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* Views expressed are those of the author and do not necessarily reflect official positions of De Nederlandsche Bank.

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Abstract

Decentralised issued crypto "currencies", like bitcoin, have the potential to drastically change the existing retail payment system and even the monetary system. Insights into the factors that influence their adoption are therefore crucial. Using a large representative sample of retailers that sell their products online, we find that acceptance of crypto payments is currently modest (2%), but there is substantial interest among retailers to adopt crypto payments in the near future. Consumer demand, net transactional benefits and perceived adoption effort influence adoption intention and actual acceptance by retailers. Regarding non-financial factors, our findings suggest that service providers who act as intermediaries between retailers, their customers, and providers of payment instruments play a crucial role as facilitators of competition and innovation in the online retail payments market by lowering such barriers. The most serious barrier for crypto acceptance seems to be a lack of consumer demand. Information from consumers indicate that those who possess cryptos, don't use it for online payments. It seems therefore unlikely that the adoption of cryptos by retailers will increase substantially, making it highly unlikely that cryptos like bitcoin will drastically change the existing retail payment system.

Keywords: bitcoin, cryptocurrency, technology adoption, two-sided markets, retailers, network externalities, cost, facilitating conditions.
JEL classifications: D22, E42, G20, O33.

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1. INTRODUCTION

This paper examines the adoption intention and actual acceptance of cryptocurrency payments like bitcoin by online retailers. Nakamoto (2008) introduced the world's first decentralised crypto currency, called bitcoin. Since cryptocurrencies do not fulfil all the functions of money, we use the term "crypto" in the rest of this paper instead of the term cryptocurrency.[1] Cryptos like bitcoin represent a new payment technology, which enable payers and payees to directly send value to each other electronically and anonymously without the need to use the services of trusted third parties, like financial institutions (Nakamoto, 2008). This allows them to move outside the scope of the traditional retail payment market with its regulated payment service providers. Instead a peer-to-peer network is used, consisting of nodes of computer systems, which provide the computer power needed to run the software for the network. The main novelty of these networks is that they have implemented the distributed ledger technology, which uses cryptographic techniques for the identification and validation of payments by network nodes; that are subsequently recorded decentrally in a public distributed ledger, called the blockchain. Since 2009 also others launched (decentralised) cryptos inspired by bitcoin, and its payment technology, of which Ethereum, Litecoin, and Ripple are well-known examples.[2] There are about 900 cryptos with a value of USD 342 billion, which corresponds with 0.3 percent of global GDP (WorldCoinIndex, 5 February 2018).

Since the introduction of bitcoin, cryptos have received considerable media attention worldwide, fuelled by the sharp appreciation of major cryptocurrencies like bitcoin compared to regular currencies, and the fluctuations therein, the close links they have with the shadow economy, but also because of the question of whether they pose a serious threat to regular currencies. It was thought that cryptos had the potential to drastically change the existing retail payment ecosystem by making traditional financial institutions like banks, which act as intermediaries between consumers and retailers, superfluous. Moreover, it was thought that, if they were to be used on a large scale, they could even affect the functioning of the monetary system (Halperin, 2013; Stevens, 2017). They are therefore of interest to economists and central bankers. Furthermore, using cryptos also entails risks for payers and payees. The network's decentralised nature obscures its members' responsibilities, meaning that none of them can be held accountable in the event of irregularities. In addition, payments and holdings in cryptos of consumers are not covered by a deposit guarantee scheme, nor can consumers rely on a compensation policy in case of fraud.

[1] In this paper we do not consider cryptocurrencies as money. According to the economic literature a cryptocurrency should not be considered as money, as it does not fulfil the three functions of money, i.e. 1) medium of exchange, 2) store of value and 3) unit of account. Thus far, cryptocurrencies fulfil the role of medium of exchange to a limited extent as the adoption and usage rate among consumers and retailers is very low. Cryptocurrencies are hardly suited to fulfilling the other two roles due to the high volatility of their exchange rates relative to regular currencies, which causes huge fluctuations in the purchasing power of savings and in consumer prices of goods and services.

[2] For more information on the technology behind bitcoin, see Nakamoto (2008) and about decentralised and centralised cryptos in general, see e.g. ECB (2015).

Insight into the factors which influence the adoption of such potentially disruptive payment technologies are therefore highly relevant. However, research on the adoption of cryptos as a means of payment by users is still in its infancy. Schuh and Shy (2015) and Silinskyte (2014) study the adoption and usage of cryptos among consumers, while Polasik, Piotrowska, Wisniewski, Kotkowski and Lightfoot (2015) shed light on the features of crypto accepting vendors.

However, as far as we know, there are no studies available on the adoption of cryptos among a large diverse group of online retailers. This paper fills that gap. Another novelty is that we enrich the economic literature with insights from other disciplines to analyse adoption decisions by retailers. Such an approach is supported by an increasing number of economists (see e.g. Hoff and Stiglitz, 2016) and is shown to be successful in the payment literature (see e.g. Van der Cruijsen and Van der Horst, 2016). Given the technical complexity and the highly innovative features of cryptos, the technology adoption literature seems to be a natural source from which to borrow insights. We address the following research question: *Which factors influence the retailer's adoption of cryptos like bitcoin?* In our analyses we pay attention to the influence of consumer demand for crypto payments, transactional benefits of receiving crypto payments relative to other means of payment, and non-financial barriers to retailers' adoption intention and actual acceptance of crypto payments.

In November and December 2016 we conducted a survey among 768 retailers who sell their products online to consumers inside (and outside) the Netherlands. We polled these retailers about their business, the acceptance of payment methods, their perceptions regarding crypto payments as well as mainstream online payment methods, their attitudes towards cryptos and their intention to adopt them as a means of payment. We use the resulting rich dataset to answer our research question. The Netherlands provide a good setting for this research, as it has a well-developed online retail market. The total value of online payments was EUR 20 billion in 2016 (Thuiswinkel.org, 2017) which corresponds with 13% market share of total retail trade.

The structure of this paper is as follows: Section 2 provides an overview on the literature on cryptos and the factors influencing adoption decisions of novel payment instruments by retailers. We pay attention to both the two-sided markets literature and the technology adoption literature. Section 3 formulates and discusses the main research question, and three related sub questions on adoption intention and actual acceptance of cryptos by retailers. Section 4 discusses the set-up of the survey and provides some descriptive statistics. Section 5 briefly describes the econometric models used for the in-depth analyses. Section 6 presents and discusses the estimation results and Section 7 summarises and concludes.

2. LITERATURE

2.1 Theoretical literature

2.1.1 Two-sided markets

Although price setting in crypto payment markets is different from price setting in the 'traditional' two-sided markets for retail payment instruments, the 'two-sided' markets literature may still provide insights into which factors drive retailer acceptance of cryptos. Next to pricing, we pay attention to the influence of the net private transactional benefits and of network externalities in case of two types of end-users.

In general, a two-sided market is a market characterised by having two demand sides instead of one, and a platform which offers its product to both demand sides. This means that a 'product' will only be sold if both sides jointly decide to 'purchase' the product. The platform determines the total price paid for the jointly-bought product and the individual prices paid by these two end-users. The crypto market may be considered as a special case of a two sided market, just like the card payments market, which has been the focus of considerable academic attention, see Verdier (2011) or Jonker (2016) for overviews. In the crypto payment market there is a decentralised platform consisting of multiple nodes which offers people the opportunity to transfer funds from one person's account to another using a particular crypto X, such as bitcoin. This transaction will only take place if both the payer and the payee have adopted crypto X and have agreed to use it for this specific transaction. If one of them prefers another payment method the transfer will not take place with X. This may happen if the net transactional benefits of another payment method or another crypto Y exceeds that of using X for either the payer or the payee. By net transactional benefits we mean the difference between the benefits of a payment with a particular payment method, minus the transactional costs associated with the payment.

In a two-sided market, network externalities on one side of the market positively influence demand on the other side. For consumers adopting crypto X becomes more attractive the higher the share of retailers who accept it, while for retailers adoption of X becomes more attractive the higher the adoption rate of X among consumers. Generally, centralised platforms which offer payment solutions try to maximise the platform's output by setting the transaction fees of the payee and the payer in such a way that total output is maximised. In practice, payment platforms often charge consumers a zero transaction fee or even a negative fee (reward) and a positive transaction fee to retailers. The transaction fee for retailers may be higher than the cost associated with delivering the payment service to retailers, as platforms try to pass on part of the cost associated with consumers to retailers, as retailer demand is assumed to be less price elastic than consumer demand. A rationale for platforms to price their payment service this way is that they want to encourage consumers to adopt their payment method, and as the consumers' adoption rate rises, so will the retailers' adoption rate due to network externalities. Note that unlike

payment card networks, in decentralised crypto platforms, such as bitcoin, do not set transaction fees for payees and payers. .However, payers may voluntarily pay a fee, as an incentive to the miners in the network to process their transaction quickly.[3] Intermediaries such as non-bank payment service providers (PSPs) which offer payment services to retailers charge transaction fees for accepting VC payments.

In the early two-sided market models, retailers were assumed to be homogeneous and to operate in a non-competitive market, in which either all retailers adopted a payment method or did not (Baxter, 1983). However, in reality retailers in different sectors may perceive different benefits from adopting a payment instrument, leading to different adoption rates across sectors (Wright, 2004). In addition, retailers may face different cost structures and consequently have different adoption rates depending on the average transaction size or sales volume (McAndrews and Wang, 2008). Furthermore, adoption depends on market competition. Retailers who face competition may accept a payment method even though the net transactional benefits are negative. They do so in order to attract consumers from competing retailers, or to prevent losing customers to competitors (Rochet and Tirole, 2002; Vickers, 2005). In highly competitive markets, platforms can therefore charge excessive fees to retailers. This has occurred in the debit and credit cards market in several jurisdictions worldwide, and has led to various antitrust lawsuits and even price regulation by competition authorities (for an overview see Jonker, 2016).

