Association for Information Systems
AIS Electronic Library (AISeL)

ICIS 2005 Proceedings

International Conference on Information Systems (ICIS)

December 2005

Assessing Customers' Value of Mobile Financial Information Services: Empirical-Based Measures

Jan Muntermann
Goethe University

Lars Janssen
Goethe University

Follow this and additional works at: http://aisel.aisnet.org/icis2005

Assessing Customers' Value of Mobile Financial Information Services: Empirical-Based Measures

Jan Muntermann and Lars Janssen
Chair of Mobile Commerce & Multilateral Security
Institute for Business Informatics
Goethe University
Frankfurt, Germany
jan@whatismobile.de   lars@human21.de

Abstract

In this paper, we assess customers' value which can be provided by mobile financial information services enabling private investors to react promptly to critical market events and to exploit the subsequent abnormal intraday stock price movements. We present two frameworks for evaluating customers' benefits of a corresponding investment. First, we empirically analyze the impact of timelier information supply on market returns. Our findings indicate that any reduction of the reaction time significantly increases revenues that can be realized by customers. Second, we propose a novel approach to measure customers' benefits by simulating realizable yields considering trading volumes, transaction costs, and reaction delays on the basis of historical market events and empirical intraday stock price series. The results provide evidence as to how the trading behavior of customers and different product implementation alternatives can affect customers' benefits and, therefore, the evaluation of the IT investment.

Keywords: Business value of IT, mobile financial information services, consumers' surplus

Introduction

Online banks and brokers have invested a significant amount of money in modern information and transaction services and related information technology infrastructure in recent years. Investments in products and services with the aim of increasing customers' benefits lead to greater customer satisfaction and, in the long run, to better corporate performance (Brynjolfsson and Hitt 1996). Nevertheless, the increasing competition within the financial sector and the resulting intense cost pressure forces organizations to assess the expected benefits that can be derived from planned IT investments.

Evaluating the business value of information technology has been a major question for researchers and managers for several years. Corresponding studies differ regarding the unit of analysis (i.e., the aggregation level at which potential effects are measured). Whereas early studies focus mainly on a high aggregation level (firm level or higher) (Brynjolfsson 1993; Lichtenberg 1995; Loveman 1988), later studies propose to analyze smaller units of analysis (e.g., application or product level) in order to achieve a better isolation of the specific benefits gained from IT investments (Goolsbee and Petrin 2004; Nevo 2003).

We propose an evaluation of customers' benefits on product level by a performance metric and a customer's value-simulation approach. We focus on an information product notifying private investors of critical market events (company announcements) that can have a significant impact on their portfolio value or open up a window of opportunity. Therefore, we assess the potential benefits that can be achieved by an investment in a corresponding notification service. The two frameworks should provide evidence as to how to evaluate customer benefits resulting from investments in mobile financial information services.

We suggest a performance metric that covers the impact of a more timely information supply on the market returns that can be realized by the customer. Furthermore, we have chosen the simulation approach for two reasons. First, as we focus on an

emergent technology and a (so far) not yet available product, the proposed method should enable investors to perform an *ex ante* evaluation of planned IT investments. Consequently, it is not possible to apply traditional methodologies, as the parameters of the underlying production or demand curve can hardly be econometrically estimated or assumed. Second, we simulate the impact of trading volumes and the reaction time on realized revenues on the assumption that the information service will decrease the reaction time of private investors. The simulation uses real market events (company announcements pursuant to Section 15 of the German Securities Trading Law) and intraday price movements taken from the Frankfurt Stock Exchange (XETRA) as input factors of the simulation.

Information Technology in the Field of Private Investors

Online brokers and banks have invested heavily in IT infrastructure in recent years in order to differentiate themselves in terms of customer attraction and to increase the number of transactions performed. These investments were mainly made in order to simplify transaction processes or to enhance the information supply for private investors. So far, most existing financial information systems supporting private investors are limited to conventional web-based pull services. Nevertheless, online brokers have designed specific business models for mobile brokerage services in order to manage customer segments, pricing models, and products (Looney and Chatterjee 2002). Looney et al. (2004) show that appropriate mobile financial information services can enhance customer satisfaction in order to retain most profitable customers, which will improve long-term profitability. They arrive at the conclusion that customers' value is a central success factor in the mobile brokerage industry and, therefore, technological opportunities have to be recognized and valuated.

In this paper, we focus on a mobile service proposed by Muntermann (2004), which notifies investors about critical market events via mobile push services. If a company whose stocks are held by the investor publishes an announcement, a notification is triggered and a push message will be sent to the customer's mobile device.

Several studies provide evidence that significant abnormal price effects following company announcements can be proven for a period of between 15 minutes and 1 hour, which opens a window of opportunity if investors are notified in time (Barclay and Litzenberger 1988; Patell and Wolfson 1984; Woodruff and Senchak 1988). The combination of personalization and timely information supply, which can be realized by the described mobile push services, can provide benefits for private investors. A corresponding notification service could prevent potential losses, as the investor is able to react to relevant market events in time or could enable them to take an investment chance. Muntermann and Güttler (2004) have shown the potential capabilities of mobile financial information services by an event study approach. However, there is little empirical evidence that an investment in these IT services can provide substantial business value.

