

DO TRANSACTION COSTS OF PAYMENT SYSTEMS DIFFER ACROSS CUSTOMERS IN E-COMMERCE?

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Abstract

Cost-efficient processing and low working capital requirements are highly important for online retailers' competitiveness and profitability. Therein, a sound understanding of transaction costs of respective payment instruments is extremely relevant when deciding which payment method to offer in e-commerce. Using a unique dataset with more than 14 million actual sales transactions from a leading European online retailer, this paper investigates the effect of customers' characteristics on retailers' transaction costs. In order to evaluate the payment choice of online retailers, the authors empirically derive cost schedules of the payment instruments invoice, credit card, PayPal and prepayment as a function of the transaction size. The results reveal extensive differences in the transaction costs and the collection time of accounts receivables across payment methods and customers. From a managerial perspective, this study illustrates how retailers can develop an efficient payment provision strategy on a customized basis with regard to low transaction costs and capital requirements.

Keywords: Payment systems, E-commerce, Transaction costs, Customer segmentation

1 Introduction

Online shopping demands for substantial information systems to allow the exchange of goods and services between buyers and sellers over the internet (Yadav and Varadarajan, 2005). Therein, a better understanding of how to efficiently serve customers enables firms to improve overall performance due to cost reductions in their retailing operations (Reimann et al., 2010). Especially the optimal payment provision towards customers is an important strategic question for both retailers' marketing- and financial objectives (Ingene and Levy, 1982) since the most desirable transaction instrument from a customer's viewpoint often does not coincide with the most cost-efficient one from a merchant's perspective (Hirschman, 1979). Subsequently, it is not surprising that researchers widely theoretically and empirically study the choice of payment instruments in business-to-consumer retailing over the last decade (Kahn and Roberds, 2009). For instance, Ching and Hayashi (2010) emphasize that the payment choice is a general function of the transaction characteristics, a customer's attitudes as well as the attributes of each payment method. Whitesell (1992) finds that the choice of payment only depends on the number and the respective value of the transaction. Stavins (2001) and Hirschman (1979) identify multiple consumers' characteristics such as age, gender, education, income, life cycle stage or personal life style to affect the choice of payment. In addition, the price of payment methods to customers and retailers influenced by merchants' reward programs (e.g. Simon et al., 2010), surcharging (e.g. Bolt et al., 2010) or discounts (e.g. Grant, 1985) as well as the attributes of the transaction instruments such as security, reliability, convenience, record keeping and speed of the transaction (e.g. Amromin

et al., 2007; Borzekowski et al., 2008; Schuh and Stavins, 2010) are important determinants in the payment decision.

Rysman (2007) finds that customers' usage and merchants' acceptance of payment instruments are positively correlated with each other. However, as yet research on the merchants' adoption and provision of payment instruments towards their retail customers as well as its respective influence on customers' payment choice remains scarce due to the absence of data (Borzekowski and Kiser, 2008; Ching and Hayashi, 2010). Especially evidence regarding payment costs to merchants associated with each transaction instrument is limited to surveys (e.g. Brits and Winder, 2005; Garcia-Swartz et al., 2006a, 2006b; Hayashi and Keeton, 2012) or aggregated statistics (e.g. ten Raa and Shestalova, 2004) as researchers do not have access to transaction-level data (Hancock and Humphrey, 1998; Klee, 2008). In addition, many transaction costs such as opportunity costs of time or costs of transportation are non-monetary and difficult to quantify with the consequence that retailers often do not consider these costs in operative- and strategic decision making (Chintagunta et al., 2012). So far, the question of which payment instruments turns out to be the most cost efficient one to retailers in providing payment service towards customers is of great interest for scholars and practitioners (Humphrey, 2010; Humphrey et al., 2003).

As a consequence, the present study examines the influence of customers' payment characteristics on retailers' transaction costs and working capital requirements in online retailing. We contribute to existing literature in four ways: First, we follow ten Raa and Shestalova (2004) who ask to investigate payment costs to retailers especially with regard to electronic payment instruments since these have not been studied yet due to missing data. We study transactions made by invoice, credit card, PayPal and prepayment in an online shopping situation using more than 14 million online sales observations provided by a leading European e-commerce retailer. Building our study up on large real-world transaction-level data with information about actual customers' behaviour and consumption, we directly contribute to Grewal and Levy (2007) and Scholnick et al. (2008) who call for further research in a technology-based environment on basis of individual sales records. Second, our study investigates the moderating influence of customers' demographics age and gender on the transaction costs to retailers since existing literature do not provide empirical evidence if demographics affect the impact of transaction size on customers' payment preferences (Abdul-Muhmin, 2010). Third, we test whether serving existing, long-life customers produce lower transaction costs to merchants compared to new customers. Answering this question is of great interest as recently the positive relationship between customers' lifetime and -profitability has drawn substantial criticism (Reinartz and Kumar, 2000, 2002). Moreover, detailed knowledge on the costs of serving new and existing customers is important to retailers in order to successfully develop effective consumer differentiating marketing strategies (Reinartz and Kumar, 2000). Finally, Srivastava et al. (1998) emphasize the need to investigate how marketing activities can lower firms working capital requirements and increase shareholders' wealth since as yet this relationship is not fully understood. We follow Rao and Bharadwaj (2008) by evaluating how variance in terms of payment timing due to both the characteristics of the payment instrument (for example prepayment versus post pay) or the speed of customers to settle the open bill affect the net present value of every single order position. On the basis of our results, we develop managerial guidelines for e-commerce retailers to provide a cost-effective payment provision strategy towards distinctive customers.

