in itself is an important research question since market transparency level lies at the heart of controversial debates. Empirical data gathered from a controlled laboratory setting may help resolve the controversy. Previous laboratory studies addressing this issue use simplified representations of financial exchanges based on simulated securities whose values are chosen randomly form some predetermined distribution. For our study, we construct a fully functional futures exchange based on real underlying securities on the internet and conduct our experiments on this exchange. Our obtained results should be more robust than those obtained from simplified financial exchanges used in previous studies. We also analyze the relation between market transparency and front runners. No previous research has been done analyzing this issue in detail. In our study, we make use of our constructed fully functional internet futures exchange and gather empirical data under alternative exchange designs and varying levels of transparency and front-runner participation. The effect of varying levels of front runner participation on the bid-ask spread and on trading gains and losses can be tested for. Additionally, the effect of varying levels of front runner order quantity (order size) can be tested for.

2. Front-runners and Market Transparency

Front runners can be defined as traders who infer security values from the displayed order (quantity). An example of a front runner (in a market where all price quantity pairs of the entire supply and demand schedule is observable to all market participants) is a trader who would enter a buy (sell) order at a price that is 1 cent above (below) the currently displayed buy (sell) price if an order quantity of greater than a certain set threshold is observed. The existence and effect of front runners on the market is intricately related to the issue of market transparency. However, currently, no research has been done analyzing this issue in detail.

Market transparency level lies at the heart of controversial debates. In theory, a totally transparent regime leads to greater popularization of information and consequently to a reduction of adverse selection. Therefore, increasing market transparency will enhance
market liquidity and improve price efficiency. Several studies, however, show that a lack of transparency can sometimes provide lower spreads (e.g. Bloomfield and O'Hara (1999), Porter and Weaver (2000)). Empirical data gathered from a controlled laboratory setting may help resolve controversy. In this study, we construct a fully functional futures exchange and gather empirical data under alternative exchange designs and varying levels of transparency and front-runner participation. Given the rapid advances in internet technology and the growing numbers of newly emerging economies starting to develop advanced financial markets, detailed analysis and research concerning the issue of market transparency under controlled laboratory conditions is timely and important.

Liquidity and transparency are two essential qualities for any financial market. Liquidity essentially reflects trading conditions and is often interpreted in the market microstructure literature as the ability for a trader to buy or sell any amount of the tradable asset immediately and at a price very near the current market price. Market transparency is the ability of market participants to observe information about the trading process (Madhavan (1996) and O'Hara (1995)). In this context, information can refer to knowledge about prices, quotes, the sources of order flow and the identities of market participants.

Transparency, furthermore, has many dimensions. Two important dimensions are the pre- and post trade dimensions (Madhavan (2000)). Pre-trade (Quote) transparency refers to the dissemination of limit order book content such as current bid and ask quotations, depths and possibly also information about limit orders away from the best prices. Post-trade (Trade) transparency refers to the public transmission of information on past trades such as execution time, volume, price and possibly information about buyer and seller identifications.

In the real world, no market is actually fully transparent and existing markets usually attempt to maintain a degree of opacity. The most often implemented means of creating opacity (or decreasing transparency) are the delayed dissemination of information (trades delayed reporting) and the use of hidden orders.

3. Experimental Market

In our research, we manipulate transparency by altering the amount of information traders can observe about other trader's activity, and examine how this manipulation affects the efficiency of the prices. In the fully transparent setting, the entire supply and demand schedule of the futures contracts are observable by all the traders. That is, all traders see the bid price, ask price, the quantity (number of contracts) corresponding to each price order. In the semiopaque setting, a certain percentage of traders are given the option to make use of hidden orders, thereby hiding the quantity portion of their order submission from other traders. In the fully opaque setting, all traders see only the price but not the associated quantity.

4. Interface Design

By leveraging the power of internet technology, this project will construct and design a fully functional internet futures exchange, creating a real-time, authentic and supportive environment for students engaging in stock inquiry. A* Trade Online website is built with MS SQL Server2000. The Web server uses the MS Internet Information Server (IIS) 4.0, and the database uses the MS Access 2000. DreamWeaver4.0 and Photoshop6.0 are used to create basic page layout and hyperlink architecture for web pages and Flash 5.0 is used as an additional tool for system function development. ASP (Active Server Page) programming is employed in web-front end complemented by JavaScript. The monthly and daily schedules are based on VB, agents developed by Java.

5. Effect of front runners

The entire experiment is repeated with varying levels of automated 'front runners' introduced into the market. Front runners are defined in this case as traders who infer security values from the displayed order (quantity). An example of an automatic front runner is to automatically enter a buy (sell) at a price that is 1 cent above (below) the displayed buy (sell) price if an order quantity of greater than a certain set threshold is observed. In detail, suppose we can currently observe the entire demand schedule and suppose the auto front runner threshold quantity is 100 shares. In this case, suppose a trader issues a limit order to buy 120 shares of say CISCO at 100 dollars, the auto front runner would kick in and issue an order to buy F shares of CISCO at 100.01 dollars, thereby front-running the trader who originally issued the buy order at 100 dollars. The effect of varying levels of front runners on the bid-ask spread and on trading gains and losses will be tested for statistical significance. Additionally, the effect of varying levels of the threshold F will be tested for statistical significance.

Our the internet futures exchange is ideal for research in several diverse fields: 1) research in behavioral finance 2) research in high frequency economics 3) questions about cognitive behavior 4) inquiry into learning agents and evolutionary environment they inhabit 5) research in human and computer interface design.

Our obtained results should be more robust than those obtained from simplified financial exchanges used in previous studies. We make use of our constructed fully functional internet futures exchange and gather empirical data under alternative exchange designs and varying levels of transparency and front-runner participation. The effect of varying levels of front runner participation on the bid-ask spread and on trading gains and losses can be tested for. Additionally, the effect of varying levels of front runner order quantity (order size) can be tested for.