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To Discount or Not to Discount: An Assessment of Perceptions, Beliefs, and Intentions to Use Electronic Auctions with Discounts ♦

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Abstract

In the digital economy, electronic auction systems are becoming more prevalent in facilitating the transactions between buyers and sellers. Auction websites, such as eBay and Amazon as well as more sophisticated platforms such as Moai and FrictionlessCommerce, have increased transaction volume by offering tailored auction protocols to specific customer groups. meet2trade[1] is a generic electronic market platform that supports various auction mechanisms. This study examines the impact of a discount in a second-price, sealed-bid mechanism on bidding behavior and market outcomes. Emphasis is thereby placed on bidders' system-based perceptions, beliefs about usage and institutional-based trust, and intention to use such an auction. Ninety students were recruited to participate in an experiment held at a western European university. The experiment observed user behavior in second-price auctions with and without a discount. The results demonstrate that although discounts do affect bidding behavior and economic outcomes, they do not influence bidder's intentions to use such auction mechanisms. Instead, we found that intention to use is influenced by institutional and usage beliefs that are shaped by system-based perceptions, which in turn provide specific advice to market engineers on the technical aspects influencing system adoption.

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1. Introduction

The design of electronic markets has become an important issue for electronic commerce. Unlike traditional markets, electronic markets are supported by a lean medium that limits technical infrastructure; thereby they have to be consciously designed to allow for relevant information flow. In essence, electronic markets are information systems that process and transport data as well as provide communication for agent interaction.

There are many scientific approaches for analyzing and designing market institutions – nevertheless, a solid engineering practice for electronic markets is essential. In-depth knowledge and understanding of various research disciplines, such as economics, computer science, and information system management, are also helpful, as these are at least indirectly involved in the creation, design, evaluation, and introduction of electronic markets (Roth 1999). Thus far, there is little knowledge on which institutions are suitable for certain situations or how the outcome of an electronic market should be measured and evaluated. Furthermore, as Roth (1999) points out, the practical design of electronic markets has to deal with the complexities of the economic environment itself as well as participants' strategic behavior. This requires more than mere familiarity with the institutional rules of a market. Additional methods and tools from other disciplines are needed to supplement traditional approaches. For example, experimental and computational economics are theories that help to elucidate market complexities and provide methods for dealing with these complexities.

Economists are therefore increasingly being regarded as "engineers" (Roth 2002; Varian 2002) with extensive knowledge and a solid foundation in theory and methodology. Indeed, the design of market institutions is evolving from a pure science into a form of engineering-market engineering (Weinhardt et al. 2003). The purpose of market engineering is to develop economically founded approaches and methods that enable designers to overcome the difficulties associated with various market problems (Neumann 2004). While designing the institutional rules, the market engineer wants to achieve a certain effect and economic performance for the market. To automate the process of designing electronic markets in a systematic and structured manner, tools are necessary (Neumann et al. 2005). At this point, several auction platforms, including the Michigan Internet AuctionBot (Wurman et al. 1998), the Global Electronic Market (Reich and Ben-Shaul 1998), the Generic Negotiation Platform (Benyoucef et al. 2000), and the meet2trade platform (Weinhardt et al. 2005), have been developed as tools for designing and configuring auctions or even testing the designed auctions and their embedded mechanisms.

Moreover, these auction platforms not only contribute to greater market participation and efficiency by allowing for various mechanisms, but they can also enrich the market and society by implementing a discount in the mechanism to increase bidding and add social values. When given to a designated group, discounts can help underprivileged segments of the population by rebating their winning bid and encouraging greater involvement in the market (Rothkopf et al. 2003). However, the effect of these discounts on overall behaviors and perceptions of market agents are relatively unknown.

In order to further the design of electronic auction systems, this exploratory work aims to evaluate the impact of auctions with a discount mechanism on agents' perceptions by asking:

What is the impact of a discount mechanism on bidders' perceptions, beliefs, and intentions towards an electronic auction system? Our purpose is to assess the system-based perceptions (i.e. system timeliness and reliability as well as information quality) on institution and usage beliefs, which further influence behavioral intention to use. We draw upon theories from two disciplines: economics (Section 2) and information systems (Section 3) to develop our research model (Section 4), and we test this model in a laboratory experiment using the meet2trade platform with ninety students at a western European university (Section 5). The results demonstrate that although discounts do affect bidding behavior and economic outcome of the auction, they do not affect bidder's intentions to use. Instead, intention to use is influenced by institutional and usage beliefs that are shaped by system-based perceptions (Section 6). Based on our findings, we discuss the impact on electronic market design and suggest future directions for research (Section 7).

2. Electronic Market Systems and Auctions

The recent development in information technologies has increased the number and functionality of information systems involved in organizations. Basic functions that are common to inter-organizational information systems are (1) input functions that accept input data from outside the system, (2) storage functions that retain input data and retrieve stored data, (3) processing functions that calculate and manipulate the input and stored data in other ways, and (4) output functions that produce processing results for use outside the system. Such inter-organizational information systems are used to characterize electronic markets (Bakos 1991). Levecq and Weber (2002) state that contrary to traditional markets, electronic markets can provide different types of services for investors and a high degree of automation based on the technology employed. Common to these definitions is that an electronic market uses technical aids to fulfill the needs of buyers, sellers, and other information carriers concerning information dissemination and transactions.

Electronic markets support the transaction processes mentioned above, enabling multiple buyers and sellers to interact, and provide additional services and tools. A transaction is considered as the exchange of objects between sellers and buyers. In particular, the ownership of objects is transferred from one agent to another and vice versa (Ströbel 2003). An electronic medium that facilitates the transaction of objects between agents constitutes an electronic market (Ströbel 2003; Ströbel and Weinhardt 2003). The electronic market allows the agents to exchange information, goods, services, etc. according to pre-specified rules or protocols. The main functions are the same as those of a traditional market: (i) matching buyers and sellers, (ii) facilitating the exchange of objects, and (iii) providing an institutional framework that enables the efficient functioning of the market (Bakos 1998). A key characteristic of electronic media and thus of electronic markets is that they are independent of time and space, as well as being ubiquitous and globally available (Schmid and Lindemann 1998). Furthermore, both human and software agents have access to electronic markets and can participate in the transaction. The market institution defines the coordination mechanism for the exchange of objects as well as the information and communication processes. The distinct phases of the electronic transaction are supported by electronic media and therefore electronic market services.