2 Conceptual framework and hypotheses development

In the following we present a brief literature review to provide a basis for the hypotheses we are going to test in our empirical study.

Using an inventory-theoretic approach for transaction purposes, the "transactions demand for cash" model developed by Baumol (1952) and Tobin (1956) builds the analytical basis to explain and understand the choice of payment. Therein, individuals have to decide on the optimal level of cash holding for transaction purposes given the costs implied to withdrawal money from the bank account and fore-

gone interests on the deposits (Baumol, 1952). In this context, the theory of transaction costs assumes that rational firms or individuals seek to minimize transaction costs involved with regard to their personal given priorities (Coase, 1937; Williamson, 1988). Following this cost-based approach in order to explain the adoption and the usage of payment instruments, researchers extend the “transactions demand for cash” model by Baumol (1952) and Tobin (1956) incorporating additional payment instruments such as cheques, credit- and debit cards (e.g. Santomero and Seater, 1996; Santomero, 1979; Whitesell, 1989, 1992) or including new interacting agents like banks and payment service providers (e.g. Shy and Tarkka, 2002).

Each payment instrument is a highly complex product with a large variety of attributes (Scholnick et al., 2008). For example, transaction instruments vary in the moment of time the customer is debited and can be classified into (a) “pre-paid”, (b) “pay-now”, and (c) “pay-later” payment methods (Stroborn et al., 2004). Payment instruments also differ in terms of convenience, risks and costs (Zhang and Li, 2006). In particular, merchants’- and customers’ transaction costs vary widely across different payment methods (Humphrey et al., 2003). Retailers incur different types of costs when offering payment service: (a) Annual fees, (b) fixed fees per transaction induced by the usage of the payment instruments, and (c) variable transactions fees depending on the value of the transaction (Bounie and Gazé, 2009). These costs extensively depend on the financial- and transaction risks individuals arise due to, for example uncertainty in the purchase process such as the probability of monetary loss of the product or payment default of one of the interacting parties (Biswas and Biswas, 2004; Grewal et al., 1994). In addition, delays in the receipts of customers’ payments represent a significant cause of additional working capital (Mian and Smith Jr., 1992). A faster collection of outstanding accounts receivables, in turn, leads to a decrease in the variability of a firm’s cash inflows over time, reduces the firm’s costs of capital and hence creates shareholders’ value (Gruca and Rego, 2005). Nevertheless, the customers’ demand and the actual consumption of a product are crucially influenced by the timing of payment as financial resources are assumed to be rare (Gourville and Soman, 1998). Moreover, a firm’s payment offer- and accounts receivables strategy have to be made cautiously as it has great marketing- and promotional implications on the customers’ purchasing behaviour (Peterson, 1969). Turning to the customer’s perspective, Klee (2008) shows that customers associated with the use of payment instruments incur (a) transaction costs such as costs of time to execute the payment, inventory costs of cash holding, authorization- as well as verification costs, and (b) opportunity costs due to differences in the rate of return across payment instruments. These identified costs which rational consumers seek to minimize crucially depend on individual’s current financial standing and the demographic background (White, 1975). In this context, Shy and Tarkka (2002) emphasize that each payment method dominates a particular transaction size with regard to its specific costs arising to the interacting parties. Subsequently, there is not only one payment instrument that serves all viable features required (Santomero and Seater, 1996). Moreover, merchants have to offer a portfolio of various payment instruments that must be suitable for different types of transactions with regard to the characteristics of the parties such as experience in online transactions, reputation ranking or age and education (Zhang and Li, 2006).

According to this stream of argumentation, we expect the payment provision to have a potentially large impact on a customer’s profitability for the retailer. Following, we propose a moderating influence of customers’ demographics and -characteristics on the relationship between the transaction size and retailers’ transaction costs in e-commerce.

2.1 Customers’ demographics

The two demographics age and gender are frequently used as segmentation variables in marketing literature, for example in the studies on payment choice (e.g. Fusaro, 2013; Schuh and Stavins, 2010), customers financing and spending behaviour (e.g. Soman, 2002; White, 1975) or technology usage (e.g. Morris and Venkatesh, 2000; Venkatesh and Morris, 2000) all implying significant variance across men and women and different segments of age. Considering this background, we expect that

both the customer's age as well as the gender to have a moderating impact on retailers' transaction costs in e-commerce.

Researchers show that older compared to younger customers significantly reach faster financial maturity as they focus more on promptly finding solutions to satisfy their financial needs (Li et al., 2005). Older aged customers prefer more personal interaction in shopping situations and do not like to use new technology as they associate the adoption and usage of innovative technologies with uncertainty and risks (Morris and Venkatesh, 2000). Furthermore, individuals of different ages significantly vary in their use of credit: Older customers on average are shown to have lower open balances than younger customers and the impact of the credit limit volume on spending behaviour is weaker compared to young consumers (Soman, 2002). Younger consumers on average more often buy their purchases on credit, borrow higher amounts from their credit cards, repay on lower rates than older aged customers and are more likely not to pay their open accounts in a timely manner (Jiang and Dunn, 2013; White, 1975). From a seller perspective, a larger amount of credit purchases as well as a greater volatility in cash inflows from sales transactions imply higher risks as well as greater costs of capital to the retailer (Berger et al., 1996; Mian and Smith Jr., 1992). Based on these two lines of reasoning, we hypothesize that:

Hypothesis 1: Older consumers will have (a) lower levels of risks and (b) a faster payment speed than younger customers leading to lower transaction costs to retailers.