A distinguishing feature of using a crypto compared to using a payment instrument based on a regular currency concerns the exchange rate between the cryptol and the regular currency. Bolt and Van Oort (2016) present an economic framework for analysing the functioning of the crypto market, and in particular the development of the exchange rate of cryptos. Both the speculative demand by investors and the transaction demand by consumers and retailers influence the development of this exchange rate. Since their introduction, cryptos have exhibited a high volatility in exchange rate with regular currencies. This can be considered as a symptom of the cryptos' early development, as in the long run, if adoption by consumers and retailers increases, there will be an equilibrium exchange rate between the crypto "currency" and regular currency, where investors' demand will put a "floor" under the exchange rate.

2.1.2 *Technology adoption literature*

In this paper we also take into account findings from the technology adoption literature, see also Aydogan (2016) or Silinskyte (2014) for overviews. The technology adoption literature initially focused

[3] When this survey was launched the median fees for bitcoin transactions were well below 1 USD, but between December 2017 -- January 2018 it was 5 USD or higher, with a peak of about USD 34 just before Christmas (see: https://bitinfocharts.com/comparison/bitcoin-median_transaction_fee.html). Miners usually process the transactions with the highest transaction fees first. Recently, the transaction times and transaction fees paid by payers have risen considerably, as the demand for bitcoin and other cryptos (as a speculative investment) has increased, which made it more difficult for payers to get their transaction into a block. The higher the voluntary transaction fee, the less blocks it takes before the transaction is processed.

on the adoption of new technologies by organisations. Later on, the models used to analyse adoption by organisations were also used for consumers. The Technology Acceptance Model (TAM) developed by Davis (1989) is one of the most widespread technology adoption theories. In the TAM model the factors perceived usefulness (PU) and perceived ease of use (PEOU) jointly determine the adoption intention of a new technology by potential users. Davis defines perceived usefulness as "*the degree to which a person believes that using a particular system would enhance his or her job performance"* and perceived ease of use as *"the degree to which a person believes that using a particular system would be free of effort".* According to TAM the greater the perceived usefulness and perceived ease of use of a new technology, the more positive people feel about it (attitude), which increases their intention to adopt it and to actually use it. Although TAM provides a solid basic framework, researchers also felt a need to extend TAM and to improve its explanatory power by including additional determinants. Venkatesh, Morris, Davis and Davis (2003) introduce the Unified Theory of Acceptance and Use of Technology (UTAUT), in which they combine insights from TAM and seven other adoption models. UTAUT consists of four main factors determining adoption intention, i.e. performance expectancy (PE), effort expectancy (EE), social influence (SI) and facilitating conditions (FC). SI is defined as "*the degree to which an individual perceives that important others believe he or she should use the new system*" and FC as "*the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system*". PE and EE are respectively fairly similar to PU and PEOU from TAM.

2.2 Empirical literature

There are few empirical studies on payment technology adoption by retailers who sell their products online. Li, Ward and Zhang (2003) and Van Hove and Karimov (2006) examine the role of risk on retailers' adoption of payment methods. Li et al. (2003) use information from 260 online eBay sellers and conclude that adoption choices reflect a balanced evaluation of the cost and convenience associated with the payment methods and the protection they provide to buyers against any risks associated with the product sold. Van Hove and Karimov (2016) surveyed 192 retailers active in five Central Asian countries and find that retailers who sell high-risk products (high value physical products) online are more likely to accept low-risk, immediate payment instruments from buyers, so that they are certain that they will receive their money. However, if buyers also run risks due to the way products are being delivered, retailers become more prone to accept higher-risk payment instruments (pay later, no payment guarantee) as well. This finding is in line with earlier findings by DNB (2007) on the Dutch online payment market.

Studies on the crypto uptake of cryptos by retailers are also scarce. Polasik et al. (2016) analyse the share of bitcoin payments in total retail sales using information of 108 bitcoin accepting retailers from different countries. The importance of bitcoin payments is relatively large among start-ups, small

retailers, in developing countries or in countries with a large shadow economy. Interestingly, the share of bitcoin in total sales increases with the bitcoin awareness of potential customers, suggesting the existence of network externalities. Silinskyte (2014) examines bitcoin adoption among a small sample of 111 bitcoin users and non-users worldwide using the UTAUT model. She finds that adoption intention is significantly influenced by the respondents' expectations regarding the performance of bitcoins and the amount of effort required to adopt them. Furthermore, actual bitcoin usage depends on facilitating conditions.

Schuh and Shy (2016) examine crypto adoption among a representative sample of US consumers using the 2014-15 Survey of Consumer Payment Choice. Actual adoption turns out to be low; about one percent or less of the consumers have ever owned cryptos. People who expect an appreciation of a crypto relative to regular currencies are more likely to hold them, suggesting that investment motives drive consumers' adoption. However, people also use them to pay for goods and services and for remittance payments to other consumers, indicating that cryptos also act as a means of payment.

3. RESEARCH QUESTIONS

Summarising, the academic literature provides several insights into which factors influence retailers' decision to accept payments with a particular payment instrument from their customers. The literature also suggests that due to the heterogeneity of retailers, they may think differently about the added value for their business to accept crypto payments. Given this background, the aim of this study is to answer the following key research question:

Q: Which factors influence the retailer's adoption intention / acceptance decision of crypto payments?

There is some overlap in the economics and the technology adoption literature with respect to the factors influencing adoption decisions, such as net transactional benefits with performance expectancy and network externalities with social influence. There are, however, also insights from the technology adoption literature which do not have a direct counterpart in the economics literature, such as effort expectancy and facilitating conditions which reflect non-financial barriers. Therefore, we enrich our empirical analysis by taking non-financial barriers into account as well. Furthermore, we distinguish between the influence of these factors on adoption intention among retailers who do not accept crypto payments as well as on current acceptance among all retailers. To be more specific, we address the following sub-questions:

Qa: Does the retailer's assessment of consumer adoption of crypto payments influence his/her adoption intention / acceptance of crypto payments?

In order to answer this question we use three measures for the retailer's assessment of consumer demand. First of all, we use the retailer's overall assessment of the adoption rate of crypto payments by online shopping consumers. According to the two-sided market literature, the utility of adopting a payment instrument by retailers increases with the adoption rate by consumers. Consequently, we expect a positive relationship between the retailers' assessment of the consumers' adoption rate and their adoption intention/acceptance of crypto payments. Secondly, studies on consumer adoption of new payment technologies show that age and gender are important (see e.g. Stavins, 2001, or Jonker, 2007). Early adoption declines with age and is relatively high among men. We therefore use the measures 'Gender composition customers' which indicates the retailer's self-reported gender composition of his/her customers and 'Age composition customers' which reflects the retailer's self-reported age composition of his/her customers.[4]

Qb: Does the retailer's assessment of the private net transactional benefits associated with accepting VC payments influence the adoption intention / acceptance of crypto payments?

Whether a retailer accepts a specific payment instrument depends on the net transactional benefits it provides. Net transactional benefits reflect the difference between the transactional benefits of payment transactions done with a particular payment instrument to the retailer (e.g. in terms of convenience or safety/security) and the retailer's transaction fee. Net transactional benefits influence the retailer's adoption intention positively. We use five indicators, see section 5.2 for further details: 'Relatively favourable safety crypto' which reflects fraud and cybercrime risk to the retailer related to crypto payments relative to other payment instruments, 'Relative favourable labour time cost crypto' which reflects time needed to handle crypto transactions by the retailer's staff compared to other means of payment, 'Relative favourable transaction cost crypto' which reflects the relative level of the retailer's transaction fees of crypto payments compared to other instruments, 'Exchange rate risk' which reflects the perceived risk associated with fluctuations in the value of crypto payments relative to other means of payment in regular currencies and 'Customers within euro area' which indicates that all the retailer's customers live in the euro area. We expect a positive impact of the three indicators relatively favourable safe, relatively favourable labour time cost and relatively favourable transaction cost of cryptos on adoption intention/acceptance and we expect that perceived exchange rate risk exercises a downward pressure on retailers' adoption intention/acceptance. With respect to retailers mainly having customers living in the euro area, we expect a negative impact, as they don't experience the advantages of crypto payments as clearly as the ones with customers from outside the euro area, such as no exchange rate fees and shorter transfer times.

[4] Gender is often known to the retailer, because customers are asked to indicate their gender when making an online purchase for addressing and billing purposes. Retailers may also have a fairly good view on their customers' age profile, even though customers often do not have to provide information about their age. The products they sell may target a specific age cohort and the first name provided for addressing/billing purposes may give an indication about a customer's age due to trends in first names (Gerhards and Hackenbroch, 2000; Twenge, Abeke and Campell, 2010).

Qc: Does the retailer's perceived level of effort associated with accepting crypto payments influence the adoption intention/acceptance of crypto payments?

According to the technology adoption literature, the lower retailers perceive the effort required to start working with a new technology within a firm, the higher the adoption intention. We use two indicators for this non-financial barrier, i.e. 'perceived ease of use' and 'perceived compatibility'. Both factors are expected to have a positive impact on retailers' adoption intention/acceptance.

4. SURVEY

4.1 Data collection

The survey was held in the period 11 November - 7 December 2016 among 768 retailers in the Netherlands. We focussed on retailers who sell their products online, as crypto payments are typically suitable for online payments and less suitable for point-of-sale payments. Research agency Panteia which is specialised in retailer research was responsible for the data collection. Panteia conducted telephone interviews in order to raise response levels and to ensure completion of the questionnaire by the responding retailers. Panteia's interviewers contacted the person of the establishment who was responsible for retail payments (usually the owner), as we are interested in the drivers of the adoption decision.