Both traditional and electronic markets use media to facilitate transactions deploying negotiation or auction protocols. The facilitation of information exchange, the negotiation over an object, the finding of an agreement, the settlement of a transaction, and lastly the economic exchange are major purposes and benefits of markets, which are independent of the underlying medium (Strecker 2004).

Market designers face a multitude of unsolved issues while designing electronic markets. The main objective of designing (traditional or electronic) markets is to improve market efficiency. Market design or mechanism design is related to the development of markets and its rules; it is a sub-field of economic design. In essence, economic design involves configuring and maintaining economic institutions (Roth 2002). For example, markets need to be designed to maximize the bid-taker's revenue, send the right price signals, mitigate collusive behavior, provide precise and accurate information to all participants, and reduce entry barriers (Badin et al. 2001). Computer-aided market engineering closes the gap between a structured design of electronic markets and the absence of methods by providing tools and techniques to support the market engineer (Neumann 2004). In particular, the auction platform meet2trade (Weinhardt et al. 2005) was developed as a tool for market engineers to create, configure, and test auctions.

This study employs meet2trade as the platform to create an auction mechanism that governs market interactions. The design of the auction system and the mechanisms are described below.

2.1 The Auction Platform: meet2trade

meet2trade is a generic, flexible trading platform that enables the easy creation and automation of auction-based markets. The platform can host markets from a large variety of domains and is able to support various mechanisms. From the market owner's perspective, the platform is configurable: it meets their individual trading needs by adapting to their preferences and tasks.

meet2trade follows a client-server oriented architecture with a central server. The server provides the running platform for all available markets as well as the hosting of all data (e.g. user data, account data, product information, protocol data, etc.) and data preparation. The clients are connected to this central server, which processes the data and provides an interface for submitting bids and displaying relevant information. The various components of meet2trade are situated, based on their functionalities, on three layers (Weinhardt et al. 2006): the *business layer* holds the core parameters for auction mechanism design and is executed by the ARTE (auction run-time environment) engine; the *database layer* encapsulates all database access through management of trading, users, and service data; and the *communication layer* prepares the data for the different client software and administrative control systems. Fig. 1 illustrates the layers and components of meet2trade (Weinhardt et al. 2006).

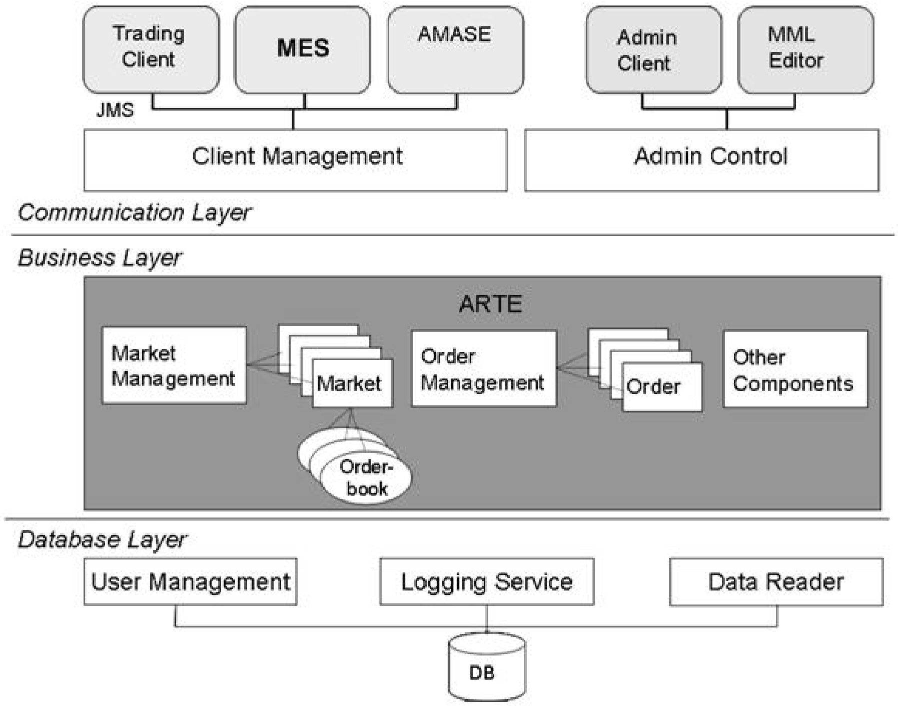

Fig. 1 Overview of meet2trade (Weinhardt et al. 2006)

A vast array of economic research can be conducted using the market design concepts offered by the platform, which are described through the client software and administrative control systems. With respect to administrative control, the MML (market modeling language) editor allows for the creation of electronic auctions by specifying the market parameters (Mäkiö and Weber 2004; Mäkiö 2006). On the other side, the client software management system handles different usage environments: (1) the trading client serves commercial users of electronic auctions, (2) the AMASE (agent-based market simulation environment) is a test-bed for automated auctions that mimic complex scenarios and strategic behaviors (van Dinther 2006), and (3) the MES (market experimental shell) serves to design and conduct experiments using generic components from the trading client, and provides realistic settings within the confines of the experimental design (Kolitz and Weinhardt 2006).

2.2 Auction Mechanisms

In the literature, second-price auctions in a symmetric independent private values auction (SIPV)[♦] setting have been the subject of many analyses and discussions. One central assumption of the SIPV is symmetry: bidders are characterized by the same probability

[♦] The SIPV has been discussed in auction theory literature. For a more detailed description on this auction model, refer for example to Wolfstetter (1999).

distribution functions of valuations (i.e. their preference parameters are drawn from the same probability distribution function). In particular, if bidders are of the same type (i.e. their preference parameters are equal), then they will have the same beliefs about the rival bidders. However, this symmetry assumption is violated in many real-life auction environments. For example, in art auctions, bidders' tastes are known to be quite idiosyncratic. Many results of the symmetric auction framework do not extend to asymmetric auctions. There is only limited literature dealing with asymmetries between commonly known distribution functions from which valuations are independently drawn.