Research in online retailing reveals behavioural and perceptual differences across women and men. Mittal and Kamakura (2001) show that, among others, gender is a moderating characteristic that influences customers' loyalty. Males and females employ different information-processing strategies while shopping (Meyers-Levy and Maheswaran, 1991; Meyers-Levy and Sternthal, 1991). Men's usage of technology support is strongly influenced by their desire for usefulness whereas women follow more their perceptions of ease of use (Venkatesh and Morris, 2000). Men have more positive attitudes towards new technologies and are more likely to adopt innovative services (Broos, 2005). Women in contrast felt less comfortable and more anxious while using the internet and online business services (Schumacher and Morahan-Martin, 2001). Males pay more attention to quickly satisfy their financial requirements and reach financial maturity (Li et al., 2005). Garbarino and Strahilevitz (2004) find that females perceive higher transaction risks in e-commerce compared to men in terms of credit card misuse, fraudulent websites or loss of privacy data. Furthermore, females generally show higher involvement in shopping than men do (Davis, 1971; Wilkes, 1975). They aim to have an easy shopping task without being distracted by complex exchange processes such as the financial purchasing of the shopping items and handling of product returns (Weijters et al., 2007). In addition, women have a greater anxiety for financial loss and deprivation of money (Prince, 1993). Following, females have on average a lower motivation to prepay as in general both transaction risks and uncertainty, for example about the product quality, from a buyer's perspective decrease with a greater difference of time to the order date (Berger et al., 1996). Men in contrast are shown to feel more confident managing risky assets, handling money and take financial risks (Barber and Odean, 2001; Prince, 1993). Males are expected to be more likely paying on time their open invoices as they seek to minimize time effort investment in order to make their shopping trip more efficient (Weijters et al., 2007). According to the presented gender differences between men and women, we hypothesize that:

Hypothesis 2: Men will have (a) lower transaction risks and (b) a faster payment speed than women leading to lower transaction costs to retailers.

2.2 New versus existing customers

Thomas (2001) shows that the costs of customers' retention are significantly below the costs to acquire new customers. Sheth, Jagdish N. Parvatiyar (1995) argues that long-life customers produce higher revenues and a higher margin per customer than lost or new customers due to greater exchange efficiencies and lower operating costs to the retailer. Furthermore, long-term customers are less likely to defect in the following years (Reichheld and Teal, 1996). Compared to traditional retailing, this ef-

fect is even higher in e-commerce where information processing is less personal without face-to-face interaction (Borenstein and Saloner, 2001). Especially in e-commerce, new customers are assumed to be more likely to default as retailers do not have any experience with these respective customers (Sackmann et al., 2011). Contrary, transactions between existing customers and retailers carry less uncertainties and risks for both parties as historical successful interactions are supposed to be the best insurance against payment- and delivery default (Crosby et al., 1990; Sackmann et al., 2011). In addition, long-term customers are more familiar with a retailer's procedures while shopping (Reichheld and Teal, 1996). New customers in contrast have to adopt and learn the practices of the operating firm and often do not feel comfortable with the new services often resulting in higher costs of operations to the retailer due to, for example, customers' uncertainty about product fit and higher return rates (Anderson et al., 2009; Keaveney, 1995). Repeating buyers who have made at least one transaction before at the shop show learning effects on basis of the past purchase experience (Wu and Chen, 2000). As a consequence, retailers and customers agree on long-term relationships with the objective of minimize associated transaction risks and costs (Crosby et al., 1990). Based on these given lines of reasoning, we expect that:

Hypothesis 3: Existing customers will have (a) lower levels of risks and (b) a faster payment speed than new customers resulting in lower transaction costs to retailers.

2.3 Payment switching versus non-switching customers

Customers often switch between payment instruments in order to purchase their shopping items (Klee, 2006a). A customer's change of payment instrument depend, among other factors, on the price of making a payment (Guthrie and Wright, 2007; Rochet and Tirole, 2003), the credit availability (White, 1975), convenience (Schuh and Stavins, 2010) or consumption restraints (Borzekowski et al., 2008). Therein, customers perceive and use payment instruments as substitutes (e.g. debit- and credit card) or as complements (Borzekowski et al., 2008; Klee, 2006b). Researchers expect customers who adopt and use multiple payment instruments to accumulate knowledge about the benefits and costs associated with each payment method and learn how to use this experience to maximize their utility while purchasing (Hirschman, 1979). For both sellers and buyers, a payment switch change the risks of the two parties: Switching from pay-later transaction instruments to advance payments are a signal of a customer's creditworthiness and minimizes sellers' uncertainty of a successful transaction as the money is received prior shipping the products to the customers (Mateut and Zanchettin, 2013). Changing from prepay to post pay transaction methods, buyers reduce risks whereas retailers extend credit to the seller and take the risks of buyers payment default (Ng et al., 1999; Smith, 1987). The latter type of customers' payment switch is of greater likelihood as researchers generally assume customers seek to maximize their utility when choosing between payment instruments, for example minimizing interest charges for prepayments (White, 1975; Whitesell, 1989). For Instance, customers in case of product uncertainty more often prefer to use pay-later instruments in order to reduce risks and facilitate the return- and refunding process (Zhang and Li, 2006). Another reason for a payment change towards post-pay instruments can be that consumers need to access lines of credit to pay off the bill at the end of the month (Chakravorti and To, 2007). Both reasons of change from a familiar payment instrument towards uncertain alternatives imply higher transaction costs to the retailer as the probability of payment default as well as the collection time of accounts receivables from the respective customer increase. This argumentation leads us to propose the following hypothesis:

Hypothesis 4: Non-switching customers will have (a) lower levels of risks and (b) a faster payment speed than switching consumers leading to lower transaction costs to retailers.