We used two sources to draw our sample. Most retailers were drawn randomly from the registers of the Reach database of research company Van Dijk. Reach includes information on 3.6 million companies in the Netherlands. The sample drawn from Reach was stratified into ten retail sectors and five company sizes in order to ensure sufficient variation in the sample of retailers.[5] Table A.1 in the annex provides an overview. In addition, Panteia contacted 102 retailers who sell products online, who were on a list of bitcoin-accepting retailers in July 2016 and whose contact details (phone number) seemed to be available.[6] As our main purpose is to identify drivers of crypto adoption, it is key to have sufficient heterogeneity in the sample and to have a sufficient number of crypto accepting firms in it. However, we have to bear in mind that our sample may not be representative for the population of retailers who sell their products online, when interpreting the outcomes with respect to the share of retailers who

[5] According to Panteia/Statistics Netherlands more than 95% of the online retailers have 10 or fewer employees. In our sample retailers with more than 10 employees are overrepresented in order to have a sufficient number of medium sized and large retailers to assess the influence of firm size on adoption decisions. As information is unavailable about the characteristics of the population of retailers who sell their products online, we are not able to check to what extent our sample represents the population of online selling retailers. Panteia drew a random stratified sample of 8,445 firms from REACH. 4,112 firms were not usable (firm was closed down, wrong address, no phone number available, firms did not sell products online). Of the remaining 4,333 firms, 1,695 firms refused to participate, 297 did not pick up the phone within 5 attempts, 189 were not open during the interview period and for 49 firms the interview could not be completed due to language problems. Based on a sample size of 4,333 firms and 741 completed interviews the response rate was 17%. Of the 102 firms on the bitcoin acceptance list, 33 firms were not usable due to several reasons. Of the remaining 69 firms, 27 completed the interview, resulting in a response rate of 39%. Response rate between 17 – 39% are not uncommon among random samples from a population.

[6] http://www.watisbitcoin.nl/

accept crypto payments and the share of retailers who intend to adopt. These outcomes are merely indicative.

Of the 768 retailers in the sample, 43 accept crypto payments. 27 of them are from a bitcoin accepting list and 16 are from the registers of Reach. The latter figure indicates that crypto acceptance of retailers in the Netherlands is fairly low, i.e. 2% of the retailers who are active in e-commerce. In our sample the share of crypto accepting retailers is higher and amounts to 6%. Most of the retailers accept iDEAL[7] payments (79%), online credit transfers (61%), followed by PayPal (46%), credit card (43%), the Belgian payment solution Bancontact (22%), cash on delivery (21%), debit card on delivery (10%), Klarna/Afterpay and the German online payment solution Sofort (both 9%).

Most of the crypto accepting retailers immediately exchange their turnover in cryptos for euros (63%), 16% exchange them for euros when the exchange rate is favourable, 2% use them for payments and another 2% exchange them for a non-euro currency when the exchange rate is favourable. 16% do not know what happens with their crypto receipts.

The questionnaire includes questions on the retailer's view on the safety, transaction cost and labour time cost associated with crypto transaction, and five commonly-used payment instruments for online purchases (iDEAL, credit transfer, credit card, direct debit, and PayPal) using a 7 point Likert scale. It also includes questions on crypto adoption by online shopping consumers in general, characteristics of respondents' customers, their payment behaviour, firm characteristics and demographic information on the respondents themselves. Furthermore, it contains questions related to the reasons for accepting crypto payments or not, and the intention to accept crypto payments. Lastly, the survey has questions related to the non-financial barriers related to crypto acceptance.

Regarding the reasons given for crypto acceptance, 42% of the retailers accept them to attract extra customers or because their customers ask for it (23%). Many retailers accept them because they are interested in new technology (21%) or because of the low transaction fees (7%). None of the retailers indicate that the privacy provided by crypto payments to their customers plays a role. Neither do they indicate that the mitigation of exchange rate risk or shorter transfer time to their account influence their adoption decision.

Unfamiliarity with cryptos is the most cited reason for non-acceptance (58%), followed by lack of consumer demand (36%), not feeling the need for acceptance (17%), lack of trust in crypto (16%), acceptance not being common in their industry (12%), safety concerns (9%) and perceived complexity (5%). Overall, both the answers given by accepting and non-accepting retailers indicate that customers' (expected) demand for crypto influences the acceptance decision.

[7] iDEAL is a payment solution used in the Netherlands, offered by banks and based on online banking. In 2015 it had a market share of 56% in the number of online payments (Betaalvereniging, 2016).

5. THE MODELS

5.1 Dependent variables

We construct two dependent variables: *Acceptance* and *Adoption intention.* The dependent variable *Acceptance* equals 1 for retailers who accept crypto payments and zero for those who do not. Of the respondents, 6% accept crypto payments and 94% do not. We use probit regressions to examine which factors influence retailers' decisions with respect to crypto acceptance. The dependent variable *Adoption intention* takes a somewhat broader perspective than *Acceptance.* Retailers who do not accept crypto payments were asked whether they would consider accepting crypto payments in the near future. *Adoption intention* takes on three values, i.e. 1 denoting the answer 'no', 2 denoting the answer 'maybe/perhaps eventually' and 3 referring to the answer 'yes'. We exclude respondents who could not answer this question and respondents who already accept crypto payments from this analysis. 7% of the non-accepting retailers intend to accept crypto payments soon, 19% reply that perhaps eventually they will accept them and 64% know for sure that they will not accept them. We estimate ordered probit regressions to examine which factors influence retailers' intention to adopt virtual currencies. An ordered probit model is an extension of the binomial probit model. The main difference is that the dependent variable can take on more than two values, which have a natural ordering. Differences in the levels of the dependent variable have a qualitative meaning instead of a purely metric one, which makes this model appropriate for the analysis of adoption intention (see e.g. Cameron and Trivedi, 2010, for more information).

5.2 Explanatory variables

Below we describe the set of explanatory variables we use to answer research questions Qa-Qc as well as the set of other control variables.

5.2.1 Consumer adoption of crypto payments

According to the two-sided market literature, retailers' adoption decisions depend on the adoption on the other demand side, i.e. consumer demand. We use several variables reflecting consumer demand. Table 1 provides the average scores for these variables for crypto accepting respondents and for those who do not. For the latter group averages are given depending on the level of adoption intention. In addition, we provide the results of 2 sample t-tests which test whether the average responses in two groups differ significantly or not.

Consumer demand crypto reflects the retailer's answer to the question *"What share of all consumers which made at least one online purchase in 2016 used virtual currency payments at least once?".*[8] On average, retailers state that 8% of the consumers used crypto payments in 2016. VC-accepting retailers think that 6% of the online shopping consumers used crypto, which is significantly lower than the 9% according to retailers who do not accept cryptos. Retailers who do not yet accept cryptos, but who intend to do so, assess consumer adoption slightly higher than retailers who are certain that they are not going to accept crypto payments (9% versus 8%). However, the difference is not statistically significant.[9]

The second and third measure for consumer demand consider the characteristics of the retailers' own customers, i.e. their gender and age. Retailers who accept cryptos indicate relatively more often than those who do not that their customers are mainly people below the age of 30 (16% versus 13%). Of the latter group, the likelihood that retailers who intend to adopt crypto payments have a relatively young clientele is at 19% almost twice as high than the 11% of the retailers who know for sure they are not going to accept cryptos, but these differences are not statistically significant. Regarding gender[10], we find that among the crypto accepting retailers, there are relatively many with mainly male customers (26%) and relatively few with mainly female customers (7%) whereas the opposite holds for retailers who do not accept crypto payments (12% mainly male customers and 25% mainly female customers). These differences are statically significant. We see a similar picture emerging when comparing the gender composition of retailers who intend to accept crypto payments, who may accept crypto payments and who know for sure they are not going to accept them, but these differences are not significant.

Table 1: Comparing retailers' perceptions with respect to consumer demand for crypto

	Acceptance		Results 2-sample t-tests	
Variable	Yes	No	p-value	
Consumer demand crypto (in %)	6%	9%	p=0.037	
Age profile own customers: mainly young (<=30 yrs)	16%	13%	p=0.53	
Gender profile own customers: mainly male	26%	12%	p=0.01	
Gender profile own customers: mainly female	7%	25%	p=0.01	
	Adoption intention			Results 2-sample t-tests
	Yes	Maybe	No	Yes vs Maybe	Maybe vs No
Consumer demand crypto (in %)	9%	9%	8%	p=0.95	p=0.17
Age profile own customers: mainly young (<=30 yrs)	19%	16%	11%	p=0.66	p=0.13
Gender profile own customers: mainly male	18%	13%	11%	p=0.44	p=0.44
Gender profile own customers: mainly female	14%	23%	26%	p=0.137	p=0.47

[8] Here we provide the exact wording of the question. In 2016 the term 'cryptocurrency' was not mentioned (often) yet in the media ,whereas the term 'virtual currencies' was. Therefore, we used the latter term in our questionnaire.
[9] In Tables 1 – 3, we used two-sample mean comparison t-tests, assuming unequal variances to tests whether groups averages are equal to each other or not.
[10] We distinguish five classes: a retailer has mainly male customers, has more male than female customers, has as many male as female customers, has more female than male customers and has mainly female customers.