Moreover, literature on affirmative actions in auctions subsidizing a class of bidders is rare. These supports are accorded to economically disadvantaged, less effective bidders. There are different ways of subsidizing such groups: advantages can be given in the form of set-asides, discounts or bidding credits, or special payment terms (Rothkopf et al. 2003). Reasons for such policies stem from thoughts about non-economic aspects such as fairness, discrimination, populism, etc. Ayres and Cramton (1996) present an example from the Federal Communications Commission (FCC) where 30 telecommunication spectrum licenses were auctioned among asymmetric bidders. In the auction, businesses owned by minorities or women were subsidized, meaning that they received a bidding credit of 40 percent. Milgrom (2004) gives a more theoretical example of an auction with asymmetric bidders and bidding credits. Both examples show that with asymmetric bidders, bidding credits might pay for the seller and that auction revenue can be increased. Such affirmative actions are also applied in procurement auctions in which contracts are auctioned. The policy of subsidizing inefficient competitors can lower project costs and enhance cost effectiveness. Corns and Schotter (1999) present an experiment on price-preference auctions with asymmetric bidders and show that choosing the right degree of price preference leads to cost effectiveness. The given examples are useful in understanding how bidding credits can positively affect the seller's expected revenue in auction models, where the symmetry assumption is dropped, and thus provide strong support for further investigation into the effects of discounts in auctions.

The interest in auctions with discounts brings up the need to find explanations to the questions on how affirmative actions such as discounts influence the bidding behavior and thus the market outcome, as well as how institutional beliefs influence user perceptions and the intention to use auction systems. Driven by these questions, our study focuses on the institutional rules of a pure *second-price auction* (SPA) and a *second-price auction with discount* (DA). The DA is based on the benchmark, second-price, sealed-bid auction proposed by Vickrey (1961) that is further augmented with a discount. The fundamental concept of such an auction is that exactly one bidder is selected to whom the discount is assigned. This bidder is called the *designated* bidder. In the DA, the pricing policy is as follows: If the winning bidder is not the designated bidder, then the price to pay is the final price of the auction, i.e. the second highest bid. If the designated bidder wins the auction, then the payment is the discounted final price of the auction.

At present, there is little research on the design of electronic auctions with discounts, and even less on bidders' perceptions vis-à-vis such systems that clearly favor some participants. Therefore, subjects' perceptions towards the auction mechanism and the system are important measures for determining the value of designing such auctions.

3. Measuring System Perception

Although online auctions have grown tremendously and are widely covered in the public and popular press (Subramanian and Zeckhauser 2004), research on online auctions and the effectiveness of various mechanisms on behavior, outcome, and especially perceptions are still relatively unknown (Pinker et al. 2003). Most studies in this area focus on variables related to transaction cost economics, such as coordination cost, asset specificity, and description of product complexity (Malone et al. 1987; Klein 1997; Klein and O'Keefe 1999). Other investigations concentrate more on mechanism design (Roth 2002; Bapna et al. 2004). Very few works have looked at users' perceptions of online auctions, especially with regard to asymmetric bidders in a discount auction.

Information systems research has developed a rich history of investigation into the factors and processes that intervene between technology investments and their economic return. Most studies are built on users' perceptions of the system or their behavioral beliefs towards the system, which impacts the system's ultimate success in an organization. Our work also hinges on users' perceptions and beliefs as an indication of system success through improvement on design, but in our investigation, the individual interacts in a market environment rather than in an organizational setting. In order to extract the salient perceptions related to auction mechanism design that later serve to predict usage intentions, we examine cognitive theories relating to technology acceptance, institution and system characteristics.

3.1 Technology Acceptance Model

One of the predominant theories in IS research is the Technology Acceptance Model, TAM, which has been tested longitudinally (Venkatesh and Davis 2000) in many different settings and with various technologies (Davis 1989). The external variables reflect system characteristics that influence the *perceived ease of use* (PEU), the user's belief of the amount of effort needed to utilize the system, and *perceived usefulness* (PU), the degree to which the user believes using the system will enhance his or her performance. Furthermore, PU and PEU affect *behavioral intention to use* (IU), which indicates intentions for future use and serves as a predictor of usage.

While there have been negative critiques of TAM, citing, for example, the model's inability to explain the external variables causing the fundamental beliefs about system usage (i.e. the influences on PU and PEU) (Legris et al. 2003), TAM is shown to be appropriate in predicting acceptance even when users are given a prototype system for evaluation. Moreover, Davis and Venkatesh (2004) demonstrate that when PU is measured for a pre-prototype system (i.e. users have no direct hands-on usage experience), the value is statistically powerful in predicting usage intentions six months after implementation. Fig. 2 represents the version of TAM for prototype development (Davis and Venkatesh 2004).

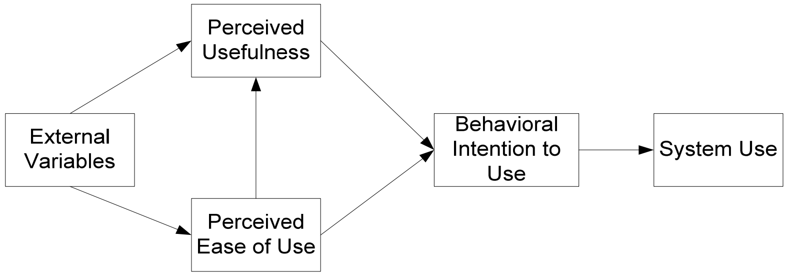

Fig. 2 TAM, reproduced from Davis and Venkatesh (2004)

Another caveat when applying TAM is that the technology under review has to be thoroughly investigated in order to extract all salient beliefs (i.e. those other than PU and PEU) that may be specific to the system or the setting in which usage occurs (Legris et al. 2003).

3.2 Institution Theory

Given that the focus of this paper is on market systems (and more specifically auctions), beliefs affecting IU in TAM must also reflect the very nature of auction systems. One particular factor involving auction systems is the mechanism presiding over the exchange among participants. The mechanism constitutes the regulative institution that determines the method in which information is communicated and more notably the conditions for trade, e.g. market price (Smith 1982). From an individual perspective, the institution influences beliefs on uncertainty and risk associated with employing the auction system to transact in the market (Ba and Pavlou 2002; McKnight et al. 2002). Therefore, the evaluation of auction systems also needs to include trust as a measure of the institution shaping the exchange (Malone et al. 1987; Bakos 1998).