3 Data

To test our hypotheses, we obtain a novel data set from a leading fashion retailer selling shoes and apparel products across Europe over the internet. The data set consists of more than 14 million sales ob-

servations between January and December 2013 collected in the German online shop including transactions made by the payment instruments invoice, credit card, PayPal and prepayment. For each order made by an individual customer the data gives the price to the merchant's on the use of the transaction instrument. Table 1 summarizes the retailer's payment cost compositions for purchases made by the transaction instruments under study.

Payment costs	Invoice	Credit card	PayPal	Prepayment
Bank fees	.07	.00	.00	.31
Interchange fees	.00	.96	.94	.00
Risk check	.17	.02	.03	.35
Dunning/Fraud	.59	.00	.00	.00
Others	.17	.02	.03	.34
Total	1.00	1.00	1.00	1.00

Table 1. Derivation of payment costs

In addition, the primary data set contains order-, transaction- as well as customer-specific information. The order- and transaction-related observations cover the order-, payment- and return-date, transaction size, number of payments per order position, type of credit card used as well as other additional online shopping-trip-specific information, for example, the number of sold as well as returned items. Furthermore, the data includes customer-related information such as the demographics age and gender, the number of orders made by the customer during a customer's lifetime, information on customers' payment default as well as details on the last payment method used.

With the received data on hand, we execute different procedures for identifying outlier effects in order to reduce data variance and assure estimation validity. For instance, we eliminate missing or implausible observations from the data set such as allowances greater than the transaction value of the respective order position. Following data purification, we are left with a total of 14,161,665 observations including 12,236,384 invoice, 935,767 credit card, 684,526 PayPal and 304,988 prepayment transactions.

According to the approach applied by ten Raa and Shestalova (2004), we perform our regression analyses on the basis of aggregated payment costs (PC) which is the sum of the cost components outlined in Table 1. The variable transaction size (TS) covers the basket size in Euros of the respective customer order. In addition, we generate a number of variables on the basis of the received raw data to assess their influence on retailers' transactions costs: The collection time of accounts receivables is the time interval expressed in days between customers' order and respective payment date of a single transaction. Next, we create the dummy transaction number which takes the value one in the event of a single customer payment action to settle the outstanding account (TN1) and zero otherwise (TN2). The latter is the case if a customer (i) makes no payment, for example in case of a full return or (ii) needs more than one payment action to settle the open invoice. In addition, we account for payment default and fraud introducing the dummy payment default (PD) that equals one if a customer defaults. Furthermore, we generate the factor variable credit card provider (CC0, CC1 and CC2) to test whether differences across the major card providers Amex, Visa and MasterCard exist.

Finally, we introduce four customer-related variables: First, the continuous variable "Age" covers the customers' age at the respective order date measured in years. Second, the gender dummy (Gender) is taking the value one if the respective customer is a male and zero in case of a female. Third, we generate the dummy customer type (CT) categorizing buyers in new and existing customers. Therein, CT equals one if the customer purchases the first time at the retailer's online store. Existing customers, in contrast, are defined to buy at least the second time or even more often at the retailer's online store. Lastly, in order to account for customers' past payment choice, we create the dummy past payment

(PP) which displays one if the customer uses the same payment method as employed in the last shopping trip to settle the bill and zero otherwise. The descriptive statistics of all relevant variables in our study are shown in Tables 2.

Variable	Mean	Median	Std. dev.	Min	Max
Payment Costs	.39	.10	3.49	.00	1,502.32
Transaction Size	55.65	39.95	68.11	.00	6,418.40
Collection Time	17.38	13.00	24.30	.00	480.96
Dummy TN1	.71	1.00	.45	.00	1.00
Dummy TN2	.29	.00	.45	.00	1.00
Dummy PD	.00	.00	.05	.00	1.00
Dummy CC0	.00	.00	.04	.00	1.00
Dummy CC1	.03	.00	.18	.00	1.00
Dummy CC2	.03	.00	.17	.00	1.00
Age	36.83	35.00	11.21	18.00	114.00
Dummy Gender	.18	.00	.38	.00	1.00
Dummy CT	.11	.00	.31	.00	1.00
Dummy PP	.91	1.00	.29	.00	1.00