Theoretical Foundation and Previous Research

Estimating the impact of IT investments on the company's business success is an important consideration for researchers and management. In recent years, several studies addressed this question, bearing partly contradictory results depending on data used and methods chosen. As value can be measured in different dimensions, evaluating the value of IT investments cannot be addressed with a single question and is typically composed into different questions (Hitt and Brynjolfsson 1996).

1. Do investments in IT increase productivity?
2. Do investments in IT improve business performance?
3. Do investments in IT create value for customers?

Depending on the addressed research question, previous studies apply different frameworks in order to evaluate the impact of IT investments.

The first issue addresses the question of how IT investments can contribute to more production output and/or less production input. Typically, this question is addressed with standard production theory using some kind of production function *f* which describes the dependency of the output on the change of one or several input variables. Generally, a production function of the form $f = \alpha e^{\lambda t} I_1^{\beta 1} I_2^{\beta 2}$ is used, where I_1 and I_2 represent the input factors (e.g., labor and IT investments) and βi the corresponding output elasticity (Davamanirajan et al. 2002; Loveman 1988). The approach postulates several assumptions which raise some drawbacks: (1) the production function form itself has to be assumed (implicating further assumptions, for example, constant

returns to scale when choosing the Cobb-Douglas production function), (2) the function parameters can econometrically be estimated, and (3) the IT investments are correlated with some kind of production output. As the approach focuses on increased physical output, reduction of costs, and input factors, it is adequate for evaluating IT investments in the manufacturing sector (Lichtenberg 1995) but can be inadequate for the service or finance sector, where these investments should provide enhanced customer service or better/prompt investment decisions. Furthermore, it is not possible to measure other advantages like increased quality, variety, convenience, and timeliness, which are also dominant success factors in these segments. Brynjolfsson (1993) found that this traditional productivity-related approach cannot be applied when analyzing the benefits of IT investments in a new technology, as the resulting effects cannot be covered by the production function. Nevertheless, this output and productivity-oriented approach can be suitable if impact factors and output can be measured reliably and the marginal contribution of each input factor to the output can be estimated and approximated by the production function form. Consequently, production theory and production functions were applied by several researchers in the 1990s (Brynjolfsson and Hitt 1993; Loveman 1988; Morrison and Berndt 1991).

The second question should provide insights into potential profitability benefits from the IT investments being unrelated to output measurement. Typically, general (e.g., growth in profits, market capitalization, etc.) or industry-specific (e.g., inventory turnover, mean time before failure, etc.) performance metrics are chosen in order to evaluate the contribution of IT to the performance metric compared to other factors (e.g., ratio of non-IT capital, marketing purchases, research and development purchases, etc.) (Barua and Kriebel 1995; Sircar et al. 2000). Several studies analyzed the correlation between IT investments and growth of business profitability. Whereas most studies performed in the 1980s and 1990s found little significant positive or even negative correlation (Franke 1987) between IT investments and business profitability (Dos Santos et al. 1993; Loveman 1988; Salerno 1985), more recent studies dispelled this paradox (Brynjolfsson and Hitt 2000; Sircar et al 2000). Evidence was found that the controversial results reported in the literature can be ascribed to various measurement problems caused by cross-sectional analyses which fail to capture lag-effects (Barua and Kriebel 1995; Kohli and Devaraj 2003; Lee 2001). The key assumption of the approach is that businesses capture the value of IT investments over time, which contradicts the theories of competitive strategy, as all firms will perform the optimal amount of IT investments in equilibrium.

The third question considers whether and to what extent investments in IT can provide benefits to customers. The idea behind evaluating customers' benefit is that this is a good proxy for the real value created. Brynjolfsson and Hitt (1996) found that companies that focus their IT investments on customer service are significantly more productive than their counterparts. Evaluating customers' benefits is mostly addressed by microeconomic theory (Bresnahan 1986; Brynjolfsson 1996). Therefore, the area under the consumer's demand curve has to be measured by econometric methods or by index numbers. The customer's demand curve itself illustrates the benefits gained from each successive amount of the product. Evaluating the benefits of IT investments with consumers' surplus overcomes several problems involved in the production function and the performance metrics approach (Brynjolfsson 1996). These approaches tend to underestimate the real value of IT investments, as the chosen factors do not cover the total contribution. Contrary to this, customers' surplus measures customers' willingness to pay for the considered product. Furthermore, it can be applied to new technologies where the productivity function elasticities or the contribution of IT to the performance metric can hardly be econometrically estimated. Consequently, the approach is adequate for supporting managerial decisions because investments in new IT products and services can be valuated. Nevertheless, the approach requires some assumptions. The shape of the underlying demand curve has to be assumed or estimated for the evaluated product, which can be challenging even if an emergent technology is addressed. Typically, a standard log-linear demand function of the form $d(p, y) = Ap^{\alpha} y^{\beta}$ is used, where p is the price of the product, y is the income and α and β are corresponding elasticities (Brynjolfsson et al. 2003). Furthermore, the demand curve itself assumes (on a product level) that the customer chooses the most beneficial amount of product units given the product price and the customer's income. This is not feasible for information products or services where splitting into product units can hardly be presumed. Further problems arise when the investor is planning to offer a new service (e.g., a new financial information service) free of charge assuming that the service will increase total revenues (e.g., from increased financial transactions resulting from timely information supply). Subramanyam and Krishnan (2001) address this problem when assessing the business value in the context of investments in customer call centers and choose the resolution time in which a given customer's problem is solved as a proxy for the business value of the IT investment. However, their approach works with this proxy in order to evaluate potential productivity gains but it is not appropriate for evaluating the provided customers' benefits resulting from lower expenditure of time.