However, from the perspective of organizational theory, institutions expand beyond the formal protocols to include cultural and normative beliefs on the social structure that regulates behavior (Scott 2001). Building on both the formative and informative conceptualizations of institutions, Pavlou and Gefen (2004) capture the perceptions of the institutional structure in the construct of *perceived trust* (i.e. the belief that the on-line system will act with integrity and benevolence). Furthermore, in an electronic commerce setting, Gefen et al. (2003) correlate perceived trust to TAM as an intervening variable from PEU to PU, as shown in Fig. 3.

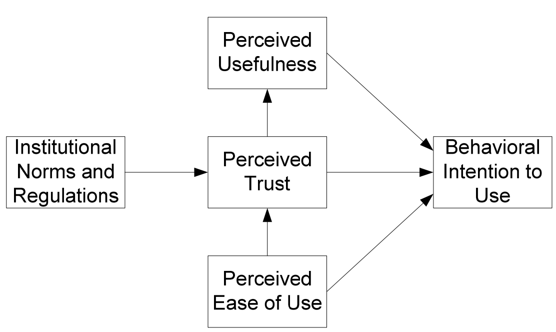

Fig. 3 Integrating perceived trust to TAM, adapted from Gefen et al. (2003)

Moreover, the perception of trust in the market mechanism or in the provider of the marketplace is affected by the perceived effectiveness of the feedback mechanism, which essentially encompasses system characteristics such as information accuracy and quality as well as system reliability (Pavlou and Gefen 2004).

3.3 System Characteristics

With respect to design research on the IS artefact, Wixom and Todd (2005) have shown that behavior variables can be connected to object-based variables related to semantic (i.e. information) and technical (i.e. system) functionalities. Fig. 4 depicts the integration of the behavioral and object-based variables adapted from their study of database warehousing software.♦ The authors believe that the model allows "for understanding and assessing the relative influence of detailed system and information characteristics; this provides important guidelines to system designers… [as to] which characteristics have the most relevant important within [a given] context" (Wixom and Todd 2005, p.99).

As a means of expanding TAM, the integrated model demonstrates that perceptions of system characteristics (or, more specifically, information and system quality, with the exception of system timeliness) influence beliefs about usage (i.e. PU and PEU).

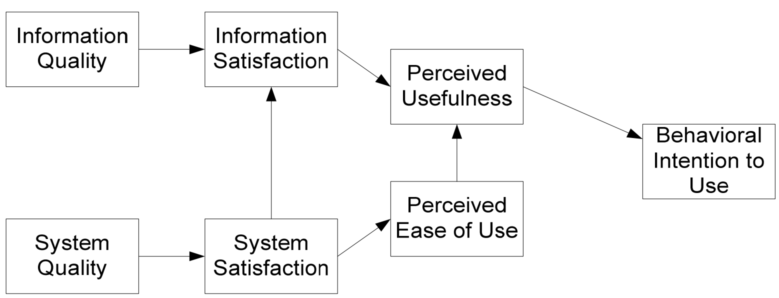

Fig. 4 System characteristics and TAM, adapted from Wixom and Todd (2005)

♦ The intervening variable, *behavioral attitude* towards usage, is not presented in Fig. 2 because Venkatesh et al. (2003) showed that behavioral attitudes are formed as a consequence of having had prolonged exposure to the system, whereby certain feelings are developed towards the usage of the system. Thus, this variable is not quite applicable to design research, when users are given prototype systems and short periods of interaction before they are questioned on their perceptions.

Based on this integrated model, the connection between perceptions of system characteristics and PU as well as PEU is unclear due to the fact that user satisfaction is used as a moderating variable. On the other hand, Seddon and Kiew (1996) tested whether a direct relationship exists between information and system quality and PU, and they found that system quality is a more significant predictor of PU than information quality. Nevertheless, there is little research to suggest relationships between information and system quality and behavioral beliefs concerning the usage of auctions or market systems.

4. Research Model

The aim of this study is to assess users' perceptions of an electronic market system by means of integrating various adoption models to include system characteristics and the institutional-based belief about the market mechanism. In essence, the independent variables are the mechanism and bidders (i.e. asymmetry between designated bidders and regular bidders in a discounted auction vs. symmetric bidders in a non-discounted auction), which influence system-based perceptions that further impact behavioral beliefs, which ultimately affect the dependent variable of intention to use. In order to clarify the goal of this study, the following research model is proposed (Fig. 5) to illustrate all encompassing variables for consideration.