5.2.2 Private net transactional benefits of crypto acceptance

Perceived risks and performance of crypto payments compared to other instruments for online payments may also influence the adoption decision (see Table 2). The variable *Exchange rate risk* reflects the respondents' perceived uncertainty in the cost associated with fluctuations in the exchange rate. They were asked the following question: *'How large do you perceive the exchange rate risks between virtual currencies and regular currencies?'* using a 1 (very low) to 7 (very high) scale.[11] Crypto accepting retailers perceive the exchange rate risk as lower (average score 4.0) than the retailers who do not accept crypto payments (average score 4.7). The difference in average scores is statistically significant at the 10% level. A similar pattern is visible within the group of non-accepting retailers distinguished by adoption intention, although these differences are not significant. The finding that crypto-accepting retailers perceive relatively low exchange rate risk may be explained by the role of payment service providers (PSPs) which facilitate crypto acceptance. Most retailers in our sample who accept crypto payments also make use of the services of a PSP (93% against 68% of the retailers who do not accept crypto payments). These PSPs act as intermediaries between retailers, their customers and providers of transfers using specific payment instruments. They often offer retailers services to mitigate exchange rate risk, which is something non-accepting retailers may not be aware of.

The results for the second measure *Customers within euro area* do not point at a relationship between the residence of the retailers' customers and *Adoption intention* and *Acceptance.* This finding is counterintuitive, as especially retailers with customers outside the euro area may benefit from crypto payments. In contrast to crypto payments, cross-currency transfers using means of payment in regular currencies have relatively high transaction fees and/or long transfer times.

Table 2: Retailers' perceptions towards cryptos relative to other payment instruments

	Acceptance		Results 2-sample t-tests	
Variable	Yes	No	p-value	
1. Exchange rate risks (1 =very low, 7=very high))	4.00	4.67	P=0.07	
2. Customers within euro area	0.74	0.78	P=0.52	
3. Relatively favourable cost crypto	1.65	1.15	P=0.00	
4. Relatively favourable safety crypto	0.98	0.74	P=0.00	
5. Relatively favourable labour time cost crypto	1.11	0.88	P=0.00	
	Adoption intention			Result 2-sample t-tests
	Yes	Maybe	No	Yes vs Maybe	Maybe vs No
1. Exchange rate risks (1=very low, 7=very high high)	4.33	4.60	4.81	P=0.41	P=0.33
2. Customers within euro area	0.87	0.80	0.78	P=0.27	P=0.60
3. Relatively favourable cost crypto	1.30	1.21	1.11	P=0.36	P=0.04
4. Relatively favourable safety crypto	0.85	0.76	0.72	P=0.09	P=0.14
5. Relatively favourable labour time cost crypto	0.98	0.93	0.86	P=0.34	P=0.01

[11] The question is asked to the 552 retailers who were familiar with crypto payments.

The third measure: *Relatively favourable cost crypto* equals the ratio of the perceived attractiveness of the cost for accepting crypto payments to the average perceived attractiveness of the cost of accepting payments with five other commonly used online payment instruments. Perceived attractiveness of the cost is based on the answer to the question: *'How high do you perceive the cost for companies of payment instrument x? By cost we mean fees paid to banks and payment service providers*". Respondents could provide an answer on a 1 (very high) to 7 (very low) scale. A ratio higher (lower) than 1 implies that the retailer perceives the cost for accepting crypto payments as more favourable, i.e. lower (less favourable, i.e. higher) than the average cost for the five other mainstream payment instruments. Also, for perceived safety and labour time cost for the retailer's staff a ratio higher (lower) than 1 implies that crypto payments are perceived as more (less) favourable than the average of the other five payment methods. [12] The survey results show that retailers who accept crypto payments perceive them as more favourable than non- accepting retailers for all three perception factors. The differences are significant at the 1% level. In general, retailers who accept crypto payments consider them as equally safe as the other five payment methods. Furthermore, they perceive them as less costly in terms of fees and with respect to labour time cost than the other means of payment. Interestingly, also retailers who do not accept crypto payments perceive crypto payments as relatively cheap. This holds even for retailers who will not accept them. Regarding the other two perception factors, retailers who do not accept crypto payments clearly perceive them as less favourable than the other payment methods. Crypto payments score particularly low on safety. Retailers who intend to accept crypto payments in the future have a significantly more positive attitude regarding the relative safety of crypto payments than retailers who may accept crypto payments, but they do not differ from them with respect to their judgement of the relative transaction cost and relative labour time cost. Retailers who may accept crypto payments do differ significantly from retailers who will not accept crypto payments with respect to these latter two perceptions.

Adoption effort

We use two constructs from the technology adoption literature that reflect adoption effort, i.e. perceived ease of use/learning cost and perceived compatibility of crypto payments with existing working procedures. For both constructs respondents could provide their opinion on two statements, all using a 7 point-Likert scale, ranging from strongly disagree (1) to strongly agree (7). The questions are listed below:

[12] Perceived safety is based on the retailer's answer to the question "*How do you perceive the safety for companies of payments with payment instrument x? Safety concerns fraud and cybercrime".* The respondents could provide an answer on a (very unsafe) to 7 (very safe) scale. Perceived labour time cost is based on the retailer's answer to the question "*How do you perceive the time needed for a company to handle payments with payment instrument x?".* The respondents could provide an answer on a 1 (hardly labour intensive) to 7 (very labour intensive) scale. In order to ensure an equal interpretation of the scores for all three perceptions (low score=bad, high score=good), the scores given to perceived cost and perceived labour time cost have been reversed for the calculation of the relative perceived cost and labour time cost.

Perceived ease of use:

1. *It's easy for me and my staff to learn to accept payments in virtual currencies.*
2. *It's clear and easy for me and my staff to understand how we receive payments in virtual currencies.*

Perceived compatibility:

3. *The acceptance of virtual currency payments fits well with all other aspects of our firm.*
4. *The acceptance of virtual currency payments fits well with the way I and/or my staff want to receive payments for our products.*

Table 3 provides average group scores per construct. Crypto accepting retailers feel significantly more positive with both perceived ease of use and perceived compatibility than the other retailers. Retailers who do not accept crypto payments, but state they will do so, score significantly higher than those who state they may accept them in the future. The latter group scores significantly higher than the retailers who know for sure they are not going to accept crypto payments. The results suggest that retailers who are quite certain about crypto acceptance, foresee a smooth transition towards crypto acceptance within their firm, compared to retailers who are still hesitant. Their expectations are supported by the experiences of crypto accepting retailers, as they are even more positive than the ones who intend to adopt them.

Table 3: Retailers' attitude towards crypto payments

	Acceptance		2-sample t-tests
Construct	Yes	No	p-value
1. Perceived ease of use	5.67	2.80	P=0.00
2. Perceived compatibility	5.29	2.58	P=0.00

	Adoption intention			2-sample t-tests	
	Yes	Maybe	No	Yes vs Maybe	Maybe vs No
1. Perceived ease of use	4.43	2.98	2.57	P=0.00	P=0.03
2. Perceived compatibility	4.49	3.45	1.99	P=0.00	P=0.00

Other variables

We also include variables which reflect demographic characteristics of the retailers (age and educational level) as well as firm characteristics (founding date, firm size measured by the number of employees, whether the retailer makes use of the services of a payment service provider or not) in the set of control variables as well as sector variables. In addition, we control for the competitiveness of the market.

6. ESTIMATION RESULTS

This section presents and discusses the estimation results of the regression analyses. Table 4 shows the estimation results for the dependent variable *Adoption intention* measuring the relative intention to accept crypto payments by retailers who do not accept crypto payments yet using the ordered probit regression model. Table 5 presents the results for the dependent variable *Acceptance* based on information of all respondents using the probit regression model. In order to check for the robustness of the estimated effects and to assess the added value of the three sets of key variables, we estimate models only containing the basic variables and the set of variables related to a specific research question (Model 1 for Qa, Model 2 for Qb and Model 3 for Qc), and we estimate a model including all variables (Full Model), for which we present the estimated parameter coefficients (β) and average marginal effects (AMEs).[13]

6.1 Effect of consumer adoption crypto payments

We find that two of the three indicators of the retailer's assessment of consumer adoption of crypto payments significantly influence the intention to adopt crypto payments (Model 1 and Full Model, Table 4) and that one indicator influences the acceptance decision (Model 1 and Full Model, Table 5). In line with the two-sided market literature, adoption intention is positively influenced by the retailer's overall assessment of crypto adoption by online shopping consumers. The average marginal effects indicate that a one percentage point higher assessment of crypto adoption by consumers, increases the probability that a retailer wants to adopt crypto payments by 0.2 percentage points and decreases the probability that (s)he does not intent to adopt them by 0.5 percentage points. The results also show a significant effect of gender composition of the retailer's customers. Retailers whose clientele mainly consists of women are 4.1 percentage points less likely to be quite certain to adopt crypto payments and 9.6 percentage points more likely not to be willing to adopt crypto payments than retailers who have a mixed clientele with respect to gender (reference group). The age structure of the retailer's customers does not affect adoption intention.

[13] Average marginal effects (AMEs) are marginal effects which are averaged across the respondents in the sample, and evaluated relative to the corresponding reference category, see e.g. Cameron and Trivedi (2010). For adoption intention, the AMEs show the impact of the explanatory variables on the probabilities that the retailer does not intend to adoption VC payments (*AME on adoption intention = 'no'*) and that the adoption intention is very high (*AME on adoption intention = 'yes'*), relative to the reference group (perhaps eventually/maybe). So, for the binomial explanatory variable 'PSP', the AMEs show how the probabilities for answer categories 'yes' and 'no' would change if a retailer made use of the services of a PSP to accept online payments from customers, compared to one who does not make use of a PSP. For a continuous variable such as 'age' the AMEs show the change in probabilities if the retailer's age increases by one year.

