DOI: 10.20472/EFC.2018.010.020

EGOR KRIVOSHEYA

Moscow school of management SKOLKOVO, National Research University Higher School of Economics, Russian Federation, Russian Federation

NETWORK EFFECTS AT RETAIL PAYMENTS MARKET: EVIDENCE FROM RUSSIAN MERCHANTS

Abstract:

This research examines the role of network externalities in card acceptance by merchants on the retail payments market in Russia. The work empirically tests the effects of both direct and indirect network externalities for the merchants' card acceptance probability based on the representative survey of 800 traditional (offline) merchants from all Russian regions. The main finding of this study is that the probability of cashless payments acceptance by merchants increases with the presence of direct and indirect or both types of network externalities, controlling for a large set of control variables, including merchants' characteristics and location-specific differences between the retailers. The results are robust to the changes in measures of network externalities and inclusion of shadow economy controls. The findings are significant both statistically and economically.

Keywords:

Retail payments; payment cards; network effects; merchants' acceptance; financial services

JEL Classification: G21, E42

1 Introduction

The increasing share of cashless means of payment up to the complete displacement of cash from circulation is one of the most discussed topics on the financial world agenda in recent years. Moving towards a "cashless economy" is one of the priorities of financial regulators in a number of countries, both developed and developing. At the same time, a significant number of private companies and business associations are working on the creation and application of the necessary tools and platforms that would stimulate the economy efficiently. On the other hand, despite numerous efforts of different market participants there is still a lack of development in this area in some countries.

The development of the digital economy depends largely on the spread of non-cash payments. In this regard, it is important to understand the proportion of cashless payments in Russia and the dynamics of it. The Central Bank of Russia has recently announced that it intends to increase the share of cashless payments up to 47-50% by the end of 2018 year, as compared to 32% in 2016 and almost 40% in 2017. The total volume of operations with the use of payment keeps growing (see Graph 1) along with an increasing share of payment transactions for goods and services and decreasing pace of growth of cash withdrawal operations (see Graph 2). The proportion of non-cash expenses in the country is largely determined by the proportion of income that the population receives on a Bank card and does not withdraw in cash, but uses for payments. This payment activity on cards, in turn, depends on many factors, ranging from the availability of payment card services in retail outlets and ending with the general trust of the population and different agents to the financial system. According to a study of analysts of the Alfa-Bank service "Potok", which conducted a survey of over 200 000 merchants, in March 2017 only 39.5% of Russian companies accepted cards. This is almost 25% more than in March 2016. However, there is still a huge potential for the growth of the acquiring market — about 60% of "cash" companies, according to the research, lose up to 20% of possible transactions because they refute cards. Government, banks and payment systems should account for the prospects and stimulate the merchants to implement acquiring systems.[1]

Retail payments market is a two-sided market. Most of the payment schemes nowadays follow the 4 party payments scheme. One side of the market consists of the individuals, who choose whether to issue and use cashless payment instruments and the issuing banks, who offer these payment acceptance products to the potential cardholders.

The other side of the market, which this study focuses on consists of the merchants and acquiring banks. Unlike individuals, the merchants make only one choice at the retail payments market: a choice whether to accept a cashless payment instrument. According to the latest market statistics, as at 2017, approximately 62% of the merchants accept cashless payments. This figure has increased dramatically since 2014, when only 51% of the merchants accepted payment cards.

[1] According to Alfa Bank's "Potok" service analysts research, published at 12.05.2017 http://news.potok.digital/statistika-ekvayringa-v-rossii/

One of the most important factors that explains up to 50% of the card acceptance demand at some market is network externalities. Put simply, the network externality is a positive effect that the usage of one user of some service has on other users of this same service. Due to the two-sided nature of the market, there are two key types of network externalities present at the retail payments market, namely, direct and indirect network externalities. In the context of this research, the direct network externalities refer to the extent towards which the higher acceptance of payment services by merchants influence the demand for accepting these payment services by other retailers. Indirect network externalities similarly capture the effect that the increased usage of retail cashless payment services by individuals has on the acceptance demand by the merchants. The aims of this study are to investigate the existence and empirically evaluate the effect of both types of network externalities for the merchants' card acceptance demand at Russian retail payments market. Key research questions, hence, can be formulated as follows: Are network externalities of either of the types present at Russian retail payments market? To what extent do the network externalities influence the merchants' demand for cashless payments acceptance?

This research aims to contribute to the small but rising literature on the determinants of card acceptance demand by merchants (Arango & Taylor, 2008a; Bounie, François, & Van, 2016; Carbó-Valverde, Liñares-Zegarra, & Rodríguez-Fernández, 2012; Hayashi, 2006; Krivosheya & Korolev, 2018; Loke, 2007; Rochet & Tirole, 2011). This literature already investigated the number of determinants including the characteristics of merchants (e.g., size, assortment, profitability), regional development (e.g., volume of retail trade in particular region, access to banking services) and contract characteristics (e.g., merchant fee, quality of services). The role of the network externalities have been established in the theoretical studies and have often been hypothesized to influence the cashless payments usage and acceptance. However, there are few empirical studies evaluating the magnitude of the network effects at the retail payments market. Moreover, to the best of my knowledge, none of the studies separate between the types of the network effects, especially in Russian market, where the role of cash has historically been high and the end-users behavior habits are yet forming. This article aims to fill these gaps by providing the empirical estimates of the effect of both direct and indirect network externalities for the merchants' card acceptance demand at Russian retail payments market.

After analyzing the literature, this is the first study to provide the empirical investigation into the effect of network externalities for the Russian retail payments market. To the best of my knowledge, only Bounie et al. (2016), Carbó-Valverde et al., (2012) and Rysman, (2007) analyze the influence of network externalities on the card acceptance probability of merchants. These studies, however, do not investigate direct and indirect network effects simultaneously focusing on the indirect network effects rather than both. The mechanisms explaining the influence of direct and indirect network externalities differ significantly and, therefore, may provide different empirical results. The former concerns, mainly, the strategic decisions of the merchants, while the latter – convenience benefits maximization (Bedre-Defolie & Calvano, 2013; Krivosheya & Korolev, 2018). This study aims to fill this gap by providing empirical investigation of the effect of both direct and indirect network effects at the retail payments market.

Besides, none of the studies provide the analysis of the network externalities at Russian retail payments market. Krivosheya and Korolev (2018) conduct the research on the determinants of merchants' behavior and estimate the levels of benefits at the Russian retail payments market. My study is complementary to the mentioned paper and uses the same dataset of Russian merchants to empirically investigate the effect of network effects on the cashless payments acceptance probability. Russian market is characterized by the high role of cash, which may affect some of the mechanisms underlying the effect of network externalities (Plaksenkov, Korovkin & Krivosheya, 2015).

Theoretical mechanisms explaining the link between merchants' acceptance demand and network externalities are linked to the level of net merchants' benefits associated with cashless payments acceptance. A merchant will accept payment cards in case its net benefits (benefits associated with payment card acceptance less of any costs attributed to such decision) exceed zero (Baxter, 1983; Bedre-Defolie & Calvano, 2013; Krivosheya & Korolev, 2018; Rochet & Tirole, 2002, 2003, 2011). Network externalities may change the value of the net benefits. Direct network externalities result from the increased share of accepting merchants, which influence the quality or the cost of the acquiring services as acquirers compete for the retailers. At the same time, in case of higher acceptance rate among the competitors, merchants may also decide to accept cashless payments in order not to lose the potential customers (maximize the opportunity benefits), which incorporate the ability to pay with cashless instruments into the choice of the retailer. Indirect network effects increase the value of direct or convenience benefits such as decreased queues, increased speed of transactions and reduced criminality rates for each particular merchant (Bedre-Defolie & Calvano, 2013; Bolt & Chakravorti, 2008; Bolt & Mester, 2017; Krivosheya & Korolev, 2018; Rochet & Tirole, 2002, 2011). Besides, higher activity of individuals at the retail payments market signifies the importance of the merchants' opportunity benefits. All in all, despite some costs associated with the card acceptance decisions as well as the habits of accepting and paying with cash present at the Russian market, based on the underlying mechanisms of influence, this study hypothesizes positive relationship between direct and indirect network externalities and card acceptance probability.

