Decision Behavior and Performance in Mobile Trading Applications

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Abstract: A common belief about decision making is that the more information we process the better our decisions. Increasingly, we rely on (mobile) information systems to filter, aggregate and present information in order to make it easier to process. With the rise of mobile IS the question arises how decision behavior differs compared to stationary settings. In this paper we analyze user actions in a repeated market environment. We conduct a field experiment in which participants can choose stationary and/or mobile access. Exhaustingly recording all user actions we can compare user performance depending on the device. We are able to distinguish between decision accuracy and behavior in a market environment and thereby provide insight into the interplay between interface, information and decision making.

1 Introduction

We propose to analyze user actions in a repeated market environment where information processing plays a key role. We designed a prediction market for macro-economic variables called the Economic Indicator Exchange (EIX)[1]. Our prediction market is setup as a continuous double auction with one stock to represent each new release of economic information. Participants buy if they think that prices underestimate the probability of an event and sell otherwise. The prediction market thereby aggregates information in the same way as a stock market, which is relatively efficient in an ex ante information sense. In the EIX field experiment with more than 1,000 participants we study the impact of mobile and stationary interfaces on user behavior and decision performance.

2 Related Work

In the following section we will first present related work for prediction markets and then summarize previous work on participant behavior in IS as well as electronic markets. Prediction markets have a long track of successful application in a wide area

[1] http://www.eix-market.de/

ranging from political to sport events sometimes outperforming established forecast methods [BNR08]. The roots of their predictive power are twofold; the market provides the incentives for traders to truthfully disclose their information and an algorithm to weight opinions. The most basic trading mechanism for prediction markets is based on a continuous double auction for one stock which represents the outcome of an event. In 2002, Goldman Sachs and Deutsche Bank created the so called 'Economic Derivatives' market. The traded contracts are securities where payoffs are based on macroeconomic data releases [GMU07]. By analyzing the forecast efficiency Gürkaynak and Wolfers [GW06] find that market generated forecasts are very similar but more accurate than survey based forecasts. To our knowledge, there exists no empirical work linking the decision making in markets to the trading interface. Kauffman and Diamond [KD90] highlight the importance of research on behavioral decision making and information presentation effects. They examine how behavioral effects may become operative in screen-based securities and foreign exchange trading activities, where users can choose among information presentation formats which support trader decision making. In the domains of decision support systems and online shopping environments the influence of the interface on decision behavior has been repeatedly demonstrated. To summarize previous work the amount and control of information, as well as the information representation [Ves94] [Ves91] does influence user behavior. As a conclusion information control has both positive and negative effects on performance [Ari00]. Malhotra [Mal82] concludes that individuals cannot optimally handle more than ten information items or attributes simultaneously. Testing decision accuracy Streufert et al. [SDH67] show that as information load increases, decision making first increases, reaches an optimum (information load ten) and then decreases. Mobile financial IS can provide a serious benefit to customers' value as shown by Muntermann and Janssen [MJ05]. They investigated realizable returns in a stock market subject to the users' reaction time to incoming events. In a simulation based on a real-world dataset, they compared two different scenarios of information latency. In the low-latency scenario customers gain more than 5 % of realizable returns compared to less than 2.5 % in the high-latency scenario. Due to the characteristics of mobile IS users are able to react nearly immediately to new information and transform their advantage into monetary gains.

3 Research Model

As more and more decisions are facilitated through mobile decision support systems, one of the most urging questions is how to design interfaces that improve decision making. In order to answer this higher research question we have to deeply understand if and how the interface influences decision making. More specifically we need to analyze how participants search for information and how they incorporate this information in their decisions process. The second main research question is: How do different interfaces affect decision behavior and decision outcome? Our setup is well-suited to study the behavioral aspects of decision making because, in contrast to financial markets (i) the outcome of events in our market is ultimately known and (ii) we can measure the participants' ex post trading performance. To give indications for these research questions we start by analyzing the participants' decision behavior in two steps which are depicted in Figure 1. In the first step we analyze which information is viewed by the participants depending on the device. Following [Ari00] we assume that participants choose different information elements as they try to adapt the interface to their informational needs. However we expect users who access the market over the mobile application to use less information elements.

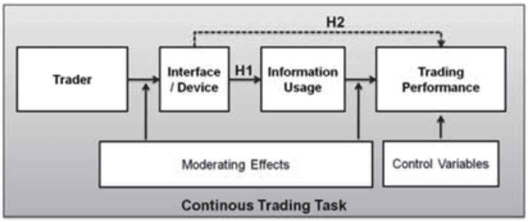


Figure 1: Research Model

In the second step, we present how the self-chosen interface influences the participants' decision behavior and decision outcome. As all traders have the same start portfolio the quantity of a trade is a proxy for the trader's confidence perception. A common financial perspective is to assume that more information leads to an increased trading quantity. As we expect mobile device users to access less information, we expect them to submit orders with lower quantity as well.

H 1 Users who use a stationary device use more information elements.

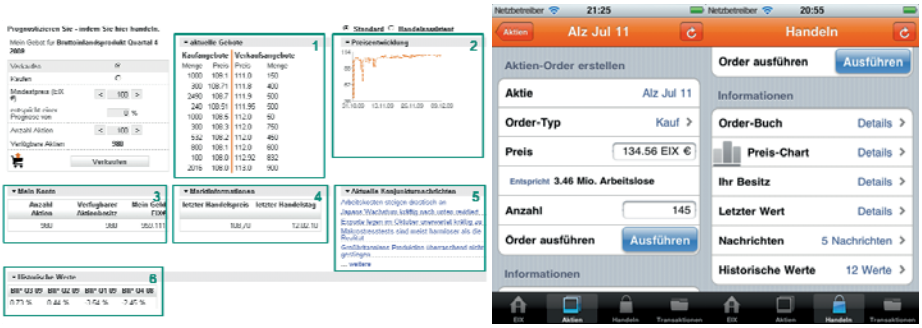
H 2a Participants using the stationary device submit orders with higher average quantity.