Another differentiation regarding the measurement of IT investment benefits is the aggregation level at which the valuation is performed and whether a qualitative or quantitative measurement approach is applied. A meta-analysis performed by Chan (2000) reviewing IT value articles in leading IS journals during the period from 1993 to 1998 segments these articles into six different aggregation levels (individual, group, organizational, industry, national, and international). Chan found that most of these studies were performed on an organizational level. None of the articles address the question of whether investments in IT create value

for customers at an individual level on a quantitative basis (Belcher and Watson 1993; Desmarais et al. 1997; Kraemer and Danziger 1993; Pinsonneault and Rivard 1998). Consequently, metrics and methodologies addressing the valuation of new products and services on an individual level that infer the willingness to pay from customers' surplus are not yet well developed.

Research Method

In order to evaluate the IT investments in the proposed mobile financial information service, we explore two different customers' value assessments. First, we apply a performance metric called *realizable return,* which covers the impact of different reaction delays on potentially realizable returns. Second, we evaluate customers' benefits that can be gained from this service by simulating *realizable yields*. According to Davern and Kauffman (2000), both approaches address the *potential* value of the IT investment and, therefore, allow an *ex ante* consideration of the IT investment. As the addressed information service does currently not exist, the evaluation of the potential (or realizable) value of the IT investment can be valuable for the selection of different projects.

Whereas IT investments in transaction services are usually evaluated on the basis of increased transaction numbers, transaction costs, etc., the evaluation of new information services and their potential benefits resulting from better or timelier information supply is difficult to quantify. We are not addressing this question with traditional consumer demand curves because of the highlighted problems resulting from the assumptions that come with the demand curve. Furthermore, as we focus on a new technology or service, assuming or estimating the shape of the demand curve bears the problems pointed out.

Therefore, we aim to bridge this gap by an alternative evaluation approach and have set up a simulation of potential investor transactions covering the impact of the information service supporting the private investor. The mobile financial information service is anticipated to improve the following aspects of the investment decisions of investors: (1) identifying market events which can have a significant impact on the customer's portfolio value or open up a window of opportunity and (2) prompt information supply resulting in timelier investment decisions. The customer benefit is estimated by the maximum trading profits (*realizable yields)* which can be realized at different delay levels. On the assumption that the mobile information system decreases reaction delays, private investors should be able to gain higher trading profits if supported by appropriate mobile notification services.

Therefore, we evaluate *realizable returns* and *realizable yields* which can be achieved at different trading delays following the announcement date.

Realizable Returns

To be able to compare potential profits which can be realized after the company announcement, we calculate realizable returns $\left|r_{di}\right|$ which are given by

$$\left|r_{di}\right| = \left| \frac{p_{it_c} - p_{it_d}}{p_{it_c}} \right|$$

(1)

with d = {0, 15, 30, 45, 60, 90 120}

where $\left|r_{di}\right|$ = realizable return of stock i at delay d

p_{it_c} = the closing price of stock i

p_{it_d} = the first available price d minutes after the announcement date

We calculate the absolute value as we want to evaluate the maximum realizable profit. Consequently, we assume that company announcements that cause falling stock prices will prompt investors to sell the affected portfolio position. In contrast to this, increasing stock prices can be exploited by the investors by buying the affected asset. This approach can be interpreted as measuring the width of the opened window of opportunity.