Using the representative sample of 800 traditional (offline) merchants from all Russian regions this article finds evidence in favor of such positive relationship. Increased share of merchants that accept payment cards increases the probability that each particular merchant accepts payment cards. This result is robust to the changes in measure of network externality and the effect persists even when I use regional level average acceptance level or the perceived acceptance share among the competitors instead of the federal region average acceptance rates as a proxy for direct network externalities. Similar results are obtained in relation to the indirect network externalities: significant positive association between acceptance demand and the share of cardholders and card users is found both at the regional and federal region levels.

The result is also economically significant. One standard deviation increase in average federal region card acceptance increases probability of acceptance by each particular merchant by 7.4 percentage points. Indirect externalities have similar effect: one standard deviation increase in average federal region usage rate of payment cards increases merchant acceptance probability by 7.04 percentage points. Combined, a standard

deviation increase in the component reflecting both network externalities increase the merchant acceptance probability by 7.74 percentage points. For comparison, additional year of operations contribute to less than 1 percentage point increase in merchant acceptance probability.

From the practical point of view, the results of the article might unveil the degree of influence on the card acceptance that different stimulating measures can have. On the one hand, network externalities might be considered as a multiplier for the different policies aimed at retail payments market. If they exist, the magnitude of the effect of the network externalities will reflect the degree towards which an increase in payment activity of end users influences the acceptance by merchants. Therefore, any stimulating measure will influence market in two ways: directly influencing the acceptance or usage of payment services by the recipient of stimulating measures and indirectly influencing the merchant acceptance via the network externalities. On the other hand, the effect of network externalities cannot be changed immediately by any existing stimulating measures. Therefore, the magnitude of the effect of such externalities also show the part of the merchants' demand that cannot be altered by any financial market policies. Thus, it would be extremely valuable for practitioners related to the development of the financial services market, in particular, retail cashless payments to realize the degree of influence they might have on the industry.

This work consists of five sections. In the next section, the theoretical mechanisms of the effect of network externalities on merchant acceptance demand will be explained. Then, relevant variables, description of the data set, descriptive statistics and methodology will be discussed in the empirical set-up in section 3. Section 4 outlines key results of empirical estimations. Section 5 concludes and outlines directions for further research.

2 Theoretical Framework and Literature Review

The decision whether to accept cashless payments or not is based on the relative levels of merchants' benefits and costs. There are two major types of benefits and costs of merchants: fixed and variable. Fixed benefits (B_s) and costs (M) are not dependent on the number and volume of transactions that happen at a particular merchant's location. On the contrary, variable benefits (b_s) and costs (m) depend on the number of cashless transactions at a particular retailer. Russian merchants do not incur explicit fixed costs with the cashless payments acceptance decision because all the necessary infrastructure is provided by the acquiring bank. Therefore, M is usually assumed to be zero. Once the size of benefits per transaction exceed the level of costs per transaction merchant starts to accept payment cards (Bedre-Defolie & Calvano, 2013; Rochet & Tirole, 2002, 2003, 2011; Baxter, 1983)

Network externalities may affect the size of all these four parameters. Network externalities are, effectively, equivalent to the increase in the number of customers at either sides of the market. The mechanisms via which the increased number of merchants and cardholders affect the benefits and fees for every merchant are explained in the following subsection. Formal review of the relevant literature studying merchant acceptance is provided towards the end of this section.

2.1 Direct network externalities

Direct network externalities in the context of this study refer to the increase in the net benefits attributed to cashless payments acceptance for each particular merchant as a result of the increased total number of merchants accepting cashless payments. I follow Krivosheya and Korolev (2018), who separate benefits of merchants into direct (those, attributed directly to the acceptance decision) and opportunity (the benefits arising from the transactions that would be forgone if the merchant did not accept payment cards). Direct net benefits may be affected by the quality of services, merchant's perception of cashless acceptance and the level of costs incurred by the merchant as a result of card acceptance. Opportunity net benefits are most likely to be affected by the share of accepting competitors as well as by the importance of the cashless payments to the customers.

Higher share of cashless payments acceptance by merchants is equivalent to the increased quantity demanded for the acquiring services (Bolt & Chakravorti, 2008; Guthrie & Wright, 2007; Hunt, 2003). Acquirers react to the increased quantity demanded by either lowering merchant discount fees charged for the same bundle of services (in terms of quality and/or quantity) or by improving the offered bundle of services without raising any acceptance costs (Bedre-Defolie & Calvano, 2013; Hasan, Schmiedel, & Song, 2012; Krivosheya & Korolev, 2018; Milne, 2006). Such change in the offering by acquirers results mainly from the nature of competition. When the acceptance levels are low, acquirers compete for the non-accepting merchants and may segment the market easier (Armstrong, 2005; Bolt, 2012; Chakravorti & Roson, 2006; Rochet & Tirole, 2002; Todd & Lawson, 2003). Segmentation of the market allows them charging higher level of fees. In case of higher acceptance levels, acquirers start to compete for the same type of merchants — accepting merchants. Merchant fees and the quality of services are among the top factors affecting the merchant's decision to accept payment cards (C. A. Arango, Huynh, & Sabetti, 2011; C. Arango & Taylor, 2008a; Arango-Arango, Bouhdaoui, Bounie, Eschelbach, & Hernandez, 2018; Bounie et al., 2016; Hayashi, 2006; Jonkers, 2011), that is why, the acquirers change these parameters first in order to attract the merchants from competing acquirer (Baxter, 1983; Bedre-Defolie & Calvano, 2013). The merchant decides to accept payment cards in case the net benefits level are non-negative (Baxter, 1983; Bedre-Defolie & Calvano, 2013; Krivosheya & Korolev, 2018). Increased quantity demanded will bring the net benefits of a merchant closer to the threshold of zero both in case of improved services quality and decreased acceptance costs. Either way, the net merchants' benefits associated with cashless payments acceptance increase leading to higher probability of cashless payments acceptance.

Another important parameter affecting the level of merchants' benefits is the perception of acquiring services by merchants. Financial markets and financial services are usually subject to the herding behavior (Chiang & Zheng, 2010; Darban & Amirkhiz, 2015; Scharfstein & Stein, 1990; Trueman, 1994). Retail payments are not different in this regard (Ali, Barrdear, Clews, & Southgate, 2014; Darban & Amirkhiz, 2015; Reinartz, Dellaert, Krafft, Kumar, & Varadarajan, 2011). On the one hand, this is explained by the behavioral biases of the managers responsible for card acceptance decisions. Once the larger share of merchants that the manager tracks start accepting payment cards, the manager decides to accept payment cards as well in order to be in line with the competitors' strategies (Bounie et al., 2016; Rochet & Tirole, 2011). On the other hand,

the higher interest in cashless payments by merchants in a particular region may produce the positive spillovers, which may be exploited by the financial services organizations aimed at acceptance increase. For instance, payment systems regularly conduct educational and marketing events aimed at explaining the benefits of cashless payments acceptance (Kabakova, Plaksenkov, & Korovkin, 2016; Krivosheya, Korolev & Plaksenkov, 2015). Such events and initiatives may change the perception of the merchants and increase the value of benefits by decreasing the amount of misinformation and other informational or behavioral biases (Bayero, 2015; Bolt & Mester, 2017; Kabakova, Plaksenkov, & Korovkin, 2016; Malphrus, 2009), thereby increasing the probability of cashless payments acceptance. Besides, regional governments or branches of financial services may subsidize the acceptance in case merchants show increased interest in cashless payments (Block & Keller, 2015; Chizhikova, 2013; Rauch & Schleicher, 2015).

The degree of acceptance among the competitors in itself may also affect merchants' decision to accept cashless payments (Bounie et al., 2016; Krivosheya & Korolev, 2018; Rochet & Tirole, 2002, 2011). Rochet and Tirole (2002) provide an intuition for this mechanism: in a two-sided market merchants that face higher competition are more likely to accept cards in order to attract customers from competitors who do not accept cashless payments. On the other hand, merchants may feel obliged to accept cards in order to retain customers that might otherwise choose the merchant location that accepts payment cards (Bounie et al., 2016; Krivosheya & Korolev, 2018; Rochet & Tirole, 2011). This is especially important for the merchants, whose target customers are active at the retail payments market and, therefore, incorporate the option to pay with a cashless method while choosing a merchant location for shopping (C. A. Arango et al., 2011; C. Arango & Taylor, 2008a; Arango-Arango et al., 2018; Krivosheya & Korolev, 2016). .