H 2b Participants using the stationary device are more likely to submit profitable orders.

In the third step we analyze how the self-chosen interface influences the participants' decision accuracy. The decision accuracy of a submitted order can be analyzed depending on the resulting profit or loss. The intuitive reasoning depending the decision accuracy is that the more information the better the decision accuracy. Even though we expect the mobile users to perform worse than their stationary counterparts, it is somehow intuitive that participants making use of both perform better than participants only using a stationary device (i.e., the mobile usage acts as a complement)

4 Experimental Setup

In the following section we describe the field experiment and the participants' decision process. In October 2009 the EIX play money prediction market was started specifically designed to forecast macro-economic variables. Until May 2010 the EIX was run as a web-based system only. In June 2010 we released a mobile trading application called EIX-Market-App (EMA) which provides mobile access to the underlying market system. The goal of the market is to forecast economic indicators up to 9 months in advance by continuously aggregating economic information. The market was launched in cooperation with the leading German business newspaper 'Handelsblatt' who helps us to reach a broad and well informed audience interested in financial markets and economic development. The market is designed as a continuous double auction without a market maker. After registration participants are endowed with 1,000 stocks of each contract and 100,000 play money units. The continuous economic outcomes are represented by one stock and paid out at data release according to a linear payout function. To increase participants' motivation and to provide incentives to truly reveal information we offer prizes worth 36,000 Euros; 8 yearly prizes (total value 10,000 Euro) are awarded according to the portfolio ranking at the end of the market period. The web-based trading interface is displayed in Figure 2a. Participants have convenient access to the order book with 10 levels of visible depth (I1), the price development (I2), the account information (I3) and market information (I4) such as the last trading day. As additional information the Handelsblatt provides access to an up-to-date economic news-stream (I5) and finally the indicator's last year's performance (I6) is displayed.



(a) (b) (c)

Figure 2: Trading screen with open information panels (a), EMA: Trading screen with links to information screens (b), (c)

Participants are able to customize their trading interface individually. By clicking the small arrows the six information panels open and close. In the default setting, only the trading mask and the six headlines are visible. After each submitted order the chosen interface is saved per user. On user return the system opens the previously used interface elements on default. The advantage is twofold; users have a convenient option to customize their trading experience and, we can assess which self-selected information pieces may have influenced the participants' decision processes.

EIX-Market-App (EMA). The EIX-Market-App (EMA) is a mobile client for the EIX designed for Apple's iPhone. EMA offers all of EIX's core features, i.e. submit and cancel orders, check the own holdings in the stock depot, access additional information like the order book, news, etc. EMA's frontend is a compromise of two design goals. First, EMA was intended to be easy to use for new users. Second, existing EIX-users should be able to use the App with minimal learning effort. Due to the limited screen size of the iPhone platform, it is not reasonable to let EMA look like EIX's web-interface. EMA's frontend tries to be close to EIX's web-interface by sharing the same menu-structure and nomenclature. Analogous to EIX's web-interface, EMA offers six stock related information screens linked from the trade screen (Figure 2c). To allow research about user's information usage prior to submitting an order, the consumption of the six information panels (respectively screens, in case of EMA) are logged in both IS presented here. EIX and EMA both track the time a user needs to create and submit an order as well as the information used in this process.

5 Methodology

In the following section we detail the tools to systematically analyze the information influence on decision behavior. We start by analyzing if different interfaces lead to different user behavior in the terms that participants search other information. Subsequently by controlling for different behavior we evaluate if participants using one interface perform better than using the other interface. For the first question we simply compare different information gathering pattern and finally compare per interface the number of information panels a participant uses when submitting an order. Turning to the second question; in our continuous market we can observe the outcome, i.e. the fundamental value of each stock. Therefore we can measure the information content of each order ex post. If an order moved the price in the right direction with respect to the final outcome of the stock, it is informed ($score_{o,i} = 1$); whereas an order moving the price in opposite direction to the final outcome price, it is uninformed ($score_{o,i} = 0$). Equation 1 measures the influence of the interface type which is 1 for the stationary interface and 0 for the mobile application on the order profitability. The dependent variable is the score described above. As this is a binary outcome we use a binomial logistic regression. As the different indicators exhibit different historic variances, e.g. exports are much more volatile than inflation, we control by adding the market dummy variables M_1 - M_5. In order to identify and control for the individual interface elements, we add a variable (λ_j) for each of the the information panels (compare Figure 2). Thus we can quantify the information effect of each panel.

$$\log \frac{\pi_{\text{Score}}}{\pi_{\text{Trade}}} = \beta \times Interfacet\,ype + \sum_{i=1}^{5} \delta_i M_i + \sum_{j=i}^{5} \lambda_j I_j \quad (1)$$

6 Summary and Conclusions

By describing a prediction market which can be accessed through a web-based stationary and mobile interface, we show the potential of analyzing decision processes in various device settings. We detail a complex trading environment which can be used to quantify trading decisions ex post. Furthermore we present a convenient way to record user behavior in both the stationary and mobile system. Furthermore we describe a method to rigorous distinguish between decision supporting and misleading information. Preliminary results suggest that the decision making process differs depending on the device used. Due to the marginal number of mobile users no conclusion concerning the proposed hypothesis can be drawn. Future research needs to investigate the impact of mobile IS on decision performance. Specifically in the domain of financial markets it is the first work to highlight the influence of the trading interface on trading behavior and performance. Due to the close relation to decision processes this paper helps to understanding the impact of IS interfaces on decision-making in general.

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