In order to corroborate our hypothesis that timelier information supply (resulting form the proposed mobile notification service) opens a window for private investors, we have to compare the realizable returns $\left|r_{di}\right|$ at different delay levels. For each delay level, the realizable returns can be interpreted as a population of returns. As we cannot assume that these samples are independent, we apply a paired-samples hypothesis test working with a paired difference $pd_{t,d1,d2}$ between the values of each sample (Groebner et al. 1999).

$$pd_{t,d1,d2} = \left|r_{id1}\right| - \left|r_{id2}\right|$$

(2)

with $(d1, d2)$ = {0, 15}, {15, 30}, {30, 45}, {45, 60}, {60, 90}, {90, 120}

To show that a decrease of d will increase realizable returns significantly, sequential tests are performed. The corresponding null and alternative hypotheses are

$$H_0 : E\left(pd_{d1,d2}\right) \leq 0$$

$$H_1 : E\left(pd_{d1,d2}\right) > 0$$

with $(d1, d2)$ = {0, 15}, {15, 30}, {30, 45}, {45, 60}, {60, 90}, {90, 120}

If the null hypothesis for two sequential delay levels can be rejected, we can prove that a decrease of the reaction delay allows higher realizable returns at a given significance level (e.g., realizable returns after 15 minutes are significantly higher than after 30 minutes following the announcement). For the statistical tests of the hypotheses, a *t*-test for paired differences is used (Groebner et al. 1999).

Realizable Yield Simulation

In order to assess customers' value of the mobile notification service, we propose the simulation of potential yields which can be realized by the investors. Therefore, returns and trading costs have to be determined, given by equations (3) and (4).

$$r_{di} = - x_i \cdot \underbrace{\frac{p_{it_c} - p_{it_d}}{p_{it_c}}}_{return\ of\ sold\ stocks} + x_i \cdot \underbrace{\frac{p_{it_c} - p_{it_d}}{p_{it_c}}}_{return\ of\ bought\ stocks}$$

(3)

with d = {0, 15, 30, 45, 60, 90, 120}

$$c_i = \begin{cases} c_{Min} & x_i < x_{Min} & \text{lower bound trading costs} \\ c_{Fi} + c_v \cdot x_i & x_{Min} < x_i < x_{Max} \\ c_{Max} & x_i > x_{Max} & \text{upper bound trading costs} \end{cases}$$

(4)

$$y_d = \sum_{i=1}^{I} r_{di} - c_i$$

(5)

where y_d =   realizable yield at delay d

x_i =   trading volume of stock i (in €)

p_{it_c} =   closing price of stock i at the announcement date

p_{it_d} =   first available price of stock i, d minutes after the announcement date

c_{Fi} =   fixed costs for trading of stock i

c_i =   variable costs for trading one unit of stock i

Given equation 5, we can evaluate the potential trading profits which can be realized after the publication of the company announcement. It is assumed that if the announcement causes a fall of the stock prices, the held amount x_i could be sold, and if it causes increasing prices x_i stocks could be bought. With the variation of the processing delay d we are able to evaluate the impact of the timelier information supply realized by the mobile notification service. If the reduction of d involves an increasing realizable return r_{di} we can evaluate customers' value by comparing these realizable returns with regard to the customer's trading behavior.

Our evaluation approach implicates some assumption regarding the investor and the capital market. First, it is assumed that the investor maximizes returns and minimizes costs. Second, we assume market clearance if the investor sells or buys any stocks, which also implies that orders will not be executed partly.

Dataset

As this study simulates the impact of the investor's reaction time on the maximum returns which can be realized after the occurrence of critical market events, appropriate market events have to be chosen. Therefore, we chose company announcements pursuant to Section 15 of the German Securities Trading Law (WpHG) (so-called *ad hoc* disclosures) as the focus event. We use a dataset of 265 *ad hoc* disclosures, which were published during stock exchange trading hours between August 1, 2003, and January 31, 2005. There is widespread evidence that this kind of event causes significant abnormal stock price reactions on an intraday basis (Barclay and Litzenberger 1988 Patell and Wolfson 1984; Woodruff and Senchak 1988). As these event study-based analyses apply adjusted returns (e.g., by general market trends), these approaches cannot be used to evaluate any returns that can be realized by investors (Carter and Soo 1999).

For each announcement, we have identified the publication date down to the exact second and the stock symbol i of the corresponding company. Given this stock symbol, we requested the intraday stock prices $p_{i,t}$ during the announcement day for each symbol to be able to analyze the following price movements. These stock price series were taken from the Frankfurt Stock Exchange (XETRA) which covers around 90 percent of the entire securities trading in Germany (Deutsche Börse Group 2003). We use these price series as a data basis for the empirical evaluation of the proposed valuation approaches and assume that the customers using the mobile information service will not impact the stock price development itself, since only 20 percent of all orders at XETRA are placed by private investors (Deutsche Börse Group 2003). As the trading volume per order of private investors should be (depending on the segment and category) below average (Glaser and Weber 2004) and as only a subset of all private investors will use a new service, we assume that this interdependency is negligible.

Empirical Results

Realizable Returns

We calculated realizable returns $|r_{di}|$ for each stock/announcement and delay level $d = \{0, 15, 30, 45, 60, 90, 120\}$. The returns of a delay level can be interpreted as return population $|R_d|$, whose center parameters are summarized in Table 1.

The means of the realizable return populations indicate that the observed market events open a window of opportunity for private investors, as average return rates greater than 5 percent can be achieved if notified promptly.