Overall, the mechanisms outlined above show that the higher acceptance rates among merchants should increase the probability of the acceptance for each particular merchant. This study, therefore, hypothesize the positive relationship between the demand for acceptance and direct network externalities at the retail payments market.

H1: An increase in the amount of merchants that accept cards leads to higher probability of card acceptance by each particular merchant.

2.2 Indirect network externalities

Indirect network externalities are associated with the benefit enjoyed by each particular merchant as a result of higher activity of the individuals at the retail payments market (Bounie et al., 2016; Carbó-Valverde et al., 2012; Krivosheya & Korolev, 2018; Loke, 2007). Unlike merchants, the individuals have two decisions at the retail payments market: to hold a payment card and to use it for the payments for goods and services. As in the previous subsection, I analyze the effect of increased share of holding and usage of cashless payments on the value of net benefits (both benefits and fees) associated with the cashless payments acceptance in order to analyze the effect on cashless payments acceptance demand.

The first major aspect of acceptance demand could be explained by the 'wanna take' phenomenon introduced by Bounie et al. (2016): merchants accept payment cards

because their utility/cost ratio is at least as good as that of other payment instruments. The potential benefits can be presented not only in the form of qualitative improvements that enhance merchants' operations, but also in the form of the acquiring contract recoupment in case when the POS terminals are used more frequently (Krivosheya & Korolev, 2018; Rochet & Tirole, 2011; Weiner & Wright, 2005; Wright, 2004). For Russian retail payments market the latter one is not the case because acquiring banks provide merchants with the POS terminals as a part of acquiring contract. Hence, in other words, in Russia merchants bear only the variable costs (merchant discount fees), avoiding fixed costs as those are incorporated by banks. This specific feature may possibly lead to the lower effect of network externalities on card acceptance as compared to the other geographic markets case where merchants bear both types of costs.

Moreover, cashless payments acceptance is associated with the increase in the indirect and operating costs for merchants. First of all, cashless methods acceptance is associated with the staff retraining (C. Arango & Taylor, 2008a; Hayashi, 2006; Krivosheya & Korolev, 2018). Besides, some merchants may refute cashless payments because of tax evasion or other shadow economy practices (Bolt, 2012; Bolt & Chakravorti, 2008; Krivosheya & Korolev, 2018; Malphrus, 2009). Finally, merchants get an additional fee per every transaction (merchant discount fee) that lowers the retailing profit margins (Baxter, 1983; Bedre-Defolie & Calvano, 2013; Rochet & Tirole, 2002, 2011). Despite this, a study by Krivosheya and Korolev (2018) found that both direct and total net benefits of the merchants in Russia exceed zero, on average, meaning that it is beneficial for most of the Russian merchants to accept cashless payments. A part of this result is attributed to the network externalities that lower the merchant fees due to the acquiring banks competition and increase merchants' direct and opportunity benefits.

First of all, the merchants' direct benefits associated with the card payments acceptance increase with the number of card-paying customers. An increase in the share of cardholders and payers with cashless payment instruments is associated with an increase in the convenience benefits of card acceptance (Rochet & Tirole, 2011). Such benefits include the faster speed of service at the point of sale and decreased queue length, higher customer throughput, lower degree of crime at the point of sale (e.g., cashier robberies and shortfalls) and lower cash handling costs (Bedre-Defolie & Calvano, 2013; Chatterjee & Rose, 2011; Krivosheya & Korolev, 2018; Rochet & Tirole, 2002, 2011). Convenience benefits are lower in case fewer cardholders pay with card because the POS terminal in this case is not used and the benefits of cashless payment acceptance cannot be enjoyed in full. All these benefits enjoyed by the merchants also lead to the higher satisfaction by consumers (Bolton, Kannan, & Bramlett, 2000; Kim, Tao, Shin, & Kim, 2010; Krivosheya & Korolev, 2016), which produce higher loyalty, more frequent visits by customers, larger sales and improved revenues for merchants (Carbó-Valverde & Liñares-Zegarra, 2011; Ching & Hayashi, 2010).

Besides, individuals are found to buy more and spend larger amounts of money when they use cashless payment methods (Bolton et al., 2000; Krivosheya & Korolev, 2016). Such behavior is explained by the ability to spend more than an individual have in his/her wallet and lower costs of money withdrawal (Baxter, 1983; Bedre-Defolie & Calvano, 2013; Wright, 2004). Cardholders also engage in impulse buying, which results in higher

revenues for merchants (Bolton et al., 2000; Plaksenkov et al., 2015) and, thus, higher level of motivation to accept payment cards.

Another aspect of merchant acceptance demand is associated with the 'must take' explanation: merchants who are not motivated to accept cashless payments by their potential benefits may nevertheless accept them because of the fear that they might lose customers or even the whole business if they refute cards (Bounie et al., 2016). This idea is also reflected by the opportunity benefits (Krivosheya & Korolev, 2018). There is a positive relationship between the popularity of cards among consumers and the level of opportunity benefits: the more consumers prefer to pay by card, the higher the potential loss for the merchant because the more likely a consumer is to incorporate the ability to pay by card at a point of sale when he/she chooses between the retailers. In case the retailer does not accept cashless payments it risks losing an individual, who is active at the payments market, to a competitor that accepts payment cards. At the same time, the decision to accept payment cards is strategic and may be undertaken in order to attract card-paying customers to a particular merchant (Arango & Taylor, 2008b; Bedre-Defolie & Calvano, 2013; Jonkers, 2011; Krivosheya & Korolev, 2018; Rochet & Tirole, 2011). Hence, as in case with merchant competition, higher shares of cardholders and payers will lead to higher opportunity benefits and, hence, acceptance demand.

Indirect network externalities, therefore, are also positively associated with the acceptance demand. In order to test the effect of indirect network externalities at the retail payments market empirically, this study, therefore, hypothesizes the following:

H2: The more cardholders choose to hold and use cashless payments, the more probable merchants are to accept the payment cards.

2.3 Effect of cashless payments market development on the acceptance demand

Due to the fact that the direct and indirect network effects are associated with the cashless payments market development at both sides of the market, the increase in cashless payments acceptance, holding and usage is equivalent to the transition towards the cashless economy. Such transition is associated with a number of benefits for all of the stakeholders at the market (Plaksenkov et al., 2015). In case of the cashless economy development, government and commercial agents may produce policies and initiatives aimed at higher acceptance rates among the merchants in order to increase the benefits associated with the cashless economy that they enjoy. The first major group of such benefits is associated with the government, while the second with the commercial players.

Government benefits from moving towards a cashless economy are associated with increased transparency of the economy due to the fact that cashless operations are not anonymous and may be easily tracked, sustainability of the banking sector and enhanced growth (Plaksenkov et al., 2015; Krivosheya, Korolev & Plaksenkov, 2015). Increased sustainability is achieved by the use of funds by banks at the merchant and individuals accounts, which may improve the liquidity of the banking system as well as produce more funds for financing purposes (such as loan generation) (Hasan et al., 2012; Plaksenkov et al., 2015). Higher growth is achieved because of the increased spending by the

customers at various merchant locations when they use cashless payments (Bolton et al., 2000; Krivosheya & Korolev, 2016).

As a result, government may promote card acceptance more aggressively using various stimulating measures and programs (Block & Keller, 2015; Krivosheya et al., 2015; Rauch & Schleicher, 2015). An analysis of such measures for both global and Russian markets is presented in Krivosheya et al. (2015), however, merchant acceptance may be promoted by nation-wide loyalty programs, acceptance subsidies and VAT discounts. Some of these measures (e.g., acceptance subsidies) are actively promoted in Russia as well. In case a particular region is active at the retail payments market, the government benefits associated with the cashless economy in this region are likely to be larger and, hence, government will promote cards even more actively, thereby increasing the magnitude of the network externalities. All in all, government promotion of cashless payment methods should support the hypotheses presented above.

Commercial players, like in case of the government, may also engage in cashless promotion campaigns (Krivosheya et al., 2015; Krivosheya, Semerikova, Korolev & Tarusova, 2017). In case a particular merchant location is active in terms of cashless retail payments transactions, commercial players such as banks and payment systems may further support the development by providing special offers, loyalty programs and educational or marketing seminars and events for the merchants (Carbó-Valverde & Liñares-Zegarra, 2011; Ching & Hayashi, 2010; Hasan et al., 2012; Krivosheya & Korolev, 2018). Participation in such programs is usually associated with higher acceptance demand, which, again, may be due to the enhanced effect of network externalities.