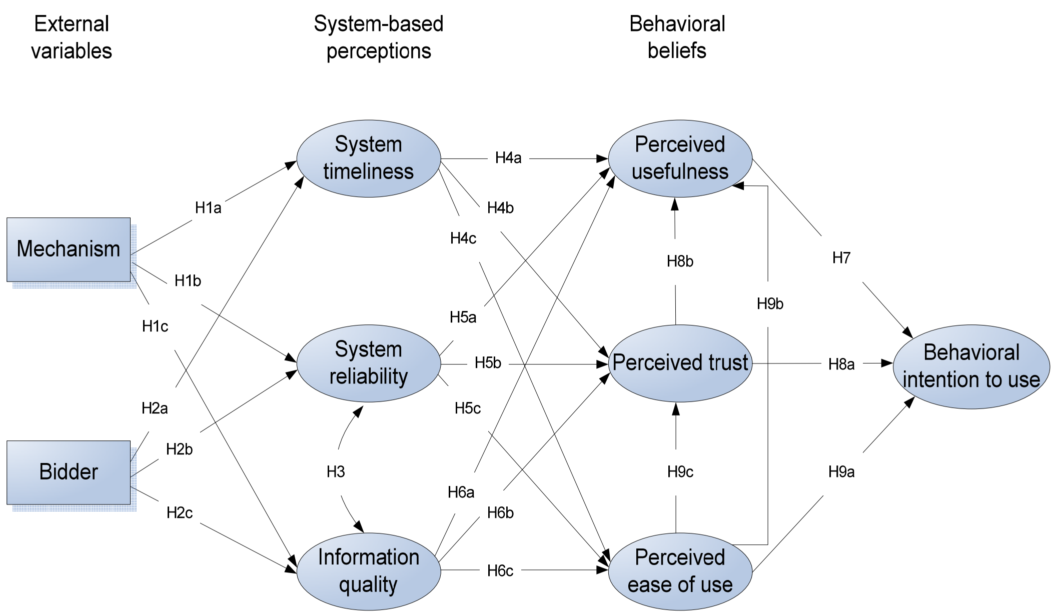

Fig. 5 Research model

4.1 External Variables

The independent variables *mechanism* and *bidder* describe the institutional rules of the auction system (be it a SPA or DA for this study) and represent the bidders' asymmetry by comparing designated bidders with regular bidders in a DA, respectively. The goal of auction design is to create systems that increase market activity and reduce transaction costs for sellers and buyers (Pinker et al. 2003). In economic literature, mechanisms that employ a discount have been demonstrated to have the capacity to increase participation and user involvement (Corns and Schotter 1999). This leads us to hypothesize that DA will lead to greater perception of system characteristics. Therefore,

H1a: The mechanism with a discount (DA) will lead to greater system timeliness.

H1b: The mechanism with a discount (DA) will have a greater influence on system reliability.

H1c: The mechanism with a discount (DA) will lead to greater information characteristics.

Furthermore, in an auction with discount, designated bidders will perceive variables related to system characteristics as being more favorable than will regular bidders who do not receive any discount on their winning bids. Hence, H2a: System timeliness will be better perceived by designated bidders than by non-designated bidders in a discount auction system.

H2b: System reliability will be more favorably perceived by designated bidders than by non-designated bidders in a discount auction system.

H2c: Information quality will be more positively perceived by designated bidders than by non-designated bidders in a discount auction system.

4.2 System-based Perceptions

Based on exploratory studies of online auction systems, time, reliability, and information complexity are important concerns for market participants; these aspects relate to the ability of the system to meet the users' exchange needs (Beam and Segev 1998). Our research model examines these main concerns through system-based variables that reflect the auction system in terms of: (1) *information quality*, which refers to the degree to which the system provides necessary information for the individual to interact in the market. System quality is broken down into two separate constructs; (2) *system reliability*, which is the degree to which the electronic market is dependable and offers accurate data; and (3) *system timeliness*, which refers to the degree which the system responds promptly to requests for information or action. Although Wixom and Todd (2005) posit that the last two variables form the construct of system quality, their study was unable to significantly demonstrate that *system timeliness* is indeed a dimension of system quality. Given that *system reliability* is a dimension of system quality, a correlation can be inferred, as Wixom and Todd (2005) have shown, between information quality and system quality.

H3: System reliability will be positively correlated to information quality.

Building on the works of DeLone and McLean (1992), Seddon and Kiew (1996), and Pavlou and Gefen (2004) that connect system-based perceptions to beliefs about usage, the following hypotheses are proposed:

H4a: System timeliness will affect PU.

H4b: System timeliness will influence perceived trust.

H4c: System

H5a: System reliability will affect PU.

H5b: System reliability will influence perceived trust.

timeliness will impact PEU.

H5c: System reliability will impact PEU.

H6a: Information quality will affect PU.

H6b: Information quality will influence perceived trust.

H6c: Information quality will impact PEU.

4.3 Behavioural Beliefs

The intervening variables consist of the beliefs about usage from TAM (Davis 1989) and trust in the institution (Gefen et al. 2003), which lead us to suggest the following hypotheses:

H7: PU will have a positive direct effect on IU.

H8a: Perceived trust will affect IU.

H8b: Perceived trust will influence PU.

H9a: PEU will affect IU.

H9b: PEU will influence PU.

H9c: PEU will impact perceived trust.

4.4 Behavioural Intention

The final dependent variable is the behavioral intention to use (IU) an electronic auction system, which reflects future intentions towards the system and serves to predict usage. Therefore, it is important for system designers to understand the determinants of IU in order to induce participants to use the auction system.

5. Methodology

The experimental design centers on comparing an auction mechanism with a discount to one without. In principle, both market mechanisms follow the same rules and differ only in the existence of a discount; all of the other design parameters are identical. The experiment consists of a *between subjects* design, which focuses on isolating the effects of levels of variables. The level of a treatment variable is only varied between single treatments and across subjects but not within one trial. The auctions differ according to the mechanisms (SPA or DA), and in DA auctions, the type of bidders varies (designated and non-designated), as depicted in Fig. 6.

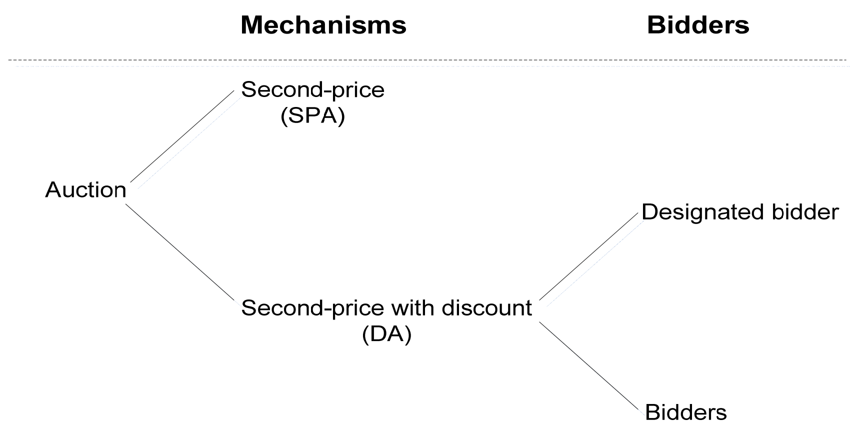

Fig. 6 Experimental design

Throughout the experiment, only the institutional rules are changed; all other parameters, including the environmental parameters, are kept on a constant level. The SPA setting constitutes the benchmark case: auctions without a discount are conducted and bidding behavior in these auctions is observed. Sessions in both settings are conducted separately and each subject participates only once in the experiment.