Table 1. Center Parameters of the Realizable Return Populations						
	$|R_0|$	$|R_{15}|$	$|R_{30}|$	$|R_{45}|$	$|R_{60}|$	$|R_{90}|$	$|R_{120}|$
Mean	6.49%	5.12%	4.67%	4.22%	3.66%	2.85%	2.47%
Median	3.24%	2.20%	1.74%	1.65%	1.58%	1.12%	1.00%

Since for all populations the mean is larger than the median, all populations feature a right-skewed data distribution. Furthermore, as the population means decrease with increasing delay level, a first (weak) indicator has been found corroborating our hypothesis that a reduction of the reaction delay tends to result in higher realizable returns (for further details regarding the population distributions, see Appendix A). The differences between the population means provide evidence as to which returns (on average) can be realized if the reaction delay of the investor is reduced by the proposed information service.

Using the *t*-test statistics for the paired differences of the neighboring realizable returns regarding the delay levels ($d1$, $d2$) = {0, 15}, {15, 30}, {30, 45}, {45, 60}, {60, 90}, {90, 120}, we are able to complete our hypothesis that the average of the realizable returns is higher the shorter the delay level.

Given the results of the test statistics in Table 2, we are able to reject the null hypotheses for all sequential delay levels at significance levels of 1 percent. Within the first 120 minutes following the announcement, each reduction of reaction time increases the rate of return that can be realized on average. This result provides strong evidence that the investment in the mobile notification service and the involved reduction of reaction time can provide significant benefits for the customers.

Realizable Yield Simulation

For a simulation of realizable yields, we control the two central parameters x_i (trading volume of stock i in €) and d (reaction delay). For all simulation price parameters, we use the empirical intraday stock price series. The trading cost parameters c_{Fi}, c_i, c_{Min}, and c_{Max} were taken from Comdirect Bank, one of the largest online brokers in Germany (Comdirect Bank 2005). Other online brokers and banks operate with comparable cost functions and charge similar trading fees. In order to evaluate the impact of the reaction delay and investment volume on the realizable yields, we simulate corresponding transactions using quotations (3) to (5) with the parameters x_i = {50, 100, 150, 200, 250, …, 1000} and d = {0, 15, 30, 45, 60, 90, 120}. As our dataset covers a timeframe of 1.5 years (August 1, 2003, until January 31, 2005), we normalize y_d so it can be interpreted as a realizable yield per year. The results of the performed trading simulation are given in Table 3 (for a graphical illustration of the simulation results, see Appendix B).

The simulation results provide evidence that (1) an increase of the reaction delay d causes a reduction of realizable yields and (2) depending on the achieved reaction time a trading volume limit exists under which the transaction costs will exceed any yields that could be realized by the investor. The customers' value of the proposed mobile information service cannot be valuated generally, as it depends on the trading behavior of the customers and the realized reduction of the reaction delay. Therefore, the simulation approach provides valuable information regarding the interdependence of trading volume, reaction delay, and realizable yields. If, for example, the online broker analyzes its customers' trading volume behavior and considers different implementation alternatives (e.g., a highly integrated mobile information service providing a higher reduction of the reaction delay compared to simpler implementation), the customers' value can be evaluated for different IT investment strategies and customer segments.

Table 2. Test Statistics for Paired Difference of Realizable Returns					
	$pd_{0,15}$	$pd_{15,30}$	$Pd_{30,45}$	$pd_{45,60}$	$pd_{60,90}$	$pd_{90,120}$
Mean	1.37%	0.45%	0.46%	0.56%	0.81%	0.39%
T-Value	4,91*	2,86*	2,72*	3,15*	2,51*	2,50*

*indicates significance on the 1% level

d [min]	0	15	30	45	60	90	120
x_i [€]							
50	-1177.87	-1297.17	-1336.25	-1376.90	-1425.99	-1497.46	-1532.94
100	-606.73	-845.35	-923.49	-1004.79	-1102.98	-1245.91	-1316.88
150	-35.60	-393.52	-510.74	-632.69	-779.96	-994.37	-1100.83
200	535.53	58.30	-97.98	-260.59	-456.95	-742.83	-884.77
250	1106.66	510.13	314.77	111.51	-133.94	-491.29	-668.71
300	1677.80	961.95	727.52	483.62	189.07	-239.74	-452.65
350	2248.93	1413.78	1140.28	855.72	512.09	11.80	-236.60
400	2820.06	1865.60	1553.03	1227.82	835.10	263.34	-20.54
450	3391.19	2317.43	1965.79	1599.92	1158.11	514.89	195.52
500	3962.33	2769.25	2378.54	1972.03	1481.12	766.43	411.58
550	4533.46	3221.08	2791.29	2344.13	1804.14	1017.97	627.63
600	5104.59	3672.90	3204.05	2716.23	2127.15	1269.51	843.69
650	5675.72	4124.73	3616.80	3088.33	2450.16	1521.06	1059.75
700	6246.86	4576.55	4029.56	3460.44	2773.17	1772.60	1275.81
750	6817.99	5028.38	4442.31	3832.54	3096.19	2024.14	1491.86
800	7389.12	5480.20	4855.06	4204.64	3419.20	2275.69	1707.92
850	7960.25	5932.03	5267.82	4576.74	3742.21	2527.23	1923.98
900	8531.39	6383.85	5680.57	4948.85	4065.22	2778.77	2140.04
950	9102.52	6835.68	6093.32	5320.95	4388.24	3030.31	2356.09
1000	9673.65	7287.50	6506.08	5693.05	4711.25	3281.86	2572.15