TABLE 4: Adoption intention crypto payments by retailers

Dependent variable: Adoption intention	Model 1 β	Model 2 β	Model 3 β	Full model β	AME Acceptance=no	AME Acceptance=yes
Retailer characteristics						
Age (yrs)	-0.022**	-0.022***	-0.014***	-0.016***	0.004***	-0.002***
	(0.005)	(0.005)	(0.006)	(0.006)	(0.002)	(0.001)
Education: Bachelor degree	0.087	0.097	0.030	0.084	-0.023	0.010
	(0.116)	(0.115)	(0.141)	(0.015)	(0.039)	(0.017)
Education: Master degree	0.038	0.075	-0.058	0.028	-0.007	0.003
	(0.157)	(0.160)	(0.176)	(0.183)	(0.049)	(0.021)
Firm age: less than 2 years	0.224	0.244	0.452**	0.467**	-0.125**	0.055**
	(0.155)	(0.155)	(0.202)	(0.212)	(0.055)	(0.024)
Firm age: 2 – 5 years	0.264*	0.277**	0.343*	0.382**	-0.102**	0.044**
	(0.139)	(0.138)	(0.177)	(0.187)	(0.049)	(0.022)
Firm size: 1 person	0.056	-0.034	-0.184	-0.134	0.036	-0.015
	(0.193)	(0.182)	(0.219)	(0.234)	(0.062)	(0.027)
Firm size: 2 – 4 people	0.010	0.0082	-0.227	-0.165	0.044	-0.019
	(0.198)	(0.192)	(0.237)	(0.234)	(0.065)	(0.028)
Firm size: 5 – 19 people	0.004	-0.007	-0.224	-0.205	0.055	-0.023
	(0.187)	(0.183)	(0.228)	(0.231)	(0.061)	(0.026)
Uses services PSP	0.328***	0.296**	0.185	0.272*	-0.073*	0.031*
	(0.122)	(0.122)	(0.156)	(0.160)	(0.042)	(0.018)
Sector: media	0.338*	0.446**	0.317	0.411*	-0.110*	0.047*
	(0.186)	(0.182)	(0.230)	(0.238)	(0.063)	(0.028)
Sector: electronics	0.510***	0.533***	0.556**	0.481**	-0.128**	0.055**
	(0.191)	(0.184)	(0.233)	(0.239)	(0.063)	(0.027)
Competition: no to weak	0.071	0.038	-0.049	-0.022	0.006	-0.003
	(0.191)	(0.188)	(0.244)	(0.261)	(0.070)	(0.030)
Competition: strong to perfect	-0.046	-0.104	-0.102	-0.102	0.027	-0.012
	(0.121)	(0.124)	(0.165)	(0.173)	(0.046)	(0.020)
Consumer adoption crypto						
Customers: mainly male	-0.024			-0.108	0.029	-0.012
	(0.157)			(0.185)	(0.049)	(0.021)
Customers: mainly female	-0.283**			-0.360**	0.096**	-0.041*
	(0.134)			(0.180)	(0.047)	(0.021)
Customers: mainly 30 years or younger	0.037			-0.142	0.039	-0.016
	(0.153)			(0.190)	(0.051)	(0.022)
Perceived degree of consumer adoption crypto	0.016**			0.018**	-0.005**	0.002**
	(0.006)			(0.009)	(0.002)	(0.001)
Missing value Perceived degree of	-0.399***			-0.091	0.051	-0.022
consumer adoption crypto (dummy 0/1)	(0.145)			(0.212)	(0.056)	(0.024)
Retailer's net transactional benefits						
Relatively favourably cost crypto		0.233**		0.214*	-0.057*	0.025*
		(0.115)		(0.124)	(0.033)	(0.014)
Relatively favourable labour time cost crypto		0.458**		0.059	-0.016	0.007
		(0.204)		(0.226)	(0.060)	(0.026)
Relatively favourable safety crypto		0.201		0.092	-0.025	0.011
		(0.183)		(0.224)	(0.060)	(0.026)
Exchange rate risk crypto		-0.066*		-0.029	0.008	-0.003
		(0.039)		(0.045)	(0.012)	(0.005)
Customers: within euro area		-0.099		-0.272	0.073*	-0.031
		(0.126)		(0.167)	(0.044)	(0.019)

Table 4 continued

Dependent variable: Adoption intention	Model 1 β	Model 2 β	Model 3 β	Full model β	AME Acceptance=no	AME Acceptance=yes
Adoption efforts						
Perceived ease of use			-0.004	-0.005	0.001	-0.001
			(0.041)	(0.042)	(0.011)	(0.005)
Perceived compatibility			0.381***	0.382***	-0.102***	0.044***
			(0.041)	(0.043)	(0.009)	(0.006)
μ_1	0.170	0.690*	1.063***	1.631***		
	(0.316)	(0.412)	(0.369)	(0.570)		
μ_2	1.166***	1.693***	2.332***	2.951***		
	(0.319)	(0.416)	(0.387)	(0.594)		
No. of observations	650	650	444	444		
Log likelihood	-458.38	-456.06	-295.41	-286.01		
Pseudo R-squared	0.083	0.088	0.208	0.233		

Notes. The table shows coefficients (β) and average marginal effects (AMEs) based on ordered probit regressions with *Adoption intention* as dependent variable. Robust standard errors are between parentheses. The sample excludes retailers who accept crypto payments or did not know their adoption intention. Reference characteristics of the firm are: firm's age higher than 5 years, firm size: 20 people and more, does not make use of the services of a PSP, sector: other than media or electronics, the firm experiences moderate competition, has a mixed clientele with respect to gender (more male than female, as many male as female, more female than male), the age of the firm's clientele is mixed or mainly consists of people aged 31 years and older, the firm accepts payments within and outside the euro area. . *p<.1, **p<.05, *** p<.01 (two-sided t-tests).

We have mixed results regarding the influence of perceived consumer adoption on retailers' current crypto acceptance (see Model 1 and Full model, Table 5). As expected, we find a negative impact of having mainly female customers on crypto acceptance; these retailers are 0.8 percentage points less likely to accept crypto payments than retailers with a mixed clientele. However, the result of general consumer adoption seems at first sight counterintuitive; it has a negative impact on retailer's crypto acceptance (Model 1) or no effect at all (Full model). A possible explanation may be that retailers who already accept crypto payments have learned about actual consumer usage of cryptos, and have developed a more realistic view on actual consumer adoption than non-accepting retailers. 44% of the crypto accepting retailers in our survey did not receive any crypto payments in 2016 and 42% reported an up to 5% share of crypto payments on total payments, which suggest a much lower consumer adoption rate than the average estimated consumer adoption of 9% by non-accepting retailers (Table 1). As with consumer adoption, the age structure of the retailer's clientele does not influence retailers' current crypto acceptance.

6.2 Effect of net transactional benefits

The estimation results show that three of the five factors reflecting the retailer's net transactional benefits associated with crypto acceptance significantly influence adoption intention (Model 2 and Full Model, Table 4), and that four of them relate significantly with crypto acceptance (Model 2, Table 5).

Retailers who anticipate relatively favourable cost for crypto transactions compared to other payment instruments have a relatively favourable attitude towards crypto adoption. The estimated average marginal effects indicate that a 1 point increase in the relatively favourable cost ratio (indicating a more favourable relative cost position of crypto payments) decreases the probability that retailers do not intend to adopt crypto payments by 5.7 percentage points and increases the probability that they want to adopt crypto payments by 2.5 percentage points (see Full model, Table 4).

We also find that retailers who expect relatively less labour time cost for handling crypto payments compared to other payment instruments have a relatively high tendency to adopt crypto payments. In addition, the perceived exchange rate risk between crypto and regular currencies by retailers has a negative impact on adoption intention. However, the estimated effects for '*Exchange rate risk crypto'* and '*Relatively favourable labour time cost crypto'* are statistically significant in model 2, but not in the full model, where also the indicators reflecting required effort to adopt crypto payments are included as control variables. As the magnitude of the estimated effects is also smaller in the full model than in models 1 – 3 it may be the case that the estimates suffer from multicollinearity bias. We examine this in section 6.5. Furthermore, the indicator '*Customers: within euro area'* is significant and has the expected sign in the full model. The average marginal effect indicates that retailers who only trade with customers inside the euro area are 7.3 percentage points more likely not to intend to accept crypto payments than retailers who sell both inside and outside the euro area.

The results of the variables reflecting net transactional benefits on crypto acceptance are to a large extent in line with those for adoption intention. Model 2 shows significant results with the expected sign for the explanatory variables '*Relatively favourable cost crypto'*, '*Relatively favourable labour time cost crypto'* and '*Exchange rate risk crypto'*. In addition, the estimation results point at a significant positive correlation between '*Relatively favourable safety crypto*' and crypto acceptance. However, as in the adoption intention model, in the full model none of these four variables turn out to be significant, although '*Relatively favourable cost crypto*' and '*Relatively favourable safety crypto'* come with p-values of 0.103 respectively 0.105 very close to significance at the 10% level. Interestingly, relative safety was not significant in the adoption intention equation (Table 4, model 2 and full model), but proves to be significant in the acceptance model (Table 5, model 2). There may be two explanations for this difference. It may be the case that retailers with most confidence in the safety of crypto payments were the first to accept them. An alternative explanation may be that the causality is the other way round; once retailers accept crypto payments they learn that these payments have relatively few safety issues. Regarding the residence of the customers, we do not find a significant effect for having customers from within the euro area on crypto acceptance, unlike crypto adoption intention.