5.1 Experimental Procedure

The experiment was conducted at the experimental laboratory of the Institute of Information Systems and Management at Universität Karlsruhe (TH) from December 14-16, 2005. The meet2trade platform served to generate the two mechanisms under the MES client. ARTE was used to configure and to employ the institutional rules of the DA mechanism and the corresponding SPA, such that each session of the experiment was configured, conducted, and settled based on the specification given by MES.

In the experiment, all decisions of the participants and answers to the questionnaires were entered into a computer terminal. Participants were randomly seated at one of 15 isolated cabins, each of which was equipped with a computer-terminal. The instructions were read aloud to all participants and each participant had to take a quiz on the rules of the experiment and auction mechanism. Once all of the questions had been answered correctly, the 15 participants were randomly divided into five groups of three, and the first auction round was started; no trial rounds were conducted. In each auction round, five independent auctions were conducted at the same time. Each group consisted of three subjects participating in the same market. The participant groups were fixed and did not change throughout the experiment. Before each auction round, participants were informed about their valuation for the object being auctioned in the current round, and their actual experimental account was displayed on the computer screen.

In each round, the bidders had to decide how much to bid for the object based on the pre-assigned valuation, and then they entered the value of their bid in the bidding screen.[♦] Once the value was confirmed, the bid was submitted and entered into MES. At the end of the round, the auction results were displayed on the screen. Information about the winning bid, the name of the winning bidder (e.g. “player 1”), the final price of the auction (i.e. the second highest price), and the price to pay for the winning bidder were indicated on the screen. Transactions were also recorded in the participants’ experimental accounts.

[♦] In each round, 15 valuations are assigned to 15 subjects at random between [100,109] (10 valuations) and [146,150] (5 valuations). Each valuation is an integer number and each value out of the two intervals is assigned only once to the participants. They are informed that the valuations are integer numbers and randomly drawn from the interval [100,150], but the probability distribution function is not revealed.

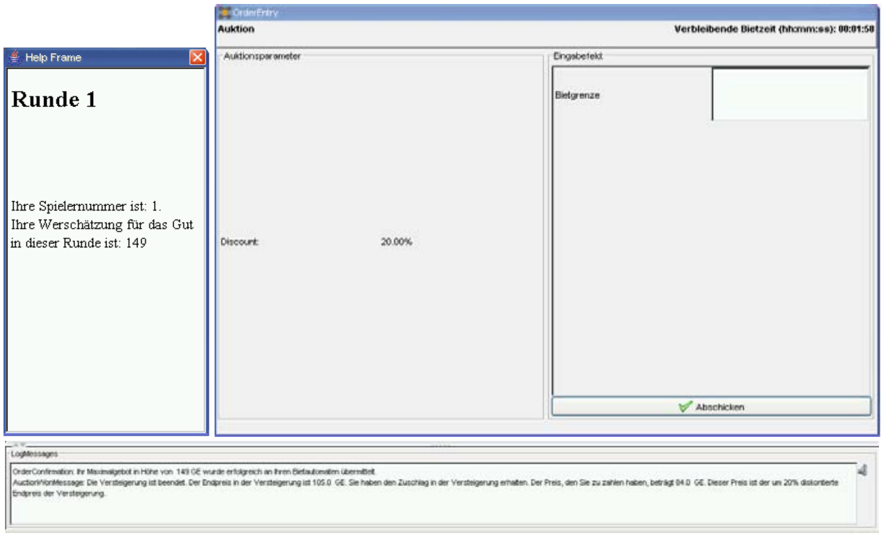

Fig. 7 Screenshot of DA created by meet2trade

In the DA setting, subjects were additionally informed of their bidder status. The designated bidder saw the message “Discount: 20%” on his or her screen; the non-designated bidders saw “Discount: no Discount” on the bidding-screen. Concerning the auction result, the designated bidder and winner in the auction was informed that the price to pay for the object was a discounted price. For example, Fig. 7 shows the screen that a designated bidder saw in the experiment. At the end of all rounds, the subjects answered 48 questions regarding their background, behavior, and perceptions of the auction system. The items for PU, PEU, and IU were adapted from Davis and Venkatesh (2004), those for perceived trust were from McKnight et al. (2002), and those for system characteristics were from Wixom and Todd (2005). The entire session lasted about 1 hour and 10 minutes and was divided into five phases as shown in Table 1.

Table 1 Duration of phases in an experimental session

Phases of Experimental Session	Approximate Duration
1. Reading of instructions	15 min
2. Quiz on instructions	10 min
14 questions about SPA setting	
17 questions about DA setting	
3. Six consecutive auction rounds	20 min
4. Questionnaire on subjects’ background, behavior, and perception of systems	15 min

48 questions	
5. Payment of subjects	10 min
Total	1h 10 min

5.2 Participants

Participants were randomly selected from a database with more than 3,000 volunteers. All participants were undergraduate or graduate students mostly from the School of Economics and Business Engineering. Only a few subjects invited for participation had participated in a negotiation or auction experiment before; in addition, only a few participants were experienced in negotiations or auctions. None of the subjects was a regular participant in either activity.

Participants took part in six consecutive auction rounds, with each auction round limited to 2 minutes. After the last round, participants were asked to complete an on-screen questionnaire consisting of 48 questions by entering the answers on the computer. The questionnaire included questions about the participants' background, their behavior in conflict situations, and their attitudes concerning auction systems. The remaining questions were about the system and user interface design.

At the end of the experiment the subjects were called one by one and paid privately. The 15 participants participated in 6 sessions. Three sessions involved the SPA setting and the rest used the DA setting. The overall descriptive information on the subjects is presented in Table 2. All individual characteristics were checked against experimental variables and no significant effects were found.

Table 2 Description of participants

Participants' characteristics		Percentage
Gender	Male	73.3
	Female	26.7
Auction Experience	No experience	28.9
	Some experience	45.6
	Experienced	25.5
Education level	Undergraduate	56.8

	Graduate	41.1
	Other	2.1
Field of study	Information engineering & management	11.1
	Business engineering	48.9
	Computer science (Informatics)	3.3
	Other	36.7

6. Results

The findings for this study are based on bidding behavior, economic outcomes, and most importantly, the responses given by participants after the auctions. First, bidding behavior and market outcomes are compared between treatments to show the impact of the discount on economic variables. Second, several analyses of variance (ANOVAs) are performed to test the effect of the manipulations on the subjective variables. Finally, factor analysis and structure equation modeling (SEM) are carried out to assess the nomological network of the research model.