Overall, theoretical mechanisms suggest that the both types of network externalities are associated with higher acceptance demand. This study further tests these hypotheses empirically in order to investigate whether the effect of network externalities is present at Russian retail payments market.

3 Empirical Set-up

3.1 Data sources

The study uses a representative sample of 800 traditional retail locations in all regions of Russia. The data is available from the proprietary database provided by the “Finance, payments and e-commerce chair” of Moscow school of management SKOLKOVO that contains the results of the nation-wide surveys of Russian merchants and Russian individuals. The survey was conducted in 2013-2014 by Public Opinion Fund (ФОМ, “Фонд общественного мнения”) together with CEFIR (Center of Economic and Financial Research). Survey consisted of face-to-face interviews and used an extensive questionnaire with focus on card acceptance and behavior of merchants at the retail payments market. Quotas for federal regions as well as the retailers size and types were introduced to ensure the representativeness for the Russian retail payments market. The survey includes only traditional (offline) merchants as it constitutes the largest share of the payments market (more than 2/3 according to the official Russian statistics (Rosstat)).

Key questions are related to the acceptance of cashless payment instruments, as well as the details on acceptance motives, reasons for refuting cards, perception of competitors’

card acceptance levels and other information regarding payments related behavior and acquiring contract details. The questionnaire also includes information on the merchant's characteristics, such as sales revenues, age, geography of the shop locations, type and services or goods offered by the merchant. Another part of the database includes similar survey of 1500 individuals Russian individuals regarding their payments behavior. The survey is representative for all Russian market as a whole and at the federal region level. Survey included quotas on age, gender and incomes and was constructed using the three stage probability sampling.

The resulting sample consists of 800 merchants, 408 of which accept cashless payments. Both accepting and non-accepting merchants are included in order to mitigate potential selection bias. The survey reveals that 50% of merchants are indifferent between cash and cards as a method of payments; nonetheless, 33% stated that they prefer being paid in cash even when they accept cards. This may be explained by the tax evasion practices and shadow economy activities. Cash is perceived as convenient and cheap, therefore, the role of it is still pointed out to be high by the merchants. These results are in line with previous research on Russian retail payments market (Chernikova, Faizova, Egorova, & Kozhevnikova, 2015; Chizhikova, 2013; Krivosheya & Korolev, 2018).

3.2 Model

In order to answer the main research questions (how direct and indirect network externalities affect card acceptance probability by merchants) this study uses the following baseline model for the initial acceptance of payment cards:

$$Acceptance_{ij}=\alpha+\beta\times DirectNE_j+\gamma\times IndirectNE_j+\theta\times M_i+\lambda\times R_j+\varepsilon_{ij}$$ Where:

- $Acceptance_{ij}$ – the acceptance of payment cards by merchant i from region j (dependent, binary variable);
- $DirectNE_j$ – the vector of direct network externalities in region j;
- $IndirectNE_j$ – the vector of indirect network externalities in region j;
- M_i – the vector of characteristics of merchant i;

  This vector of control variables includes such characteristics as the type of the merchant (supermarket, kiosk, pharmacy, etc. with a reference category being minimarkets), the age of the merchant, merchants' reference to the network, product groups (food and beverage, durables and clothes).

  R_j – the vector of characteristics of region j;

These control variables include the natural logarithm of thevolume of cashless transactions on goods and services in the region per capita, dummy variables for the population of the merchant's location (over 1 million people, between 500 thousand and 1 million, less than 100 thousand), with reference category being cities with population between 100 and 500 thousand people, logarithm of retail turnover per capita, logarithm of GRP per capita.

- ε_{ij} – normally distributed iid errors with zero-mean and constant variance. The robust version of errors estimation is used to alleviate the potential econometric issues such as heteroscedasticity.
- α, β, γ, θ, λ - are the vectors of coefficients.

3.3 Dependent Variable

$Acceptance_{ij}$ is the main dependent variable. It is a binary variable that represents the fact of merchant's card acceptance. Thus, it takes the value of o 1, if a merchant is accepting cashless payments and 0 otherwise. The data on merchants' acceptance is available directly from the survey of merchants. Questionnaire asked merchants the following question: Do you accept payment cards for the payments for products and services?

3.4 Explanatory Variables

In this work the explanatory variables are $DirectNE_j$ and $IndirectNE_j$, which stand

for direct and indirect network externalities respectively.

3.4.1 Direct Network Externalities

Direct network externalities represent the effect of increased merchants' acceptance on the probability of acceptance of cashless payments by each particular merchant. Outlined mechanisms include both the effects of perceived acceptance rates by the merchants' competitors, which may affect the strategic decisions implemented by each particular merchant and actual acceptance levels in particular region, which may affect the behavior of acquirers and governments as well as the merchants. In order to test the former mechanisms explicitly this study uses the perceived level of acceptance across competitors.

The degree of competition affects merchants' decision to accept cards because in the light of competitive pressure merchants are morelikely to accept cards in order to attract customers from the competitors who do not accept cashless payments or may feel obliged to accept cards in order to retain customers that may otherwise choose other retailers (theoretical models are provided in Rochet & Tirole, 2002, 2003, 2011).

Evans and Schmalensee (1999) have also suggested that if a merchant finds that all his competitors accept cards, this may indicate to the merchant that his competitors find credit cards acceptance to be profitable. Hence, the merchant is motivated to match the competitors and is more likely to accept cards as well. The findings in their study show that the higher the percentage of competitors that accept credit cards in transactions as perceived by the merchant, the higher likelihood that the merchant is motivated to participate in the card payment schemes.

Data on perceived acceptance among the competitors is available from the surveys of Russian merchants. , Merchants were asked to self-assess the share of competitors in their market who accept cards. In case they exhibited problems with naming an exact number, they were provided a multiple choice type question with estimated ranges (less than a quarter, 25-50%, 50-75%, 75-100%). Based on the responses to these questions I generate a dummy variable, which takes value 1 if the merchant perceives that more than 50% of its competitors accept cards as a method of payments, and 0 if this share is less

than 50%. The notion of competitors is not defined explicitly by an interviewer and was assessed by the merchant itself.

In order to test the mechanisms relating to the actual acceptance levels I use the average level of actual acceptance in the Region/Federal Region. Similar measure is provided in Bounie et al. (2014, 2016). They used the representative surveys on European (in 2016) and French (in 2014) merchants and individuals. Their studies are based on the following proxies for network externalities: the probability that the purchase in a merchant of particular type and transaction value is completed using cashless method and the average value of transactions in specific retail segment. However, these measures do not separate direct and indirect network effects. They are also based on strict assumptions regarding cardholders' preferences on accepting merchants choice and include authors' calculations performed on proprietary ECB data (Bounie et al., 2014, 2016). Because the surveys on the individuals and merchants conducted in these studies were held in different years, the use of direct acceptance rate is impossible, which leads to no separation of the externalities' effects.

Since both surveys used in this study were conducted in the same time period, I am able to use the first best measure of the network externalities and calculate the average share of merchants that accept cashless payments in a particular region and federal region. Since the survey data is sampled in a way to represent federal regions, I use the latter measure for the main analysis and leave the regional measures for the robustness checks. The variable is calculated as a ratio of the number of accepting merchants in region or federal region to the total number of merchants sampled from this region. The problem of reverse causality is unlikely to arise in my analysis despite the fact that the average acceptance rate might be theoretically affected by the acceptance of each particular merchant in sample. There is enough variation at both regional and federal region level and one particular merchant and merchant location is unlikely to affect the aggregate outcomes at regional or federal region levels due to the size of the retail industry. There are at least 100 observations sampled per each of the 8 federal regions and each of the 21 Russian regions is represented by at least 25 merchants (most of the regions, however, include more than 30 merchants). Therefore, the acceptance fact by each particular merchant will not affect the average acceptance level in region or federal region. Besides, potential reverse causality issue is addressed by using the perceived share of acceptance among competition dummy variable outlined above in some of the regression specifications.