Table 3. Simulated Realizable Yields in € for *d* = {0, 15, 30, 45, 90, 120} and *x_i* = {50, 100, …, 1000} per Year

Summary and Conclusion

In this paper, we have evaluated customers' value of mobile financial information services notifying private investors about critical market events in time. After introducing common IT valuation approaches, we have addressed typical problems that result from inherent assumptions. We find that the question of whether investments in emerging products and services create value for customers on an individual-level basis is far from settled and metrics and methodologies addressing this valuation econometrically are not well developed yet. Therefore, we have developed two frameworks to assess customers' value and to empirically evaluate these benefits. As we focus on an information service not yet available, both frameworks address the potential value of the IT investment to provide an *ex ante* evaluation of planned implementations.

Our findings indicate that private investors being informed more timely are enabled to realize significantly higher market returns. On average, a reaction delay of 15 minutes involves more than 5 percent of realizable returns compared to less than 2.5 percent for a reaction delay of 120 minutes following the market event. Furthermore, the simulation based on real market events (company announcements) and intraday price movements taken from the Frankfurt Stock Exchange uncovers the interdependence between customers' trading behavior, reduced reaction delays, and yields which can be realized by customers. We can show that there is a minimum trading volume below which trading cannot be profitable and how investments in more integrated mobile services resulting in shorter reaction delays can be valuated.

Compared to other studies, we focus on the product level in order to achieve a better isolation of the specific benefits gained. Furthermore, we performed primary data collection to overcome the lack of data and to control data integrity. The chosen simulation approach overcomes the necessity for several assumptions (e.g., the customer's demand curve). The proposed approaches can provide evidence as to how to evaluate the often neglected customers' value of planned investments in emergent products and services. Our approach can be generalized for other IT investment evaluations where a reduction of information processing delay could provide benefits for customers or organizations. This includes, for example, IT investments in the fields of supply chain management, information logistics, or risk management, all of which are highly relevant domains and where related studies could uncover potential benefits that could be realized by investments in appropriate IT products and services.

In further research, we will extend our simulation model regarding additional factors (e.g., different trading strategies) which can have an impact on the evaluation process. Once appropriate information systems are available, a comparison of the *ex ante* and *ex post* investment evaluation will allow an assessment of the divergence between potential and realized value of the IT investment.
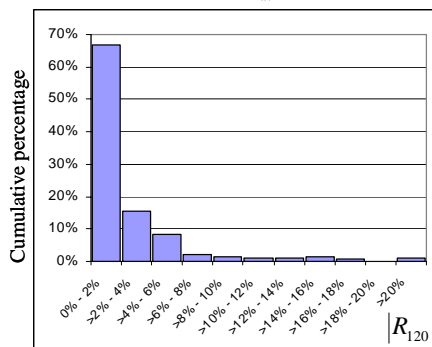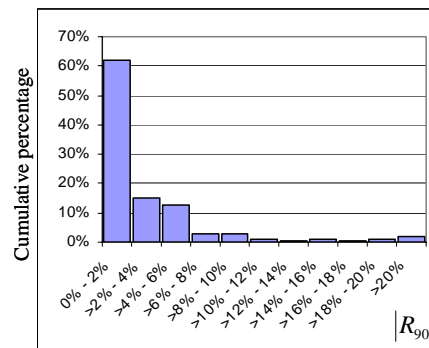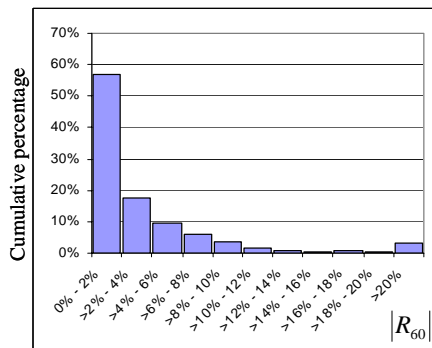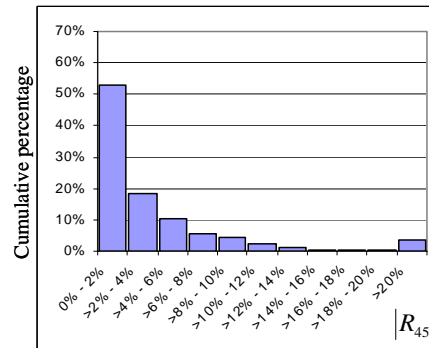
Acknowledgments

References

Barclay, M. J., and Litzenberger, M. "Announcement Effects of New Equity Issues and the Use of Intraday Price Data," *Journal of Financial Economics* (22), 1988, pp. 71-99.