TABLE 5: Acceptance crypto payments by retailers

Dependent variable: Acceptance	Model 1 β	Model 2 β	Model 3 β	Full model β	AME Acceptance=yes
Retailer characteristics					
Age (yrs)	-0.030***	-0.025***	-0.018	-0.021**	-0.0003***
	(0.008)	(0.008)	(0.011)	(0.010)	(0.0003)
Education: Bachelor degree	0.098	0.023	0.030	0.079	0.001
	(0.192)	(0.199)	(0.241)	(0.264)	(0.005)
Education: Master degree	0.328	0.233	-0.024	-0.114	-0.002
	(0.224)	(0.235)	(0.293)	(0.356)	(0.005)
Firm age: less than 2 years	-0.206	-0.289	-0.188	-0.137	-0.002
	(0.275)	(0.300)	(0.363)	(0.368)	(0.005)
Firm age: 2 – 5 years	0.261	0.265	0.124	0.118	0.002
	(0.218)	(0.244)	(0.275)	(0.284)	(0.005)
Firm size: 1 person	0.176	-0.106	-0.367	-0.473	-0.0075
	(0.315)	(0.204)	(0.401)	(0.415)	(0.007)
Firm size: 2 – 4 people	0.245	0.127	-0.232	-0.208	-0.003
	(0.314)	(0.315)	(0.405)	(0.404)	(0.005)
Firm size: 5 – 19 people	-0.663*	-0.732*	-1.369**	-1.285**	-0.010**
	(0.392)	(0.418)	(0.579)	(0.598)	(0.007)
Uses services PSP	0.753***	0.715***	0.523	0.449	0.006
	(0.230)	(0.256)	(0.343)	(0.328)	(0.007)
Sector: media	0.014	0.139	0.052	0.165	0.003
	(0.296)	(0330)	(0.354)	(0348)	(0.008)
Sector: electronics	-0.151	0.024	-0.345	-0.562*	-0.005*
	(0.254)	(0.247)	(0.306)	(0.331)	(0.004)
Competition: no to weak	0.059	0.186	0.021	0.071	0.001
	(0.332)	(0.332)	(0.511)	(0.510)	(0.010)
Competition: strong to perfect	0.276	0.435*	-0.040	0.023	0.0042
	(0.217)	(0.226)	(0.271)	(0.291)	(0.005)
Consumer adoption crypto					
Customers: mainly male	0.345*			0.012	0.0002
	(0.208)			(0.276)	(0.005)
Customers: mainly female	-0.628**			-0.829**	-0.008**
	(0.283)			(0.388)	(0.007)
Customers: mainly 30 years or younger	-0.074			-0.003	-0.0001
	(0.251)			(0.305)	(0.005)
Perceived degree of consumer adoption crypto	-0.029**			-0.008	-0.0001
	(0.014)			(0.174)	(0.0003)
Retailer's net transactional benefits					
Relatively favourable cost crypto		0.435***		0.283	0.005
		(0.128)		(0.174)	(0.005)
Relatively favourable labour time cost crypto		0.546*		0.191	0.003
		(0.309)		(0.416)	(0.006)
Relatively favourable safety crypto		0.606**		0.591	0.010
		(0.268)		(0.365)	(0.008)
Exchange rate risk crypto		-0.111*		-0.086	-0.001
		(0.063)		(0.063)	(0.002)
Customers: within euro area		-0.326		0.132	0.002
		(0.202)		(0.249)	(0.005)

Table 5 continued

Dependent variable: Acceptance	Model 1 β	Model 2 β	Model 3 β	Full model β	AME Acceptance=yes
Adoption effort					
Perceived ease of use			0.362***	0.372***	0.006***
			(0.071)	(0.080)	(0.004)
Perceived compatibility			0.300***	0.275***	0.004***
			(0.069)	(0.070)	(0.003)
Constant	-1.221***	-2.407***	-3.451***	-3.697***	
	(0.447)	(0.632)	(0.604)	(0.842)	
No. of observations	761	761	521	521	
Log likelihood	-133.99	-121.19	-84.46	-75.07	
Pseudo R-squared	0.190	0.267	0.431	0.494	

Notes. The table shows coefficients (β) and average marginal effects (AME) based on probit regressions with crypto acceptance as dependent variable. Robust standard errors are between parentheses. Reference characteristics of the firm are: firm's age higher than 5 years, firm size: 20 people and more, does not make use of the services of a PSP, sector: other than media or electronics, the firm experiences moderate competition, has a mixed clientele with respect to gender, the age of the firm's clientele is mixed or mainly people aged 31 years and older, the firm accepts payments from inside and outside the euro area. . *p<.1, **p<.05, *** p<.01 (two-sided t-tests).

6.3 Effect of adoption effort

Regarding the drivers reflecting the effort required to adopt a new technology, we find a positive effect for '*Perceived compatibility*' on adoption intention. This holds for both model 3 and the full model. The average marginal effects indicate that a 1 point higher score for perceived compatibility (1-7 scale) decreases the probability that a retailer does not intend to accept crypto payments by 10.2 percentage points and increases the probability that (s)he intends to adopt them by 4.4 percentage points. However, we do not find a significant impact of '*Perceived ease of use'* on adoption intention. This indicates that either the extent to which retailers think it will be easy for their staff to learn to use a new technology does not influence adoption intention or that due to multicollinearity between '*Perceived ease of use'* and *'Perceived compatibility*' (correlation between the two indicators is 0.52, see Table B.2) the estimate for '*Perceived ease of use'* is biased downwards.

Both drivers correlate positively and significantly with crypto acceptance (Model 3 and full model, Table 5). Regarding '*Perceived ease of use'*, we feel this may imply that retailers who have already adopted crypto payments anticipated relatively low learning cost compared to non-accepting retailers anticipate, but it may also be the case that they found it easier to learn to handle crypto transactions ex ante than they expected a priori. A similar interpretation may be given to '*Perceived compatibility*'. The average marginal effects indicate that a 1 point higher score given for '*Perceived ease of use'* and '*Perceived compatibility'* go together with a 0.6 respectively 0.4 percentage point higher crypto acceptance rate.

6.4 Effect of other control variables

Next to variables reflecting consumer demand, net transactional benefits and adoption effort, we include control variables reflecting characteristics of the respondents, firms and sector. We find that adoption intention and crypto acceptance are both negatively related with the respondents' age, although the estimated average marginal effect for adoption intention is larger than for acceptance. A 1 year increase in age corresponds with a 0.4 percentage point higher probability that the retailer does not intend to accept crypto payments and a 0.2 percentage point lower probability that (s)he intends to accept crypto payments. The age effect on actual acceptance is smaller: a 1 year increase in age results in a 0.06 percentage point lower probability that a retailer actually accepts crypto payments. The respondent's educational level does not influence adoption intention and actual acceptance.

Regarding firm characteristics, we find a negative effect of the firm's age, with firms existing less than 5 years having a significantly higher adoption intention than firms which have existed 5 years or longer. However, the firm's age does not affect actual acceptance. Firm size as measured by staff size does not influence adoption intention, but turns out to relate significantly to current acceptance. Firms with 5 - 19 employees are 1.0 percentage point less likely to accept crypto payments than firms with 20 or more employees (reference group). Furthermore, adoption intention is positively related with whether the retailer uses the services of a PSP to handle customer payments. The average marginal effect of the intention not to adopt crypto payments drops by 7.3 percentage points if a retailers uses a PSP, while the intention to accept crypto payments increases by 3.1 percentage points. Actual acceptance increases by 0.6 percentage points, though this effect is not significant in the Full model. Note however, that PSP usage is statistically significant in models 1 and 2, and the estimated coefficients are also higher than in model 3 or the full model. Maybe, the variables '*Perceived ease of use'* and/or *'Perceived compatibility'* pick up some of the effect of using a PSP. If a retailer uses the services of a PSP, which acts as an intermediary between the retailer and its customers, crypto acceptance may not lead to changes in the working processes of the firm itself as it has outsourced customer payment handling to the PSP. Likewise, the retailer's own staff does not have to learn new skills to handle payments with the new payment method, as this only holds for the PSP's staff. However, note that there are no strong indications of multicollinearity between using a PSP and the two indicators of adoption effort (see section 6.5).

Regarding sector, we find that retailers who are active in the sectors '*Media*' or '*Electronics*' have a significantly more positive attitude towards crypto adoption than retailers active in other sectors (reference group). However, with respect to current acceptance, we do not find a significant sector effect. We only find a negative effect for retailers active in the electronics sector, but this only holds in the full model, not for models 1 – 3. Regarding competition, we do not find any effect of it on adoption intention, but according to models 1 and 2 in Table 5, retailers who face strong to perfect competition are more

likely to accept crypto payments than retailers who face moderate competition (reference group). However, this effect is not present in model 3 and in the Full model.

6.5 Robustness check

The explanatory power of the estimated models for *Adoption intention* and *Acceptance* increase considerably when including the two adoption effort indicators '*Perceived ease of use'* and '*Perceived compatibility'* as explanatory variables. This indicates that enriching economic models with insights from the technology adoption literature when analysing the uptake of new payment technologies may be promising. The results also show that some of the explanatory variables which are significant in models 1 and/or 2 are not significant anymore when including these two indicators as explanatory variables.

There may be two possible explanations for this. First, the different composition of the retailers in the sample in Models 1 and 2 compared to Models 3 and the Full model may affect the estimation results. Many respondents find it difficult to express their '*Perceived ease of use'* or '*Perceived compatibility'* of working with crypto payments. These people are included in the regressions of Models 1 and 2, but not of Model 3 and the Full model. We have re-estimated Models 1 and 2 for both *Adoption intention* and *Acceptance* using retailers with responses on '*Perceived ease of use'* and '*Perceived compatibility'* (Table B.1, Annex B). It turns out that the estimation results for Models 1 and 2 are robust to the adjusted sample; the estimated effects of the variables reflecting usage of a PSP, consumer adoption of crypto and retailer's net transactional benefits remain fairly the same, as well as the estimated explanatory power of the models. There are only a few variables which are not significant anymore at the 10% level, though the magnitude of the estimated effect remains roughly the same.