Table 2. Descriptive statistics primary data set

4 Methodology

This study examines retailers' choice of payment provision towards their customers. In order to evaluate the payment offer of retailers in online retailing, we apply the "transactions demand for cash" framework developed by Baumol (1952) and Tobin (1956) in an e-commerce setting. Therein, we focus on the common used payment instruments in German e-commerce being invoice, credit card, PayPal or and prepayment (Stroborn et al., 2004). As we are interested on the specific costs implied by the usage of each distinctive payment instrument, we follow ten Raa and Shestalova (2004) and estimate separate cost functions for each payment type using ordinary least squares regression analysis (OLS). Our study takes on a comprehensive cost-approach in order to evaluate the effective payment offer from a retailer's perspective. Therefore, our cost analysis considers both payment costs (PC) to the retailer (refer to Table 1) as well as cost of capital (CoC) due to interest expenses on the outstanding accounts receivables of every single order position. This approach is well in-line with Whitesell's (1989) assumption implying that individuals seek to select the payment instrument with the objective of minimizing all associated transaction costs. Equation 1 depicts the total transaction costs (TC) a retailer encounters by offering payment method i at order date t :

$$TC_{i,t} = PC_{i,t} + CoC_{i,t}$$

Equation 1. Calculation of transaction costs

In order to quantify working capital requirements, we build on the well-established cost of capital concept by Modigliani and Miller (1958). According to Ingene and Levy (1982), we discount the transaction size of each customer order by the time needed to collect the money from the customers using an appropriate discount rate r for the internet retail business proposed by Damodaran (2014) on January 2014 amounting to 10 %. Calculating the cost of capital can be formally illustrated as follows:

$$CoC_{i,t} = TS_{i,t} \cdot \left((1+r)^{\left(\frac{\text{days}}{365}\right)} - 1 \right)$$

Equation 2. Cost of capital calculation

As we expect customers to differ in term of risks and payment speed, we execute regression analysis in two steps. First, we estimate retailers' payment costs to disentangle the effect of risk across customers on retailers' total transaction costs. Second, we continue with the estimation of the retailer's total transaction costs including arising cost of capital. Similar in both regressions, the dependent variables payment- and transaction costs are estimated using a set of explanatory variables: We integrate the fixed intercepts TN1 and TN2 in our model to account for the number of transactions needed in order to settle the open invoice. According to Whitesell (1989), we further incorporate the transaction size as the major explanatory variable in the econometric models. To test whether the effect of the transaction size on the costs is moderated by payment-type-specific or customer-related factors we add interaction terms of the variables customers' payment default (PD), type of credit card provider (CC1 and CC2), customers' demographics (Age and Gender) as well as customers' classifications (CT and PP) to our regression model. Finally, ε denotes the error term. The equation 3 represents our research model:

$$TC_{i,t} = \beta_1 \cdot TN1_{i,t} + \beta_2 \cdot TN2_{i,t} + \left(\beta_3 + \beta_4 \cdot PD_{i,t} + \beta_5 \cdot CC1_{i,t} + \beta_6 \cdot CC2_{i,t} + \beta_7 \cdot Age_{i,t} + \beta_8 \cdot Gender_{i,t} + \beta_9 \cdot CT_{i,t} + \beta_{10} \cdot PP_{i,t} \right) \cdot TS_{i,t} + \varepsilon_{i,t}$$

Equation 3. Estimation of retailers' transaction costs

To assure the validity of our estimates, we check our model against the presence of common model biases. As the pair-wise correlation coefficients are all well below the threshold criterion of 0.8 (Kennedy, 2008), we suggest that multicollinearity is not a problem. Applying the Breusch and Pagan (1979) Lagrangian-multiplier test, we cannot confirm the hypothesis of constant variance in each of our estimation models. Subsequently, we account for heteroskedasticity using Huber-White robust standard estimators (White, 1980).

5 Results

This study derives retailers' transaction cost functions of invoice, credit card, PayPal and prepayment in e-commerce. Therein, we estimate the effect of various basket sizes on retailers' transaction costs and concentrate on the question whether this relationship is moderated by customers' characteristics. The main results of the OLS regression analyses are summarized in the following. Table 3 depicts the output of the payment cost regression analyses.

Variable	Invoice	Credit card	PayPal	Prepayment
TN1	4.04 *** (0)	22.22 *** (0)	46.10 *** (0)	11.49 *** (0)
TN2	12.46 *** (0)	36.11 *** (0.01)	88.51 *** (0.01)	15.30 *** (0)
TS	.29 *** (0)	3.02 *** (0)	1.21 *** (0)	.00 *** (0)
TS : Age	-.01 *** (0)	.00 *** (0)	.00 *** (0)	.00 *** (0)
TS : Gender	-.01 (0)	-.01 *** (0)	.00 ** (0)	.00 *** (0)
TS : CT	.04 ** (0)	-.03 *** (0)	.00 . (0)	.00 *** (0)
TS : PP	-.01 (0)	-.01 *** (0)	.00 . (0)	.00 (0)
Observations	12,236,384	935,767	684,526	304,988
Adj. R2	.46	.93	.98	.83

Note: . = $p < 0.1$, ** = $p < 0.01$, *** = $p < 0.001$. Huber-White robust standard errors in parentheses. TS : PD, TS : CC1 and TS : CC2 excluded for brevity.

Table 3. Regression output payment costs

The estimates of the transaction cost regression analyses including cost of capital arising to retailers are represented in Table 4.