Barua, A., and Kriebel, C. T. "Information Technologies and Business Value: An Analytic and Empirical Investigation," *Information Systems Research* (6), 1995, pp. 3-23.

Belcher, L. W., and Watson, H. J. "Assessing the Value of Conoco's EIS," *MIS Quarterly* (17:3), 1993, pp. 239-253.

Bresnahan, T. F. "Measuring the Spillovers from Technical Advance: Mainframe Computers in Financial Services," *The American Economic Review* (76:4), 1986, pp. 742-755.

Brynjolfsson, E. "The Contribution of Information Technology to Consumer Welfare," *Information Systems Research* (7:3), 1996, pp. 281-300.

Brynjolfsson, E. "The Productivity Paradox of Information Technology," *Communications of the ACM* (36:12), 1993, pp. 66-77.

Brynjolfsson, E., and Hitt, L. M. "Beyond Computation: Information Technology, Organizational Transformation and Business Performance," *Journal of Economic Perspectives* (14:4), 2000, pp. 23-48.

Brynjolfsson, E., and Hitt, L. M. "The Customer Counts," *Information Week*, September 1996, pp. 48-54.

Brynjolfsson, E., and Hitt, L. M. "Is Information Systems Spending Productive? New Evidence and New Results," in *Proceedings of the Fourteenth International Conference on Information Systems,* J. I. DeGross, R. P. Bostrom, and D. Robey, (Eds.), Orlando, FL, 1993, pp. 47-64.

Brynjolfsson, E., Hu, Y., and Smith, M. D. "Consumer Surplus in the Digital Economy: Estimating the Value of Increased Product Variety at Online Booksellers," *Management Science* (49:11), 2003, pp. 1580-1596.

Carter, M., and Soo, B. "The Relevance of Form 8-K Reports," *Journal of Accounting Journal of Accounting Research* (37:1), 1999, pp. 119-132.

Chan, Y. E. "IT Value: The Great Divide Between Qualitative and Quantitative and Individual and Organizational Measures," *Journal of Management Information Systems* (16:4), 2000, pp. 225-261.

Comdirect Bank "Preis- und Leistungsverzeichnis," Quickborn, August 24, 2005 (available online at **http://www.comdirect.de/static/pdf/corp0099.pdf**)

Davamanirajan, P., Mukhopadhyay, T., and Kriebel, C. H. "Assessing the Business Value of Information Technology in Global Wholesale Banking: The Case of Trade Services," *Journal of Organizational Computing and Electronic Commerce* (12:1), 2002, pp. 5-16.

Davern, M. J., and Kauffman, R. J. "Discovering Potential and Realizing Value from Information Technology Investments," *Journal of Management Information Systems* (16:4), 2000, pp. 121-143.

Desmarais, M. C., Leclair, R., Fiset, J., and Talbi,. H. "Cost-Justifying Electronic Performance Support Systems," *Communications of the ACM* (40:7), 1997, pp. 39-48.

Deutsche Börse Group "XETRA - The Electronic Trading Platform," Frankfurt, 2003 (available online at **www.xetra.com**).

Dos Santos, B. L., Peffers, K., and Mauer, D. C. "The Impact of Information Technology Invest Announcements on the Market Value of the Firm," *Information Systems Research* (4:1), 1993, pp. 1-23.

Franke, R. H. "Technological Revolution and Productivity Decline: Computer Introduction in the Financial Industry," *Technological Forecasting and Social Change* (31), 1987, pp. 143-154.

Glaser, M., and Weber, M. "Overconfidence and Trading Volume," CEPR Discussion Paper (DP 3941), Centre for Economic Policy Research, University of Mannheim, 2004.

Goolsbee, A., and Petrin, A. "The Consumer Gains from Direct Broadcast Satellites and the Competition with Cable TV," *Econometrica* (72:2), 2004, pp. 351-381.

Groebner, D., Shannon, P., Fry, P., and Smith, K. *Business Statistics: A Decision-Making Approach*, Prentice Hall, Upper Saddle River, NJ, 1999.

Hitt, L. M., and Brynjolfsson, E. "Productivity, Business Profitability, and Consumer Surplus: Three Different Measures of Information Technology Value," *MIS Quarterly* (20:2), 1996, pp. 121-142.

Kohli, R., and Devaraj, S. "Measuring Information Technology Payoff: A Meta-Analysis of Structural Variables in Firm-Level Empirical Research," *Information Systems Research* (14:2), 2003, pp. 127-145.

Kraemer, K. L., and Danziger, J. N. "The Usefulness of Computer-Based Information to Public Managers," *MIS Quarterly* (17:2), 1993, pp. 129-148.

Lee, S. C. "Modeling the Business Value of Information Technology," *Information & Management* (39:3), 2001, pp. 191-210.

Lichtenberg, "The Output Contributions of Computer Equipment and Personnel: A Firm Level Analysis," *Economics of Innovation and New Technology* (4:3), 1995, pp. 201-217.