A second explanation may be that explanatory variables suffer from multicollinearity with the explanatory variables '*Perceived ease of use'* and '*Perceived compatibility'*. According to the correlation matrix in Table B.2 there are no signs of strong correlation between these and the other explanatory variables. Apart from the strong correlation of 0.52 between '*Perceived ease of use'* and *'Perceived compatibility'*, there is moderate correlation ranging between 0.15 and 0.19 between the variables '*Perceived ease of use'* and '*Using services PSP'*, *'Relatively favourable cost crypto'* and '*Relatively favourable labour time cost crypto*' and between the variables '*Perceived compatibility'* and '*Sector Electronic*', '*Relatively favourable cost crypto'*, '*Relatively favourable labour time cost crypto'* and '*Relatively favourable safety crypto*'. Also the Variance Inflation Factors (VIFs) of the explanatory variables do not point at multicollinearity (See Table B.3 in Appendix B). The average VIF is 1.45, the minimum VIF found is 1.08 and the maximum is 3.17. As a rule of thumb a VIF smaller than 10 is fine.

Given that especially the estimated effects of '*Using services PSP'*, *'Relatively favourable cost crypto'* and '*Relatively favourable labour time cost crypto'* become smaller and insignificant after including indicators of adoption effort as explanatory variables suggests that these variables are to some extent alike. Therefore, when discussing the results for Qb (net transactional benefits) in the concluding remarks we will focus on the results for Model 2. Furthermore, the moderate, positive correlation between '*Using services PSP'* and '*Perceived ease of use'* and '*Perceived compatibility'* indicates that PSP usage actually acts as a facilitating condition for online retailers to accept crypto payments by removing or lowering the required effort for retailers to adopt the new payment technology.

7 CONCLUDING REMARKS

Currently, the acceptance of crypto payments by retailers who sell their products online is modest. However, there is interest among retailers to adopt crypto payments in the near future, indicating that acceptance may rise once certain (perceived) barriers are lowered. In this paper we examine which factors drive retailer adoption intention and actual acceptance of crypto payments. We pay special attention to the impact of consumer adoption of crypto payments (Qa), the retailer's perceived net transactional benefits associated with crypto payments (Qb) and the retailer's perceived level of adoption effort (Qc). We find that that all these three factors influence the adoption intention of online retailers in the expected way. Furthermore, we find that net transactional benefits and perceived adoption effort correlate positively with current crypto acceptance.

The reason why acceptance has remained limited, is because most retailers feel no to limited added value of crypto payments compared to other payment methods. In this respect, the survey results suggest an important role for PSPs. PSPs facilitate crypto acceptance by mitigating risk (e.g. volatility in exchange rate) and by handling the crypto payments on behalf of retailers. In that respect, PSPs fulfil an important role in the retail payments industry. They may enhance innovation and competition in the provision of payment services by acting as intermediaries between (new) players and retailers.

A crucial factor limiting crypto adoption by retailers turns out to be low consumer demand. Further research is needed to gain more insight into the factors influencing consumer adoption of cryptos and the barriers consumers encounter. The upward trend in the transfer times and transaction fees for crypto payments paid by payers may act as hurdles for consumers who want to use cryptos for peer-to-peer payments or for paying online purchases. In that respect, it seems unlikely that crypto acceptance by online retailers will rise substantially in the near future.

References

Aydogan, S. (2016), *Insights on Consumer Payment Behavior: What Factors Determine and Allow to Influence the Use of Payment Instruments?,* PhD thesis, Vrije Universiteit Brussel.

Betaalvereniging (2016), Annual Report 2015, available via https://www.betaalvereniging.nl/wp-uploads/2016/07/Annual-Report-Dutch-Payments-Association-2015.pdf.

Bolt, W. and M. van Oordt (2016), On the value of virtual currencies, DNB Working Paper 521.

Cameron, A. C. and P. K. Trivedi (2010) *Microeconometrics using Stata*. Texas: Stata Press.

Davis, F.D. (1989), Perceived usefulness perceived ease of use, and the user acceptance of information technology. *MIS Quarterly* 13(3), 319-340.

DNB (2007), Customer satisfaction with Internet payments, *DNB Quarterly Bulletin* March 2007, 33-36.

ECB (2015), Virtual currency schemes – a further analysis, February 2015, Frankfurt.

Eurostat (2016), E-commerce statistics for individuals, 7 February 2017, available via http://ec.europa.eu/eurostat/statistics-explained/index.php/E-commerce_statistics_for_individuals

Gerhards, J. and R. Hackenbroch (2000), Trends and causes of cultural modernization. An empirical study of first names. *International Sociology* 15(3), 501 – 531.

Halperin, D. (2013), Bitcoin, Information paper for the Payments System Board, May 2013 meeting, RBA, available via https://www.rba.gov.au/information/foi/disclosure-log/pdf/131419.pdf

Hoff, K. and J.E. Stiglitz (2016), Striving for balance in economics: Towards a theory of the social determination of behaviour, *Journal of Economic Behaviour and Organization* 126(B), 25-57.

Jonker, N (2007), Payment instruments as perceived by consumers – a public survey, *De Economist* 161(1),19 – 44.

Jonker, N. (2016), Regulating Interchange Fees for Card Payments in J. Górka: "*Transforming Payment Systems in Europe*", Palgrave Macmillan, Hampshire, 149 – 181.

Li, H., R. Ward and H. Zhang (2003), Risk, convenience, cost and online payment choice: a study of eBay transactions, Working Paper, Georgia Institute of Technology.

Nakamoto, S. (2008), Bitcoin: a peer-to-peer electronic cash system, unpublished manuscript, retrieved from https://bitcoin.org/bitcoin.pdf.

McAndrews, J. and Z. Wang (2008), The economics of two-sided payment card markets: pricing, adoption and usage, Research Working Paper 08-12 (December 2008), The Federal Reserve Bank of Kansas City.

Polasik, M., A.I. Piotrowska, T.P. Wisnieuwski, R. Kotkowski and G. Lightfoot (2015), Price fluctuations and the use of bitcoin: an empirical enquiry, *International Journal of Electronic Commerce* 20(1), 9-49.

Rogers, E.M. (1995), Diffusion of Innovations, 4th edition, The Free Press, New York.

Schuh, S. and O. Shy (2016), U.S. consumers' adoption and usage of bitcoin and other virtual currencies, working paper.

Silinskyte, J. (2014), Understanding Bitcoin adoption: Unified theory of acceptance and use of technology (UTAUT) application, Master's thesis, Leiden University.

Stavins, J. (2001), Effect of Consumer Characteristics on the Use of Payment Instruments, New England Economic Review 3, 21-31.

Stevens, A. (2017), Digital currencies: Threats and opportunities for monetary policy, NBB Economic Review, Chapter 5, June 2017.

Thuiswinkel.org (2017), Online bestedingen passeren de grens van € 20 miljard in 2016 (Online expenditures exceeded EUR 20 billion in 2016), press release 3 March 2017, available via https://www.thuiswinkel.org/nieuws/3348/online-bestedingen-passeren-de-grens-van-20-miljard-in-2016.

Twenge, J., E.M. Abeke and W. K. Campell (2010), Trends in American Parents' choices for children's names 1880 – 2007, *Social Psychological and Personality Science* 1(1), 19 – 25.

Van der Cruijsen, C, and F. van der Horst (2016), Payment behaviour: the role of socio-psychological factors, DNB Working Paper 532.

Van Hove, L and F. Karimov (2016), The love of risk in retailers adoption of payment methods: evidence for transition countries, *Electronic Commerce Research* 16(1), 27-72.

Venkatesh, V., M.G. Morris, F.D. Davis and G.B. Davis (2003), User acceptance of Information Technology: Toward a unified view, *MIS Quarterly* 27(4), 425-478.

Venkatesh V., M.G. Morris, F.D. Davis and G.B. Davis (2003), User acceptance of Information Technology: Toward a unified view, *MIS Quarterly* 27(4), 425-478.

Verdier, M. (2011), Interchange fees in card payment systems. A survey of the literature, *Journal of Economic Surveys* 35(10), 273 – 297,

Vickers (2005), Public policy and the invisible price: competition law, regulation and the interchange fee, *Proceedings of a Conference on Interchange Fees in Credit and Debit Card Industries*, Federal Reserve bank of Kansas City, Santa Fe, New Mexico, 231 – 247.

WorldCoinindex (2017), 10 August 2017, available via https://www.worlVCoinindex.com.

Wright, J. (2004), The determinants of optimal interchange fees in payment systems, *Journal of Industrial Economics* 2(1), 1 – 26.

Rochet, J.C. and J. Tirole (2002), Cooperation among competitors: some economics of payment card associations, *RAND journal of economics* 33(4), 549 – 570.