Variable	Invoice		Credit card		Pay Pal		Prepayment	
TN1	44.78 ***	(0)	46.45 ***	(0)	46.24 ***	(0)	21.44 ***	(0)
TN2	72.66 ***	(0)	89.43 ***	(0.02)	90.11 ***	(0.01)	34.09 ***	(0.01)
TS	1.37 ***	(0)	3.34 ***	(0)	1.21 ***	(0)	.11 ***	(0)
TS : Age	-.01 ***	(0)	.00 ***	(0)	.00 ***	(0)	.00	(0)
TS : Gender	-.15 ***	(0)	-.05 ***	(0)	.00 .	(0)	-.01 **	(0)
TS : CT	-.08 ***	(0)	-.08 ***	(0)	.00 .	(0)	-.04 ***	(0)
TS : PP	-.13 ***	(0)	-.03 ***	(0)	.00	(0)	.01 .	(0)
Observations	12,236,384		935,767		684,526		304,988	
Adj. R2	.47		.67		.96		.47	

Note: . = $p < 0.1$, ** = $p < 0.01$, *** = $p < 0.001$. Huber-White robust standard errors in parentheses. TS : PD, TS : CC1 and TS : CC2 excluded for brevity.

Table 4. Regression output transaction costs

Let us start with the customers' demographics: In the estimation models of invoice, credit card and PayPal transactions the regression shows a statistically significant effect of customers' age on the transaction costs. Especially the negative impact of the variable age in the invoice estimation model supports our hypothesis 1 implying that the retailer incurs lower transaction risks and receive the money faster when serving older aged customers. The coefficients in the models of credit card, PayPal and prepayment do not reveal considerable differences across younger and older customers. Opposed to the age, the customer's gender reveals a greater effect on the transaction costs. In-line with our hypothesis 2, the transaction costs in each of the estimation models appear to be higher for women compared to men. Females imply higher risks to the retailer and need more time to settle their shopping bills. The latter effect is especially high in invoice transactions in which customers receive and probably return the purchased articles prior paying (Stroborn et al., 2004).

In-line with hypotheses 3a, the regression results show new customers compared to existing customers to be more expensive to serve in invoice transactions due to higher involved transaction risks. This is the case because retailers incur higher risks for new customers as there is no shopping history available to evaluate customers' credit worthiness. Therefore, new customers have on average a higher probability of fraud and payment default which leads to higher payment costs in invoice transactions. Contrary to invoice transactions, in credit card payments new customers show a lower level of payment costs compared to new customers. The explanation is that new customers on average have significantly smaller basket sizes as well as higher return rates than existing customers. Thus, orders of new customers in generally cause lower interchange fees which, in turn, have an extensive cost impact as interchange fees represent the biggest portion of payment costs in credit card transactions (refer to Table 1). With regard to customers' payment behaviour, we suggest learning effects from past purchase experiences to be present for existing customers resulting to a faster payment settlement and lower respective costs of capital to the retailer. The empirical results, however, show a contrary picture: We find new opposed to existing customers to settle open accounts significantly faster. Existing customers wait longer until balancing their open bills as they are experienced in shopping at the online retailer as well as with the merchant's dunning- and punishing process. This, in turn, leads to higher costs of capital arising to the retailer for existing customers in our setting. Although this finding is against our hypotheses 3b, it is in-line with some research on capital budgeting decision making. Therein, existing customers are assumed to have bad dept behaviour and a worse willingness to pay in a timely manner (Sachdeva and Gitman, 1972). Considering both, payment costs and costs of capital, the effect of the costs of capital component outweighs the payment costs to the retailer and makes new

customers in total cheaper to serve in e-commerce. Comparing the four payment instruments under study, this effect is especially significant in invoice transactions where the time of customers' payment settlement matter most.

Finally, the estimates PP show that customers using the same payment instrument similar to the last shopping trip induce significantly lower transaction costs compared to consumers who switch between transaction methods. This finding is well in-line with respective theory and supports our hypothesis 4. We find that especially the time to collect money from payment non-switching customers is significantly shorter due to a familiar and hence faster customers' payment action especially relevant in invoice transactions. Contrary, customers who switch across payment instruments need to explore the payment process of the new instrument and are more likely to exploit the time period agreed to pay the retailer resulting in higher costs of capital in the respective order position.

5.1 Case study: Optimizing the payment offer towards customer groups

In order to provide a sound decision basis to find the optimal customized payment composition, we graphically illustrate the differences in the transaction cost schedules for each specific customer segment. Following ten Raa and Shestalova (2004), we derive linear transaction cost functions specified by (i) fixed costs represented by the respective intersection point with the y axis and (ii) variable costs depending on the value of the transaction reflected in the slope of each cost function. For illustration purposes, we calculate cost schedules for two contrasting customer groups: The first group A covers females, who are existing and payment switching customers. The group B includes men who shop the first time at the retailer and are going to be payment method non-switching buyers. Figure 1 represents the transaction cost schedules for customers of group A. It reveals that irrespective of the transaction value, prepayment is the most cost-efficient payment instrument for merchants to offer for these customers. The second preferable instrument is PayPal. Credit card has lower fixed but higher variable costs compared to invoice. Therefore, up to a transaction value of €6 credit card is cheaper compared to invoice whereas at basket sizes above this threshold invoice outperforms credit card and is more cost-efficient to offer besides prepayment and PayPal.