Looney,. C. A., and Chatterjee, D. "Web-Enabled Transformation of the Brokerage Industry," *Communications of the ACM* (45:8), 2002, pp. 75-81.

Looney, C. A., Jessup, L. M., and Valacich, J. S. "Emerging Business Models for Mobile Brokerage Services," *Communications of the ACM* (47:6), 2004, pp. 71-77.

Loveman, G. W. *An Assessment of the Productivity Impact on Information Technologies*, Oxford University Press, Cambridge, UK, 1988.

Morrison, C. J., and Berndt, E. R. "Assessing the Productivity of Information Technology Equipment in U.S. Manufacturing Industries," NBER Working Paper No. W3582, National Bureau of Economic Research, Cambridge, MA, 1991.

Muntermann, J. "Notifying Investors in Time: A Mobile Information System Approach," in *Proceedings of the 10th Americas Conference on Information Systems*, E. Stohr and C. Bullen (Eds.), New York, 2004 pp. 2825-2833.

Muntermann, J., and Güttler, A. "Mobile Financial Information Services: Capabilities of Suitable Push Services," in *Proceedings of the 9th Pacific-Asia Conference on Information Systems*, C-P. Wei (Ed.), Shanghai, 2004, pp. 648-658.

Nevo, A. "New Products, Quality Changes and Welfare Measures Computed From Estimated Demand Systems," *Review of Economics & Statistics* (85:2), 2003, pp. 266-275.

Patell, J., and Wolfson, M. "The Intraday Speed of Adjustment of Stock Prices to Earnings and Dividend Announcements," *Journal of Financial Economics* (13), 1984, pp. 223-252.

Pinsonneault, A., and Rivard, S. "Information Technology and the Nature of Managerial Work: From the Productivity Paradox to the Icarus Paradox?," *MIS Quarterly* (22:3), 1998, pp. 287-311.

Salerno, L. M. "What Happened to the Computer Revolution?" *Harvard Business Review* (63:6), 1985, pp. 129-138.

Sircar, S., Turnbow, J. L., and Bordoloi, B. "A Framework for Assessing the Relationship Between Information Technology Investments and Firm Performance," *Journal of Management Information Systems* (16:4), 2000, pp. 69-97.

Subramanyam, R., and Krishnan,. M. S. "Business Value of IT-Enabled Call Centers: An Empirical Analysis," in *Proceedings of the 22nd International Conference on Information Systems*, V. Storey, S. Sarkar, and J. I. DeGross (Eds.), New Orleans, Louisiana, pp. 55-64.

Woodruff, C., and Senchak, A. "Intradaily Price-Volume Adjustments of NYSE Stocks to Unexpected Earnings," *The Journal of Finance* (43:2), 1988, pp. 467-491.

Appendix A: Realizable Return Populations
with *d* = {0, 15, 30, 45, 60, 90, 120}

Realizable returns |r_{di}| for *d*=0

Realizable returns |r_{di}| for *d*=15

Realizable returns |r_{di}| for *d*=30

Realizable returns |r_{di}| for *d*=45

Realizable returns |r_{di}| for *d*=60

Realizable returns |r_{di}| for *d*=90

Realizable returns |r_{di}| for *d*=120
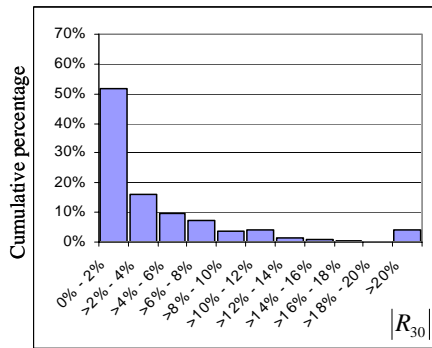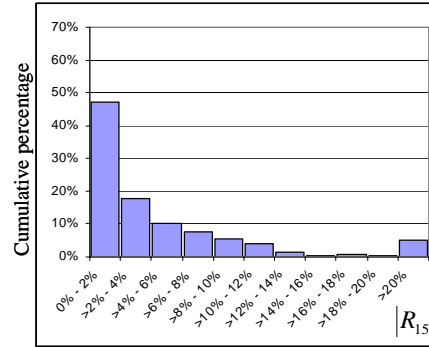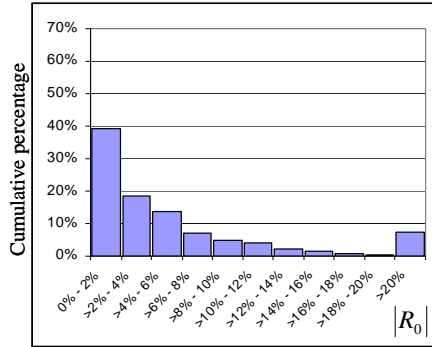
Appendix B: Realizable Yields for *d* = {0, 15, …, 120}
and *x_i* = {50, 100, …, 1000}