3.4.2 Indirect Network Externalities

Similarly to the case with the direct network externalities, the actual share of the individuals holding and using payment cards are calculated for each particular region and federal region in sample. Proxies similar to those in Bounie et al. (2014) were also used in Carbo-Valverde et al. (2013), however, their measures do not account for the separation of the direct and indirect externalities that are important for the two-sided nature of the retail payments market. There are four versions of the indirect network effects calculated for my study. The first two proxies are the average holding of cards at Regional and a Federal Region level. Although the holding of cards might reflect some of the mechanisms outlined in theoretical framework, other mechanisms relating to the size

of the merchants benefits appear only when the individual uses a card. That is why, apart from the individuals' average holding of cards I also use the average usage of cards for cashless transactions at Regional and Federal Region levels. There are 8 federal regions and 21 regions used in individuals' survey. Due to high correlation between the holding and usage levels at the same level I use these proxies separately.

In order to compare the results with previous studies I also aggregate both network externalities in one variable. To do so I use the principal component analysis and predict the factor using the network externalities proxies based on their cross correlations. In most of the samples these are the (federal) regional usage of cards and (federal) regional acceptance levels.

3.5 Control variables

Following the existing literature, a number of control variables is included in order to account for other variables that possibly explain card acceptance by merchants. I follow Krivosheya and Korolev (2018), who use the same sample of merchants and estimate the probit model as the first stage in two-step Heckman selection model to analyze the determinants of merchants' benefits size. All of the merchant-level data is available from the survey data. All of the regional data is collected from official Russian statistics (Rosstat).

Firstly, it is important to account for the merchant's type. Loke (2007) has found the type of business is a significant determinant to explain the participation of merchant in card payment schemes. Historically, different merchant segments started accepting cards in different time periods (Arango & Taylor, 2008a; Hayashi, 2006; Jonkers, 2011). In order to account for these historical differences, I define six dummy variables for each type of a shop: hypermarkets/supermarkets, specialized food stores, specialized non-food stores, stalls/kiosks/micro-retailers, pharmacies and minimarkets. The last one (minimarkets) is used as a reference category.

Secondly, the retail network affiliation may affect merchants' card acceptance. Retailers are more likely to accept cashless payments because they make a decision once at the middle management level rather than for each individual merchant location (Arango & Taylor, 2008b; Krivosheya & Korolev, 2018). In order to control for the retail networks I introduce a dummy variable, which takes the value of 1 if a retailer is a part of the retail chain and 0 otherwise.

Thirdly, the age of the merchant is accounted for. Loke (2007) and Arango & Taylor (2008a) explain that the card acceptance may take form of learning-by-doing and more experienced merchants may, firstly, expand enough to experience pressure from the consumers demanding cashless payments and, secondly, may realize the benefits of cashless payments acceptance. I introduce the merchant's age variable, which is measured in years, with minimum and maximum values being 0 and 54 years accordingly, the mean age of the sample is 7.20 years.

Fourthly, I account for the product assortment. Different product categories may affect acceptance probability because of the marketing ways of selling products (e.g., food and beverages require faster payment processing compared to other groups, especially durables, due to shorter product lifecycle). Following Bounie et al. (2016) I implement

dummies for assortment groups adapted to the data set: shops selling food and beverages, durable goods and clothes, which take the value of 1 if a merchant sells these products in its store and zero otherwise.

Environment in which merchant operates may also affect the cashless payments acceptance probability. Following Krivosheya and Korolev (2018) and Bounie et al. (2016) I introduce the number of regional controls to account for the state of retail transactions, city size and other determinants of region that were found significant in previous studies.

Firstly, as locations in which merchants are presented are inhabited differently, the control for the population size should be applied. Larger cities are more likely to accept payment cards as convenience benefits of acceptance become larger(Arango & Taylor, 2008b; Bounie et al., 2016; Loke, 2007). I implement the four dummy variables for the city size: with population of over 1 million people, population between 500 thousands and 1 million, population between 500 and 100 thousands and population less than 100 thousands. The reference category is the cities with population between 500 and 100 thousands.

Secondly, regional centers status may also influence the probability of merchant's acceptance. The regional centers in Russia have different financing, subsidizing and tourism level, road networks, which are crucial to merchants in the sense of logistics and presented assortment, convenience of payments and quality of bank services (Chernikova et al., 2015; Chizhikova, 2013). Regional center is accounted for using the dummy variable, which takes value of 1 if the city is a regional center and 0 otherwise.

Thirdly, regional development was controlled for. I include the GRP per capita to account for the scale and efficiency of the regional economy in which the merchant is located. Larger regions have better banking quality and average transactions volume, which may induce merchants to accept cashless payments (C. Arango & Taylor, 2008b; Bounie et al., 2016; Hayashi, 2006). In order to normalize the value of GRP per capita I take natural logarithm of this value. To account for the state of retail sector development, the volume of retail trade per capita in the region was controlled for, also transformed using natural logarithm. Finally, to account for the volume of cashless payments market development and the average check, logarithm of cashless payments value is taken as control. Although these variables are used in the main analysis, I exclude these variables in a number of robustness checks to address potential multicollinearity issues. My main results stay unchanged regardless of inclusion of these variables.

Finally, in a number of robustness checks I also control for the shadow economy and economic crimes intensity, as Russia was included in top-5 countries with the greatest shadow economy level (about 33.7% of GDP according to IMF survey). Previous studies hypothesized that the grey activity in a sector may affect probability of cashless payments acceptance. On the one hand, merchants are more likely to refute transparency offered by cashless payments (Malphrus, 2009). On the other hand, regional governments may stimulate cashless payments acceptance if tax evasion practices are widespread and region suffers from shadow economy segment (Chernikova et al., 2015; Chizhikova, 2013; Krivosheya et al., 2015). Two control variables were considered. The first one is the logarithm of the average size of additional fees resulting from checks, measured in

thousand rubles. The second one is the logarithm of the number of economic crimes in region. Data is taken from Rosstat.

3.6 Estimation method

Previous literature used binary choice models (e.g. Loke, 2007; Bounie et al., 2015, 2017) to model the probability of merchant's card acceptance. I use a standard binary probit model as it allows measuring the strength of influence of the explanatory variables on the dependent variable and is appropriate for determining core factors that influence probability of card acceptance by merchants. This study follows Bounie, François, and van Hove (2016) and uses probit to estimate merchants' acceptance probability. Besides, probit model is undertaken following Krivosheya and Korolev (2018), who used the same dataset as in this study and used probit to estimate the selection equation before implementing a two-step Heckman section model. Probit and logit models provide similar results but the probit model might provide better estimation of probability at the expense of computational complexity. Unlike linear probability model, the resulting probability estimates do not exceed the range from 0 to 1. Also, probit allows for non-constant marginal effects across sample. Economic significance is analyzed using the marginal effects calculation at average values of independent variables. Robust standard errors are used in the analysis to control for potential problems with errors such as heteroscedasticity.

Descriptive statistics for the variables used in the analysis are provided in Table 1, outlining the minimum and maximum values, as well as standard deviations and mean values. Multicollinearity is one of the potential problems for the parametric regression because it leads to inconsistency of standard errors and hinders the power of regression. To account for it, correlation matrix, presented in Table 2, was analysed. Cross-correlations of the variables included in the analysis indicate that there are some signs of multicollinearity among the variables chosen for the models, but the exclusion and inclusion of the correlating variables and the series of the variables doesn't change the results of regression. Key variables, however, do not exhibit the signs of multicollinearity. I have decided to leave those variables that could potentially lead to multicollinearity, as all of them are theoretically important for the explanation of why merchants may or may not accept cards for payment and, therefore, mitigate omitted variable bias. Most of the specifications do not include highly correlated variables simultaneously.