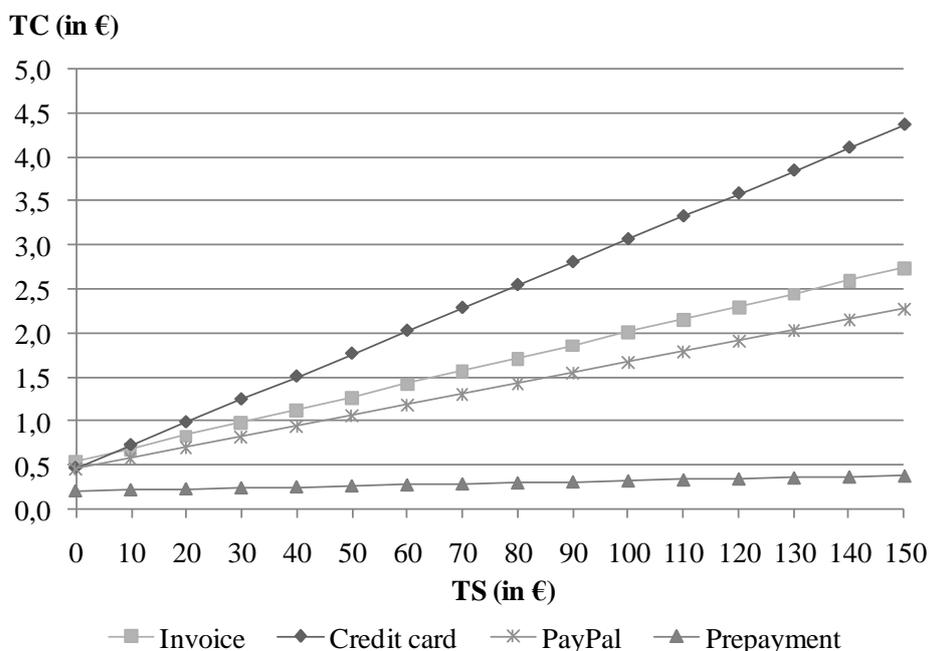


Figure 1. Transaction cost schedules of payment instruments for customers of group A

Let us now turn to the cost schedules for customers of group B outlined in Figure 2.

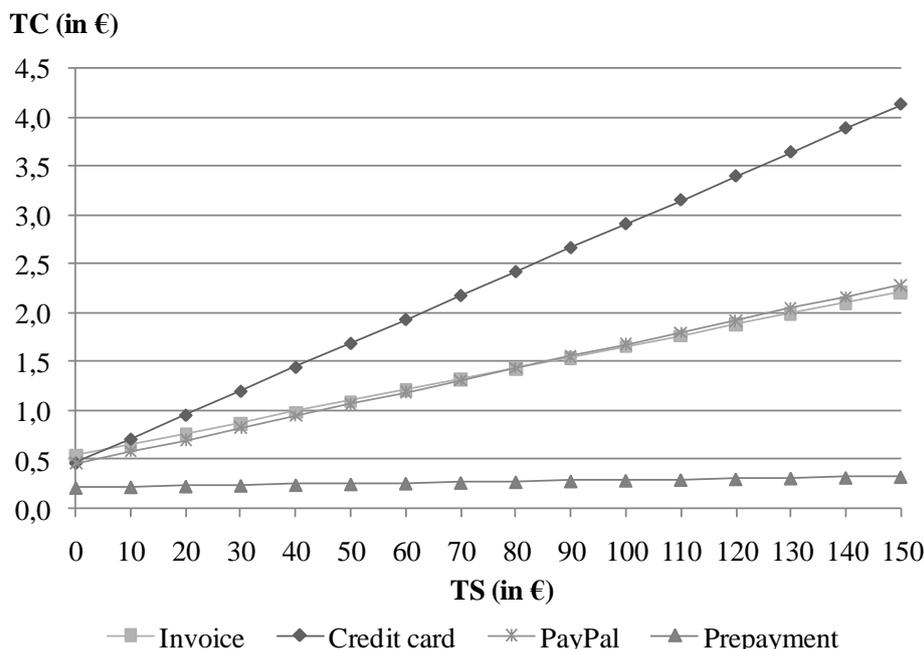


Figure 2. Transaction cost schedules of payment instruments for customers of group B

Comparing Figure 1 and Figure 2, significant changes in the intersection points as well as in the slopes of the cost functions entail new cut-off points across the payment methods. Prepayment still remains to be the most cost-efficient payment method also for this type of customers. PayPal is the second best payment method in terms of costs up to transaction sizes of €76, whereas invoice dominates credit card and PayPal transactions for large basket sizes above this threshold due to lower variable costs.

5.2 Sensitivity to changes in the discount rate

In order to illustrate the sensitivity of our results with regard to changes in the discount rate we repeat regression analysis in a similar setting varying the discount rate by $\pm 5\%$ starting from the base case with an underlying discount rate of 10%. Table 5 summarizes the variance in retailers' transaction costs and respective cost rankings of payment instruments at an exemplary transaction value of €100 for the given customer base in our setting.

r	Invoice	Credit card	PayPal	Prepayment
5%	62.91 (2)	90.07 (4)	99.85 (3)	68.91 (1)
10%	100.00 (2)	100.00 (4)	100.00 (3)	100.00 (1)
15%	135.71 (3)	109.56 (4)	100.28 (2)	158.16 (1)

Note: Base case (discount rate r of 10%) is set as the references level (=100). Relative position of payment methods in cost ranking shown in parentheses. Regression output of case studies omitted for brevity.