6.1 Bidding Behaviour of Participants and Market Outcome

In both auction mechanisms, bidders show a general tendency to underbid (i.e. they bid below their dominant strategy). Table 3 shows the mean bids of the different treatments against the theoretical mean bid (i.e. mean dominant strategy). Based on the Wilcoxon signed rank test, the bids in the DA (mean bid = 125.19) are significantly higher that those in the SPA (mean bid = 115.40) with a p-value of less than 0.001, and the bids in the DA for designated bidders (mean bid = 141.69) are significantly higher than those of bidders (mean bid = 116.95) with a p-value of less than 0.001. Even more interesting is that bidders without a discount in the DA made significantly higher bids (with a p-value of less than 0.001) than their counterparts in the SPA.

Table 3 Average bids in SPA and DA settings

Setting	Mean Dominant Strategy	Mean Bid	Mean Deviation
SPA	119.00	115.40	-3.60
DA – all bidders	128.92	125.19	-3.73
DA – designated bidders	148.75	141.69	-7.06
DA – non-designated bidders	119.00	116.95	-2.05

Throughout the course of the experiment, designated bidders in the DA had difficulties in adapting their behavior towards the dominant strategy. In contrast, bidders without a discount in the DA and bidders in SPA needed only a few rounds to adapt their behavior and submit bids close to the dominant strategy. This explains the higher mean deviation experienced by the designated bidders.

In terms of the outcome, this study shows that under symmetries (i.e. bidders' valuations are realizations of independent random draws of the same variable); the seller cannot extract extra revenue by offering a discount. On average, the seller's revenue in the DA is lower than that in the SPA. The differences in central tendency with respect to the revenues are significant with a p-value of less than 0.05. However, the economic surplus is greater for DAs than SPAs, showing that discounts bring greater rewards to the overall market (see Table 4).

Table 4 SPA and DA auction outcomes for theoretical benchmark and experiment

Setting	Description	Revenue	Payoff	Surplus	Payoff	
					Designated	Non-Designated
SPA	Theoretic Solution (mean) with induced valuations	114.23 100%	25.77 100%	140 100%	-	-
	Experimental results (mean)	112.41 98.41%	24.17 93.79%	**136.58** **97.56%**	-	-
DA	Theoretic Solution (mean) with induced valuations	112.17 100%	27.01 100%	139.18 100%	38.79 100%	14.09 100%
	Experimental results (mean)	109.66 97.76%	28.7 106.26%	**138.35** **99.40%**	38.59 99.48%	16.03 113.77%

6.2 Analyses of Variance

Before we can verify our research model, we need to determine effect of the treatments (SPA vs. DA) on our subjective variables (Lattin et al. 2003). Since our model encompasses seven dependent constructs (i.e. system timeliness, system reliability, information quality, PU, perceived trust, PEU, and IU), two ANOVAs presented in Table 5 serve to measure the variance caused by the independent variables. Surprisingly, the results show that neither the discount nor the asymmetry of the bidders significantly affected the participants' perceptions of the system characteristics, beliefs about usage and institutional-based trust, and IU.

6.3 Factor Analysis and Structure Equation Modelling

Factor analysis serves to examine the validity of the constructs reflected by more than one item. Table 5 conveys the univariate statistics of the items and reliability values for each factor. The internal consistency is indicated by the Cronbach's alpha, which is above 0.7 for all factors except for system timeliness. The Cronbach's alpha for system timeliness may be skewed due to the fact that this factor is measured by only two items (Lattin et al. 2003).

Table 5 Measurement Properties and ANOVA for Subjective Variables

	Measurement Properties				ANOVA	
	Items	Mean	Std. dev.	Reliability (Cronbach's alpha)	Mechanisms (p-value)	Bidders in DA (p-value)
Perceived usefulness	PU1	4.3667	1.5247	0.840	0.167	0.506
	PU2	4.3333	1.3657			
	PU3	3.9889	1.5102			
	PU4	4.7111	1.4002			
Perceived ease of use	PEU1	5.8778	1.1595	0.907	0.850	0.507
	PEU2	5.6333	1.3857			
	PEU3	5.8222	1.1859			
Perceived trust	PT1	3.9556	1.6484	0.776	0.738	0.236
	PT2	4.5556	1.4696			
	PT3	4.4111	1.7281			
	PT4	4.2889	1.6776			
Information quality	IQ1	4.2889	1.7498	0.829	0.404	0.779
	IQ2	4.0111	1.6860			
	IQ3	5.0667	1.5125			
	IQ4	4.9444	1.5533			
	IQ5	5.0556	1.3354			
	IQ6	4.5556	1.3748			
System reliability	SR1	5.7333	1.1974	0.822	0.216	0.694
	SR2	5.4889	1.4162			
	SR3	5.5889	1.1406			
	SR4	5.3111	1.2238			
System	ST1	5.0111	1.5397	0.664	0.591	0.461

timeliness	ST2	4.9667	1.1163			
Behavioral intention to use	IU1	3.9889	1.6860	0.842	0.265	0.102
	IU2	4.1889	1.5857			
	IU3	4.1111	1.5466			
	IU4	4.4667	1.2649			

The convergent and discriminant validities are apparent in the rotated factor matrix, shown in Table 6 of Appendix A, as related items load highly to similar factors and poorly to dissimilar factors.

Based on the insignificant findings from the ANOVAs, we removed the external variables (i.e. mechanisms and bidders) and combined the responses from all treatments to test the structural model with only the subjective variables. Modeling was accomplished by EQS software for estimating the path coefficients, correlation, and variance explained using maximum likelihood (Bentler 2004). The research model was refined to include only significant relationships between constructs; these are reported in Fig. 8. Although the fit indices are lower than the general recommendation, they remain in the acceptable range for an exploratory type of study that is not aimed at confirming an existing model, meaning CFI and NNFI above 0.80, as well as RMSEA below 0.10 (Bollen 1989).