Annex A. Sample characteristics

Table A.1: *Decomposition sample by industry and firm size (number of workers)*

	Number of workers						
Industry	1	2-4	5-19	20-99	>=100	n.a.	Total
Retail trade: Consumer electronics, telecom & a white goods	31	32	12	8	1	0	84
Retail trade: home, garden & kitchen	57	38	14	6	5	0	120
Media & entertainment	43	12	15	7	1	0	78
Fashion	77	31	18	9	4	0	139
Travel (flights, hotels, etc.)	2	1	9	10	3	0	25
Sports & recreation	23	12	20	3	2	0	60
Tickets (parks, events, etc.)	1	1	8	13	12	0	35
Food & drinks	25	18	12	9	3	1	68
Health & personal care	20	15	5	2	0	0	42
Other products /services	57	26	22	9	3	0	117
Total	336	186	135	76	34	1	768

Annex B. Robustness check

TABLE B.1: *Adoption intention and acceptance crypto payments using restricted and unrestricted samples*

	Dependent variable: Adoption intention				Dependent variable: Acceptance			
	Model 1 (Table 4)	Model 1 restricted sample	Model 2 (Table 4)	Model 2 restricted sample	Model 1 (Table 5)	Model 1 restricted sample	Model 2 (Table 5)	Model 2 restricted sample
	β	β	β	β	β	β	β	β
Age (yrs)	-0.022**	-0.019***	-0.022***	-0.018***	-0.030***	-0.030***	-0.025***	-0.026***
	(0.005)	(0.006)	(0.005)	(0.006)	(0.008)	(0.008)	(0.008)	(0.009)
Education: Bachelor degree	0.087	0.047	0.097	0.037	0.098	0.037	0.023	-0.044
	(0.116)	(0.132)	(0.115)	(0.134)	(0.192)	(0.202)	(0.199)	(0.211)
Education: Master degree	0.038	0.062	0.074	0.076	0.328	0.261	0.233	0.180
	(0.157)	(0.181)	(0.160)	(0.186)	(0.224)	(0.237)	(0.235)	(0.247)
Firm age: less than 2 years	0.224	0.349*	0.244	0.390**	-0.206	-0.222	-0.289	-0.296
	(0.155)	(0.187)	(0.155)	(0.189)	(0.275)	(0.293)	(0.300)	(0.316)
Firm age: 2 – 5 years	0.264*	0.392**	0.277**	0.418**	0.261	0.252	0.265	0.266
	(0.139)	(0.165)	(0.138)	(0.167)	(0.218)	(0.231)	(0.244)	(0.235)
Firm size: 1 person	0.056	0.023	-0.003	-0.036	0.176	0.136	-0.106	-0.174
	(0.193)	(0.218)	(0.182)	(0.210)	(0.315)	(0.334)	(0.204)	(0.308)
Firm size: 2 – 4 people	0.010	-0.095	0.008	-0.087	0.245	0.189	0.127	0.047
	(0.198)	(0.222)	(0.192)	(0.225)	(0.314)	(0.338)	(0.315)	(0.337)
Firm size: 5 – 19 people	0.004	-0.108	-0.007	-0113	-0.663*	-0.648	-0.732*	-0.765*
	(0.187)	(0.210)	(0.183)	(0.211)	(0.392)	(0.413)	(0.418)	(0.430)
Uses services PSP	0.328***	0.407***	0.296**	0.333**	0.753***	0.766***	0.715***	0.712***
	(0.122)	(0.150)	(0.122)	(0.150)	(0.230)	(0.246)	(0.256)	(0.270)
Sector: media	0.338*	0.330	0.446**	0.431**	0.014	0.136	0.139	0.327
	(0.186)	(0.224)	(0.182)	(0.215)	(0.296)	(0.324)	(0330)	(0345)
Sector: electronics	0.510***	0.712**	0.533***	0.725***	-0.151	-0.159	0.024	-0.016
	(0.191)	(0.227)	(0.184)	(0.220)	(0.254)	(0.271)	(0.247)	(0.264)
Competition: no to weak	0.071	0.122	0.038	0.024	0.059	0.101	0.186	0.177
	(0.191)	(0.241)	(0.188)	(0.236)	(0.332)	(0.357)	(0.332)	(0.363)
Competition: strong to perfect	-0.046	0.011	-0.104	-0.080	0.276	0.273	0.435*	0.384
	(0.121)	(0.147)	(0.124)	(0.150)	(0.217)	(0.230)	(0.226)	(0.236)
Consumer adoption crypto								
Customers: mainly male	-0.024	-0.090			0.345*	0.279		
	(0.157)	(0.174)			(0.208)	(0.214)		
Customers: mainly female	-0.283**	-0.293*			-0.628**	-0.618**		
	(0.134)	(0.164)			(0.283)	(0.289)		
Customers: mainly 30 years or younger	0.037	-0.072			-0.074	-0.096		
	(0.153)	(0.182)			(0.251)	(0.267)		
Assessment consumer adoption crypto	0.016**	0.018**			-0.029**	-0.022*		
	(0.006)	(0.008)			(0.014)	(0.013)		
MV assessment consumer adoption crypto	-0.399***	0.143						
	(0.145)	(0.189)						
Retailer's net transactional benefits								
Relatively favourable cost crypto			0.233**	0.217*			0.435***	0.406***
			(0.115)	(0.119)			(0.128)	(0.136)
Relatively favourable labour time cost crypto			0.458**	0.428*			0.546*	0.504
			(0.204)	(0.220)			(0.309)	(0.323)
Relatively favourable safety crypto			0.201	0.128			0.606**	0.616**
			(0.183)	(0.211)			(0.268)	(0.275)
Exchange rate risk crypto			-0.066*	-0.063			-0.111*	-0.090
			(0.039)	(0.039)			(0.063)	(0.058)

Table B.1 *Continued*

	Dependent variable: Adoption intention				Dependent variable: Acceptance			
	Model 1	Model 1 restricted sample	Model 2	Model 2 restricted sample	Model 1	Model 1 restricted sample	Model 2	Model 2 restricted sample
	β	β	β	β	β	β	β	β
Customers: within euro area			-0.099	0.180			-0.326	-0.309
			(0.126)	(0.149)			(0.202)	(0.209)
μ_1 (adoption intention)/ Constant (acceptance)	0.171	0.279	0.690*	0.766*	-1.221***	-1.058**	-2.407***	2.161***
	(0.316)	(0.363)	(0.412)	(0.464)	(0.447)	(0.476)	(0.632)	(0.633)
μ_2	1.166***	1.339***	1.693***	1.844***				
	(0.319)	(0.366)	(0.416)	(0.471)				
No. of observations	650	444	650	444	761	521	761	521
Log likelihood	-458.38	-340.86	-456.06	-336.206	-133.99	-124.37	-121.19	-122.62
Pseudo R-squared	0.083	0.086	0.088	0.098	0.190	0.162	0.267	0.2413

Notes. The table shows coefficients (β) and average marginal effects (Mfx) based on ordered probit regressions with adoption intention as dependent variable. Robust standard errors are between parentheses. The sample excludes retailers who accept crypto payments. Reference characteristics of the firm are: firm's age higher than 5 years, firm size: 20 people and more, does not make use of the services of a PSP, sector: other than media or electronics, the firm experiences moderate competition, has a mixed clientele with respect to gender, the age of the firm's clientele is mixed or mainly people aged 31 years and older, the firm accepts payments within and outside the euro area. *p<.1, **p<.05, *** p<.01 (two-sided t-tests).

TABLE B2: *Correlation matrix key explanatory variables*

Based on 521 respondents

	Uses services PSP	Sector: media	Sector: electronics	No-weak competition	Strong - perfect Competition	Customers mainly male	Customers mainly female	Customers mainly <=30 yrs	Consumer adoption crypto	Relatively favourable cost crypto	Relatively favourable labour time cost crypto	Relatively favourable safety crypto	Exchange rate risk crypto	Customers within euro area	Perceived ease of use	Perceived. Compatibility
Uses services PSP	1.00															
Sector: media	-0.17	1.00														
Sector: electronics	0.17	-0.10	1.00													
Competition: no to weak	-0.04	0.04	-0.04	1.00												
Competition: strong to perfect	0.01	0.00	0.06	-0.51	1.00											
Customers: mainly male	0.02	0.03-	0.09	0.08	-0.03	1.00										
Customers: mainly female	0.04	-0.10	-0.16	-0.07	0.06	-0.22	1.00									
Customers: mainly 30 years or younger	0.11	-0.07	0.13	0.01	0.01	0.02	0.13	1.00								
Assessment consumer adoption crypto	-0.15	-0.06	-0.08	-0.00	-0.03	0.01	0.15	-0.01	1.00							
Relatively favourable cost crypto	0.05	-0.10	0.04	0.01	0.01	0.02	-0.01	-0.06	0.02	1.00						
Relatively favourable labour time cost crypto	0.07	-0.08	0.07	-0.07	0.04	0.06	-0.00	0.01	-0.00	0.31	1.00					
Relatively favourable safety crypto	0.03	-0.10	0.04	0.02	-0.00	0.10	0.01	-0.07	0.03	0.23	0.23	1.00				
Exchange rate risk crypto	-0.02	-0.03	-0.00	-0.13	0.10	-0.01	-0.03	0.01	-0.10	-0.07	-0.11	-0.14	1.00			
Customers: within euro area	0.04	-0.13	0.07	-0.08	0.10	-0.12	0.12	-0.04	0.09	0.10	0.11	-0.04	-0.07	1.00		
Perceived ease of use	0.15	-0.02	0.14	-0.03	0.08	0.03	-0.06	0.07	-0.09	0.17	0.17	0.14	-0.05	-0.05	1.00	
Perceived compatibility	0.19	-0.03	0.18	-0.03	0.09	0.09	-0.07	0.13	-0.07	0.19	0.19	0.18	-0.10	-0.04	0.52	1.00

TABLE B.3: *Variance inflation matrix explanatory variables*

Based on 521 respondents

Variable	VIF	SQRT (VIF)
Age (yrs)	1.34	1.16
Education: Bachelor degree	1.24	1.11
Education: Master degree	1.26	1.12
Firm age: less than 2 years	1.69	1.30
Firm age: 2 – 5 years	1.62	1.27
Firm size: 1 worker	3.17	1.78
Firm size: 2 – 5 workers	2.70	1.64
Firm size: 6 – 19 workers	1.91	1.38
Uses services PSP	1.14	1.07
Sector: media	1.13	1.06
Sector: electronics	1.16	1.08
Competition: no to weak	1.43	1.19
Competition: strong to perfect	1.41	1.19
Customers: mainly male	1.12	1.06
Customers: mainly female	1.27	1.13
Customers: mainly 30 years or younger	1.13	1.06
Assessment consumer adoption crypto	1.14	1.07
Relatively favourable cost crypto	1.18	1.09
Relatively favourable labour time cost crypto	1.26	1.12
Relatively favourable safety crypto	1.19	1.09
Exchange rate risk crypto	1.08	1.04
Customers: within euro area	1.13	1.07
Perceived ease of use	1.47	1.21
Perceived compatibility	1.54	1.24
Mean VIF	1.45	

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