Table 1

	Mean	S.D.	Min	Max
Merchant accepts cards	0.51	0.50	0.00	1.00
Hypermarket, Supermarket	0.06	0.24	0.00	1.00
Specialized Food Store	0.05	0.21	0.00	1.00
Specialized non-food Store	0.14	0.34	0.00	1.00
Stalls, kiosks, micro-retailers	0.35	0.48	0.00	1.00
Pharmacy	0.07	0.26	0.00	1.00

Retail Network	0.25	0.43	0.00	1.00
Merchant's age	7.20	6.27	0.00	54.00
Food, Beverages	0.55	0.50	0.00	1.00
Durables	0.05	0.22	0.00	1.00
Clothes	0.11	0.32	0.00	1.00
More than 1 mln	0.38	0.48	0.00	1.00
From 500 thous. to 1 mln	0.15	0.36	0.00	1.00
Less than 100 thous	0.15	0.36	0.00	1.00
Regional Center	0.59	0.49	0.00	1.00
GRP per cap, log	5.77	0.49	5.04	7.17
Volume of cashless transactions per cap., log	-8.78	1.10	-10.54	-6.02
Volume of retail trade per cap. in region, log	5.10	0.24	4.57	5.63
More than 50% of competitors accept cards	0.31	0.46	0.00	1.00
Regional Average Acceptance Level	0.51	0.12	0.20	0.70
Federal Region Average Acceptance rate	0.51	0.07	0.39	0.63
Regional Average Usage of Cards	0.54	0.09	0.40	0.76
Regional Average Holding of Cards	0.71	0.11	0.42	0.88
Federal Region Average Usage of Cards	0.54	0.08	0.46	0.72
Federal Region Average Holding of Cards	0.72	0.09	0.49	0.79
PCA of Regional Network Effects	0.00	1.19	-2.57	2.82
PCA of Federal Region Network Effects	-0.00	1.33	-1.96	2.86

Table 2

		-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-21	-22	-23	-24	-25	-26
-1	Merchant accepts cards	1.00																									
-2	Hypermarket, Supermarket	0.21	1.00																								
-3	Specialized Food Store	-0.06	-0.06	1.00																							
-4	Specialized non-food Store	0.10	-0.10	-0.09	1.00																						
-5	Stalls, kiosks, micro-retailers	-0.27	-0.19	-0.17	-0.29	1.00																					
-6	Pharmacy	0.12	-0.07	-0.06	-0.11	-0.21	1.00																				
-7	Retail Network	0.33	0.38	-0.04	0.06	-0.14	0.15	1.00																			
-8	Merchant's age	0.03	-0.01	0.02	0.01	-0.09	0.07	0.07	1.00																		
-9	Food, Beverages	-0.07	0.13	0.17	-0.41	-0.14	-0.24	-0.08	0.02	1.00																	
-10	Durables	0.11	0.08	-0.05	0.17	-0.01	-0.06	0.09	0.09	-0.19	1.00																
-11	Clothes	0.04	0.13	-0.08	0.13	0.03	-0.07	0.03	-0.05	-0.23	0.06	1.00															
-12	More than 1 mln	0.05	0.00	-0.02	0.13	-0.06	-0.00	0.06	0.02	-0.04	-0.05	0.00	1.00														
-13	From 500 thous. to 1 mln	0.04	-0.02	-0.05	-0.03	0.05	0.06	-0.01	0.02	-0.13	0.14	0.08	-0.32	1.00													
-14	Less than 100 thous	-0.10	-0.01	-0.03	-0.06	0.04	-0.03	-0.00	-0.03	0.04	-0.00	-0.05	-0.33	-0.18	1.00												
-15	Regional Center	0.06	0.01	0.07	0.12	-0.07	0.03	0.08	0.01	-0.07	0.01	0.06	0.64	0.12	-0.51	1.00											
-16	GRP per cap, log	0.07	-0.02	-0.08	0.12	-0.05	-0.00	0.02	-0.13	-0.15	0.03	0.00	0.24	0.07	-0.02	0.09	1.00										
-17	Volume of cashless transactions per cap., log	-0.05	-0.05	-0.11	-0.05	0.02	-0.04	-0.06	-0.06	0.02	0.01	-0.07	-0.47	-0.15	0.62	-0.81	0.27	1.00									
-18	Volume of retail trade per cap. in region, log	0.06	-0.03	-0.11	0.11	-0.06	-0.01	-0.00	-0.06	-0.10	-0.01	0.00	0.47	-0.08	-0.11	0.12	0.73	0.23	1.00								
-19	More than 50% of competitors accept cards	0.40	0.24	-0.08	0.10	-0.20	0.11	0.28	0.02	-0.01	0.06	0.01	0.08	-0.01	-0.04	0.09	-0.00	-0.05	-0.02	1.00							
-20	Regional Average Acceptance Level	0.24	-0.03	-0.11	0.01	-0.03	-0.01	0.05	0.03	-0.03	-0.02	0.02	0.09	0.02	-0.13	0.03	0.28	0.06	0.26	0.18	1.00						
-21	Federal Region Average Acceptance rate	0.14	-0.02	-0.04	-0.02	-0.03	0.01	0.03	-0.03	-0.03	0.02	-0.04	-0.02	0.05	-0.03	-0.02	0.32	0.12	0.08	0.11	0.59	1.00					
-22	Regional Average Usage of Cards	0.08	0.00	0.00	0.07	-0.06	-0.01	0.06	0.12	0.03	-0.03	-0.03	0.20	-0.27	-0.04	0.08	-0.04	-0.03	0.14	0.12	0.40	0.60	1.00				
-23	Regional Average Holding of Cards	0.09	-0.01	0.05	0.12	-0.10	-0.03	0.09	0.09	0.03	-0.05	-0.01	0.32	-0.33	-0.00	0.22	-0.09	-0.16	-0.02	0.17	0.41	0.54	0.62	1.00			
-24	Federal Region Average Usage of Cards	0.11	0.00	-0.04	0.03	-0.03	0.00	-0.01	-0.08	-0.02	-0.01	-0.03	0.06	-0.08	0.00	-0.01	0.43	0.17	0.24	0.10	0.45	0.77	0.74	0.31	1.00		
-25	Federal Region Average Holding of Cards	0.11	0.01	0.01	0.13	-0.10	-0.01	0.07	-0.06	-0.04	0.01	-0.01	0.12	-0.09	0.07	0.12	0.34	0.01	0.01	0.13	0.46	0.78	0.48	0.77	0.57	1.00	
-26	PCA of Regional Network Effects	0.17	0.00	-0.01	0.03	-0.05	-0.01	0.07	0.07	0.00	-0.04	-0.01	0.13	-0.18	-0.01	0.04	0.18	0.02	0.22	0.15	0.84	0.76	0.84	0.62	0.77	0.66	1.00
-27	PCA of Federal Region Network Effects	0.13	-0.01	-0.04	0.01	-0.03	0.01	0.01	-0.06	-0.02	0.01	-0.04	0.02	-0.02	-0.01	-0.02	0.40	0.15	0.17	0.11	0.55	0.94	0.71	0.44	0.94	0.72	0.81

4 Results

4.1 Unilateral tests

At first, statistical tests are performed to examine the relationship between the probability of acceptance and the explanatory variables. Although simple correlation coefficient might provide the misleading results in case of a binary variable, some insights are unveiled by looking at the correlation between the probability of merchant's card acceptance and the perception of the merchant about competitors acceptance. It is positive (0.40) and statistically significant at any reasonable significance level. The correlation between the probability of card acceptance and average acceptance level is also positive (0.24 for the Regional level and 0.14 for the Federal Region level) and statistically significant at any reasonable significance level. Therefore, there is some correlation between my key explanatory variables proxying the network effects and the fact that merchant accepts payment cards.

To test it more formally, I conduct the comparison of means test using the sub- samples of accepting and non-accepting merchants. First, I compare the means of the perceived share of competitors accepting payment cards. The corresponding t-statistic for the comparison of means test is -12.57, which means that the perceived share of competitors accepting payment cards is larger across the accepting merchants. Similar is also true for the other variables proxying the direct network effects. T-statistic for the equality of means of the actual (federal) regional average acceptance rate is -7.01 (-4.02). Hence, direct network effects variables are indeed larger for the sub-sample of accepting merchants, which supports the hypothesis H_1.

In order to pre-test the hypothesis H_2 I conduct similar equality of means test using the indirect network externalities measures. Simple correlation between the probability of

card acceptance and average card holding is positive (0.09 for the Regional level and 0.11 for the Federal Region level) and statistically significant at any reasonable significance level. T-statistic for the equality of means test of the average cardholding rate variables is - 2.21 (-3.13) at (federal) regional level. The correlation coefficient between the probability of card acceptance and average card usage is also positive (0.08 for the Regional level and 0.11 for the Federal Region level) and statistically significant at any reasonable significance level. T-statistics for the equality of means across the sub-samples are respectively -2.17 and -3.1 at the regional and federal region levels for the usage variables.

These results are in line with the mechanisms developed in the theoretical framework section and support hypothesis H_2. However, to test these hypotheses properly I conduct the multilateral tests set-up in the previous section.