Table 5. Sensitivity of estimation results to changes in the discount rate

The results in Table 5 emphasize that the transaction costs are greatly influenced by the discount rate. For instance, at interest rates of 5% and 10% the optimal payment provision strategy in the illustrated example is prepayment, invoice, PayPal and credit card starting with the most-cost efficient instrument. Discounting with a rate of 15%, the most cost-efficient payment instrument is prepayment fol-

lowed by PayPal, invoice and credit card. This result, in turn, implies that retailers individually have to evaluate their provision of payment service using an appropriate interest rate for their business.

6 Discussion

Following we discuss theoretical as well as managerial implications of our research results.

6.1 Academic contributions

The provision of adequate payment technologies towards customers is an important success factor with direct implications on firms' profitability and its need of capital (Ingene and Levy, 1982; Torkezadeh and Dhillon, 2002). Especially in e-commerce customers reveal a high sensitivity to the availability of payment services as it influences many value propositions of the respective shopping trip such as convenience, time, privacy, safety and costs (Keeney, 1999). However, the desired payment instrument from customers often do not coincide with the most profitable one from a retailer's perspective (Hirschman, 1979). Our study bridges this gap as we provide insights regarding transaction costs arising to retailers when offering payment service in B2C e-commerce. We contribute to existing literature in three ways: First, we extend the approach by ten Raa and Shestalova (2004) by deriving transaction cost functions for the online payment methods invoice, credit card, PayPal and prepayment. Opposed to existing research, our model represents a more comprehensive approach in evaluating the efficient choice of payment instrument from a retailer's perspective as it considers both (i) payment costs, and (ii) costs of capital due to financing expenses of the products until the payment receipts from the customers. Therein, we believe to be among the first to quantify differences in the collection time of accounts receivables across customers and payment instruments in e-commerce. Insights regarding the costs of capital associated with each payment instrument directly contribute to the call of Srivastava et al. (1998) as it enhances retailers' understanding of how effective marketing activities, e.g. offering discounts to customers when using a certain payment method, should be structured in order to lower firms' working capital requirements and increase shareholders' wealth. Second, researchers ask for further studies on the choice of payment on basis of large transaction-based data (e.g. Kahn and Roberds, 2009; Scholnick et al., 2008). Fortunately, we have access to large single-source data with more than 14 million actual sales transactions allowing us to distinguish between customers with respect to the demographics, new versus existing customers as well as payment switching and non-switching behaviour. Although these characteristics have been used to explore the consumer's behaviour, we believe to be among the first to discover differences across customers regarding the transaction costs a retailer encounters when providing payment service in e-commerce. Third, regarding our empirical results, we find customers to extensively differ in terms of (a) risks and (b) speed of payment to settle shopping purchases. Both effects significantly influence retailers' transaction costs and the need of working capital, especially relevant when offering invoice transactions. We show that young women who have shopped at least once before at the retailer and often change the type of payment imply the highest transaction costs to the retailer. These findings extend prior research as we identify customers' characteristics such as gender, age, customers' tenure at the retailer as well as the past payment choice to significantly affect retailers' transaction costs in e-commerce.

6.2 Managerial implications

Our study enhances the understanding of retailers' transaction costs in e-commerce and illustrates how transaction costs differ across payment instruments and customers. Three important managerial guidelines can be derived from our study results: First, we empirically identify customers' demographics and relational-based characteristics to significantly affect retailers' transaction costs. More precisely, we estimate the influence of four customers' characteristics on the transaction costs: (i) Old versus young customers, (ii) males versus females, (iii) new versus existing customers, and (iv) payment switching versus non-switching customers. The detailed knowledge of each of these factors and their

respective magnitude enables retailers to make discretionary decisions on a customer-by-customer basis to increase profitability. Second, on the basis of our empirical results, we develop a framework that can be used to derive a retailer's most effective payment provision strategy in terms of costs and working capital requirements of every single order position. Moreover, we provide practitioners with an integrated model that identifies the cost-effective payment schedule regarding distinctive customers. Therein, the estimated transaction cost functions and the respective intersection points are a powerful basis to decide whether invoice, credit card, PayPal or prepayment is best to offer towards each individual type of customer. Furthermore, the framework can be used to supervise and evaluate the current payment provision strategy to ensure its successful implementation in a continuously changing environment. Finally, identifying customers who are less profitable for retailers in terms of transaction costs and working capital requirements help retailers to work out new customer-specific marketing strategies. For instance, the present study provides a customer classification with regard to their payment behaviour and arising transaction cost to the retailer that can be used in additional marketing activities in e-commerce such as advertisement or fraud prevention to the strategic advantage of the firm.

6.3 Limitations and directions for further research

The large data set employed in our study consists of more than 14 million actual sales transactions of more than 100.000 randomly chosen online shopping customers allowing the results to be generalized. As we focus on data of one single company, further research on this topic should investigate the stability of the results by performing similar studies of different companies, customer groups, and sales channels. Our study also raises some additional issues worthy for future research as the approach described here could be easily extended to provide further insights on transaction costs in online shopping situations. For instance, the influence of additional customers' demographics such as income, education or social backgrounds as well as classification criterions like customers' past spending behaviour, the frequency of customers' purchases or the recency of the last order can be of interest as the identification of relevant payment-specific customer segments is proposed to be a useful predictor for consumers' future payment behaviour (Buckinx and Van den Poel, 2005). Finally, additional forms of payments such as mobile transaction instruments can be analyzed in terms of transaction cost and working capital requirements. We hope our study motivates future research that contributes to the understanding of the transaction costs in online retailing.

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