The findings indicate that 70% of the variance of IU can be explained by PU (R^2 = 22%), which is significantly influenced by system timeliness and perceived trust. Meanwhile, perceived trust (R^2 = 36%) is affected by system reliability and PEU (R^2 = 10%), which is influenced by information quality. The correlation between system reliability and information quality was found to be significant.

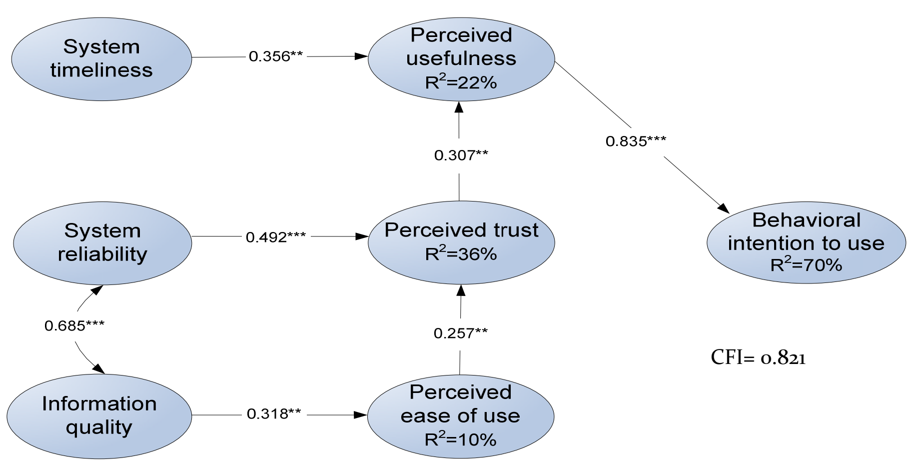

Fig. 8 Research model results

7. Discussion and Future Research

Based on a prototype of an electronic market system from the meet2trade platform, this study outlines the antecedents that affect the intention to use such a system for trading in the marketplace. The participants were subjected to different settings in order to examine their perceptions, beliefs, and intentions regarding an auction system with a discount mechanism.

Surprisingly, the results of this exploratory study reveal that objective manipulation of the mechanism and bidder has no effect on the subjective variables. The main reason may be that the treatment variables are external to the system and thus did not affect subjects' perceptions towards the system. This presents an interesting insight for market engineers into the intention of users to adopt electronic auction systems. Since the mechanism is embedded in the system and does not affect human interactions with the system, bidders do not perceive any difference in the impact of the mechanism with a discount on IU, even though their bidding behavior and market outcome are significantly affected by the manipulations of the experimental design. In fact, IU is primarily affected by PU, which corresponds to the findings by Davis and Venkatesh (2004) that IU is mostly influenced by PU in prototype settings. This implies that users express intentions to employ electronic market systems that clearly give them a relative advantage in performing their trades.

In addition, perceived trust is an intervening variable between PU and PEU, as shown by Gefen et al. (2003). Thus, market agents who perceive the system to be easy to use are likely to find it useful if they also believe that the system is trustworthy. Moreover, there does not appear to be a direct relationship between PEU and PU stating the importance of perceived institution-based trust in shaping the belief of usefulness for such an auction system.

The system-based perceptions are essential factors for market engineers as they form their beliefs about usage and institutions. Contrary to the literature, information quality affects only PEU and not PU. This may be an artifact of the system under investigation, whereby the information provided affects the users' view of the cognitive effort required by the system and not necessarily its usefulness. On the other hand, system timeliness affects PU, which is indicative of auction dynamics embedded into these market systems. The speed at which bids are processed by the system impacts the agents' performance in the auction. Perceived trust is formed from the beliefs concerning system reliability. This finding reflects the importance of the dependability of the mechanism in awarding the rightful winners, as perceived by the users. Therefore, different system characteristics play different roles in formulating beliefs. Furthermore, we showed that there is a difference between system reliability and timeliness, which would explain the need to separate these two factors rather than to lump them together as system quality.

One of our major limitations is the low fit of the indices of the data to our research model. This was caused by the small sample size used in the experiment. SEM by means of maximum likelihood estimation usually requires more than 150 respondents (Bentler 2004). In future work, we hope to compare other types of mechanisms that clearly affect bidders' interactions with the systems to see if there are any differences in their perceptions of electronic auction systems.

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Appendix A

Table 6 Rotated Factor Matrix

	Perceived usefulness	System reliability	Perceived ease of use	Information quality	Behavioral intention to use	Perceived trust	System timeliness
PU1	.732	.034	.134	-.025	.328	.060	.142
PU2	.654	.142	.111	.095	.081	.242	.047
PU3	.593	-.008	-.062	.202	.216	.232	.101
PU4	.739	-.048	.060	.038	.185	.232	.274
PEU1	.075	.095	.870	.152	-.056	.076	.122
PEU2	.076	.057	.795	.175	.147	.123	.092
PEU3	-.018	.083	.880	-.008	.026	.068	.217
PT1	-.047	.229	.174	.097	.409	.533	.061
PT2	.066	.369	.287	.094	.293	.616	.033
PT3	.239	-.108	.018	.013	.030	.729	.267
PT4	.224	.146	.068	-.058	-.047	.614	.072
IQ1	-.081	.244	.076	.463	.419	.147	.187
IQ2	-.153	.144	.011	.511	.358	.202	.258
IQ3	.100	.184	.269	.718	-.083	-.228	.182
IQ4	.083	-.003	.184	.700	.039	-.015	.182
IQ5	.276	.385	-.029	.572	.238	.139	-.002
IQ6	.133	.398	.071	.550	.307	.177	-.103
SR1	.050	.600	.171	.345	-.001	.269	.020
SR2	.126	.657	.046	.124	-.058	.293	-.116
SR3	-.087	.824	.068	.045	.124	-.050	.150
SR4	.018	.687	.156	.226	.044	.055	.376
ST1	.040	-.032	.292	.039	.036	.019	.681
ST1	.174	.158	.034	.146	.173	.189	.610
IU1	.222	-.027	-.018	.111	.578	-.016	.161
IU2	.585	.026	.007	.136	.565	.079	.267
IU3	.476	-.049	.097	.022	.653	.167	.244
IU4	.451	.156	.166	.110	.505	.174	.014