4.2 Multilateral tests

In order to answer my main research question I estimate the card acceptance probability model using the probit estimation method as outlined in the empirical set-up. I first test the effect of the direct network externalities in order to test hypothesis H_1. The results are presented in Table 3.

At first, I introduce a model without the inclusion of any network externalities. Model (1) presents the results of the regression estimation for this baseline model, which reveals the relationship between the probability of card acceptance by the merchant and control variables. The explanatory power of the model can be measured by the pseudo-R-squared, which is equal to 11.8%. It is similar to that found in the literature (e.g., Arango & Taylor, 2008a; Bounie et al., 2016; Carbó-Valverde et al., 2012; Krivosheya & Korolev, 2018). Among the significant controls found in the regression model, shop type affects probability of card acceptance: supermarkets are more likely to accept cards, whereas stalls, kiosks and micro-retailers are overall less likely to accept them. Retail network affiliation also positively influences the probability of card acceptance, which can altogether be explained by the economies of scale, higher patency of buyers and reputational issues. Overall, all of the controls are in line with the previous literature and are of expected sign (e.g., the significance of controls coincides with Krivosheya & Korolev (2018)). Since the controls have expected influence I can proceed with tests for my key hypotheses and use the sample in order to extend findings from existing literature.

Table 3

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Baseline Model	Direct NE: Share of competitors	Direct NE: Share of competitors with economic crimes	Direct NE: Regional Acceptance	Direct NE: Federal Region Acceptance	Direct NE: Federal Region Acceptance with economic crimes
NETWORK EFFECTS						
More than 50% of competitors accept cards		0.962***	0.959***			
		(0.123)	(0.123)			

Regional Average Acceptance Level				3.361***		
				(0.499)		
Federal Region Average Acceptance rate					2.681***	2.322**
					(0.766)	(0.908)
Regional Average Holding of Cards						
Regional Average Usage of Cards						
Federal Region Average Holding of Cards						
Federal Region Average Usage of Cards						
PCA of Regional Network Effects						
PCA of Federal Region Network Effects						
SHOP TYPE						
Hypermarket, Supermarket	0.651**	0.295	0.305	0.893***	0.702**	0.694**
	(0.307)	(0.344)	(0.352)	(0.345)	(0.313)	(0.313)
Specialized Food Store	-0.415*	-0.291	-0.312	-0.243	-0.384	-0.397
	(0.240)	(0.247)	(0.251)	(0.244)	(0.243)	(0.244)
Specialized non-food Store	-0.109	-0.208	-0.200	-0.0673	-0.0805	-0.0801
	(0.186)	(0.194)	(0.194)	(0.192)	(0.188)	(0.188)
Stalls, kiosks, micro-retailers	-0.687***	-0.628***	-0.655***	-0.690***	-0.674***	-0.685***
	(0.124)	(0.126)	(0.126)	(0.129)	(0.125)	(0.126)
Pharmacy	0.136	0.00576	-0.00826	0.284	0.176	0.165
	(0.229)	(0.236)	(0.235)	(0.233)	(0.229)	(0.229)
MERCHANT'S CHARACTERISTICS						
Retail Network	0.827***	0.730***	0.752***	0.801***	0.817***	0.828***
	(0.130)	(0.137)	(0.138)	(0.131)	(0.131)	(0.133)
Merchant's age	-0.00577	-0.00637	-0.00730	-0.0100	-0.00627	-0.00650
	(0.00880)	(0.00954)	(0.00952)	(0.00909)	(0.00889)	(0.00889)
PRODUCT ASSORTMENT						
Food, Beverages	-0.136	-0.152	-0.154	-0.140	-0.130	-0.132
	(0.131)	(0.133)	(0.133)	(0.137)	(0.133)	(0.132)
Durables	0.523**	0.583**	0.590**	0.614**	0.521**	0.523**
	(0.254)	(0.280)	(0.282)	(0.278)	(0.260)	(0.259)
Clothes	0.0717	0.141	0.169	0.0733	0.0909	0.0976
	(0.178)	(0.187)	(0.188)	(0.183)	(0.181)	(0.182)

CITY SIZE						
More than 1 mln	0.140	0.00156	0.153	0.246	0.112	0.175
	(0.204)	(0.222)	(0.233)	(0.214)	(0.206)	(0.224)
From 500 thous. to 1 mln	0.0611	0.0102	0.190	0.148	0.0609	0.130
	(0.175)	(0.188)	(0.203)	(0.185)	(0.178)	(0.199)
Less than 100 thous.	-0.348*	-0.297	-0.302	-0.289	-0.271	-0.289
	(0.207)	(0.211)	(0.218)	(0.213)	(0.210)	(0.216)
Regional Center	-0.163	-0.287	-0.243	-0.0838	-0.145	-0.129
	(0.222)	(0.233)	(0.235)	(0.227)	(0.227)	(0.228)
REGIONAL CHARACTERISTICS						
GRP per cap, log	0.0855	0.112	0.171	-0.132	-0.136	-0.0731
	(0.164)	(0.171)	(0.198)	(0.174)	(0.177)	(0.207)
Volume of cashless transactions per cap., log	-0.0298	-0.133	-0.0503	0.0337	-0.0539	-0.0156
	(0.125)	(0.133)	(0.144)	(0.131)	(0.127)	(0.141)
Volume of retail trade per cap. in region, log	0.0434	0.397	2.11e-05	-0.101	0.397	0.154
	(0.391)	(0.414)	(0.615)	(0.397)	(0.410)	(0.629)
Average size of additional fees resulting from checks (thous. RUR), log			0.101			0.0504
			(0.126)			(0.122)
Number of economic crimes in region, log			0.378**			0.130
			(0.187)			(0.214)
Constant	-0.733	-3.705	-3.384	-0.0222	-2.860	-2.231
	(2.526)	(2.702)	(3.394)	(2.580)	(2.634)	(3.342)
Observations	785	785	785	785	785	785
Pseudo R2	0.118	0.185	0.190	0.163	0.129	0.130

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

In model (2) I extend the baseline model by adding the direct network externalities variable, measured by the merchant's perception of competitors' cashless payments acceptance level. Controlling for the shop type, merchant characteristics, product assortment, city size and regional characteristics, the merchant's perception of competitors acceptance is positively and significantly ($p < 0.01$) associated with the probability of merchant's card acceptance. Higher level of acceptance rate among the competitors perceived by merchant increases the likeliness that the merchant will start accepting cards as a method of payments (everything else being equal). The result is robust to the addition of economic crimes controls, as can be seen from model (3). From the economic point of view, if a merchant perceives that more than half of the competitors accept payment cards, the probability of merchants' acceptance increases by 35.97 percentage points (compared to the situation when less than 50% are expected to accept payment cards).

Models (4) and (5) extend these results using the alternative measures for the direct network externalities, i.e. average acceptance level for the region and federal region accordingly. Both Models (4) and (5) show that higher average acceptance level leads to higher probability of card acceptance by a merchant on both regional and federal region levels. The variables are significant at 1% significance level. From the economic point of view, one standard deviation increase in the federal region average acceptance rate increases the probability of card acceptance by 7.4 percentage points. Model (6) also controls for the economic crimes. Federal Region average acceptance remains significant.. The variable positively and significantly affects the probability of cards acceptance, though now at 5% level, possibly, because of the potential multicollinearity between shadow economy variables. When all of the regional level controls are excluded in the unreported robustness checks, the results of all the direct externalities variables remain significant and of the same sign.

Overall, models (2) – (6) test the H_1 hypothesis of the presence of direct network externalities on Russian retail payments market. All of the listed above models confirm positive and significant effect of the direct network externalities. This result is also robust to changes in the composition of controls and changes in the explanatory variable estimation method. Mechanisms outlined in the theoretical framework persist on Russian market despite the role of the shadow economy and the habits of using cash. Hence, net benefits of each particular merchant increase as a result of increased activity of other merchants and, thus, lead to higher probability of cashless payments acceptance.

Table 4

VARIABLES	(7) Indirect NE: Regional Holding	(8) Indirect NE: Regional Usage	(9) Indirect NE: Federal Regional Holding	(10) Indirect NE: Federal Regional Usage	(11) Indirect NE: Federal Regional Usage with economic crimes
NETWORK EFFECTS					
More than 50% of competitors accept cards					
Regional Average Acceptance Level					
Federal Region Average Acceptance rate					
Regional Average Holding of Cards	1.167**				
	(0.547)				
Regional Average Usage of Cards		1.455**			
		(0.614)			
Federal Region Average Holding of Cards			1.556**		

			(0.631)		
Federal Region Average Usage of Cards				2.207***	1.758**
				(0.697)	(0.792)
PCA of Regional Network Effects					
PCA of Federal Region Network Effects					
SHOP TYPE					
Hypermarket, Supermarket	0.597	0.583	0.677**	0.652**	0.649**
	(0.370)	(0.371)	(0.308)	(0.307)	(0.308)
Specialized Food Store	-0.272	-0.244	-0.416*	-0.398*	-0.415*
	(0.307)	(0.306)	(0.241)	(0.241)	(0.242)
Specialized non-food Store	-0.112	-0.110	-0.131	-0.115	-0.108
	(0.205)	(0.205)	(0.187)	(0.186)	(0.186)
Stalls, kiosks, micro-retailers	-0.697***	-0.704***	-0.668***	-0.691***	-0.706***
	(0.138)	(0.138)	(0.124)	(0.124)	(0.125)
Pharmacy	0.153	0.154	0.162	0.140	0.130
	(0.252)	(0.256)	(0.227)	(0.229)	(0.229)
MERCHANT'S CHARACTERISTICS					
Retail Network	0.884***	0.886***	0.814***	0.838***	0.850***
	(0.144)	(0.145)	(0.131)	(0.131)	(0.133)
Merchant's age	-0.0192**	-0.0200**	-0.00555	-0.00543	-0.00608
	(0.00973)	(0.00962)	(0.00887)	(0.00869)	(0.00871)
PRODUCT ASSORTMENT					
Food, Beverages	-0.130	-0.139	-0.135	-0.143	-0.145
	(0.148)	(0.149)	(0.132)	(0.132)	(0.132)
Durables	0.858***	0.850***	0.522**	0.531**	0.531**
	(0.284)	(0.283)	(0.259)	(0.257)	(0.257)
Clothes	-0.0221	-0.00567	0.0691	0.0876	0.102
	(0.202)	(0.202)	(0.179)	(0.180)	(0.182)
CITY SIZE					
More than 1 mln	0.371	0.377	0.0789	0.159	0.249
	(0.520)	(0.515)	(0.207)	(0.206)	(0.220)
From 500 thous. to 1 mln	0.349	0.289	0.102	0.136	0.231
	(0.417)	(0.402)	(0.178)	(0.178)	(0.194)
Less than 100 thous.	-0.232	-0.151	-0.374*	-0.289	-0.305
	(0.268)	(0.269)	(0.208)	(0.209)	(0.215)
Regional Center	-0.573*	-0.547*	-0.188	-0.182	-0.153
	(0.315)	(0.305)	(0.227)	(0.224)	(0.227)

REGIONAL CHARACTERISTICS					
GRP per cap, log	0.269	0.333	-0.123	-0.111	-0.0299
	(0.201)	(0.204)	(0.186)	(0.175)	(0.203)
Volume of cashless transactions per cap., log	-0.122	-0.147	-0.0383	-0.0502	0.00494
	(0.203)	(0.202)	(0.126)	(0.126)	(0.140)
Volume of retail trade per cap. in region, log	-0.0138	-0.249	0.434	0.210	-0.0833
	(0.474)	(0.481)	(0.424)	(0.400)	(0.611)
Average size of additional fees resulting from checks (thous. RUR), log					0.0654
					(0.122)
Number of economic crimes in region, log					0.228
					(0.204)
Constant	-3.016	-2.351	-2.686	-1.830	-1.346
	(3.414)	(3.417)	(2.661)	(2.583)	(3.301)
Observations	642	642	785	785	785
Pseudo R2	0.133	0.134	0.123	0.126	0.128

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In order to test hypothesis H_2 I proceed with testing the effect of indirect network externalities separately from the analysis outlined above. The corresponding models are presented in Table 4. Firstly, I analyze regional level indirect network effects and then proceed to the federal region level ones. Baseline model is the same as the one used in table 3. Model (7) reveals that the regional average level of cardholding positively and significantly ($p < 0.05$) affects the probability of cashless payments acceptance by a merchant.

Although cardholding does affect some of the mechanisms explained in the theoretical framework, card usage is observable by merchants and lead to higher convenience benefits (e.g., Krivosheya & Korolev, 2018). Hence, I add the regional level card usage variable in order to address the robustness of results. Model (8) presents the results. Regional average usage of cards positively and significantly correlates ($p < 0.05$) to the probability of card acceptance by a merchant.

Similarly, models (9) and (10) measure indirect network externalities effect at the Federal Regions. Although there is enough variation at the regional level, the sample was constructed in a way to represent federal regions and, thus, results using federal regions may provide better effect estimates despite some loss of variation in the explanatory variable. Model (9) exploits average holding variable and shows that it positively and significantly affects ($p < 0.05$) the probability of card acceptance by a merchant. In Model

(10) I undertake the average usage approach and find that Federal Region average usage of cards positively and significantly affects (at 1% significance level) probability of card acceptance by a merchant. Economic significance of the result is also calculated using the marginal effects at average values of all of the variables. One standard deviation increase in average federal region usage rate of payment cards increases merchant acceptance probability by 7.04 percentage points.

Finally, I also control for the economic crimes in Model (11). The results are robust to the inclusion of these additional controls for the average size of additional fees resulting from checks and number of economic crimes in region. Besides, when all regional variables are excluded from the model to mitigate potential multicollinearity problem, the effect of indirect network externalities stays unchanged. This further highlights the robustness of the regression results.

Models (7) – (11) outlined above test the H_2 hypothesis of the presence of indirect network externalities on Russian retail payments market. All of the listed models confirm the positive and significant effect of the indirect network externalities. Hence, individuals' activity at retail payments market indeed affects the net benefits of the retailers, which in turn increases the probability to accept cashless payments.

Table 5

VARIABLES	(12) Direct + Idirect NE	(13) Direct + Idirect NE	(14) Direct + Idirect NE: Regional level separated	(15) Direct + Idirect NE: Federal Region leve separated	(16) Direct + Idirect NE: Regional level component	(17) Direct + Idirect NE: Federal Region level component	(18) Direct + Idirect NE: Federal Region level component with economic crimes
NETWORK EFFECTS							
More than 50% of competitors accept cards	1.056***	0.938***					
	(0.141)	(0.124)					
Regional Average Acceptance Level			3.701***				
			(0.768)				
Federal Region Average Acceptance rate				2.063*			
				(1.198)			
Regional Average Holding of Cards							
Regional Average Usage of Cards	0.992		-0.405				
	(0.641)		(0.742)				
Federal Region Average Holding of Cards							
Federal Region Average Usage of Cards		1.681**		0.780			

		(0.711)		(1.096)			
PCA of Regional Network Effects					0.222***		
					(0.0478)		
PCA of Federal Region Network Effects						0.146***	0.126***
						(0.0406)	(0.0482)
SHOP TYPE							
Hypermarket, Supermarket	0.116	0.297	0.693*	0.690**	0.635*	0.679**	0.674**
	(0.417)	(0.343)	(0.395)	(0.312)	(0.379)	(0.310)	(0.310)
Specialized Food Store	-0.107	-0.282	-0.159	-0.385	-0.199	-0.387	-0.401*
	(0.325)	(0.247)	(0.302)	(0.243)	(0.304)	(0.242)	(0.243)
Specialized non-food Store	-0.216	-0.214	0.00990	-0.0894	-0.0741	-0.0973	-0.0945
	(0.212)	(0.193)	(0.209)	(0.188)	(0.207)	(0.188)	(0.187)
Stalls, kiosks, micro-retailers	-0.633***	-0.633***	-0.694***	-0.679***	-0.698***	-0.683***	-0.693***
	(0.138)	(0.127)	(0.141)	(0.125)	(0.139)	(0.125)	(0.125)
Pharmacy	-0.0954	0.00662	0.239	0.169	0.212	0.161	0.151
	(0.264)	(0.235)	(0.256)	(0.229)	(0.254)	(0.229)	(0.229)
MERCHANT'S CHARACTERISTICS							
Retail Network	0.819***	0.739***	0.886***	0.824***	0.872***	0.829***	0.838***
	(0.151)	(0.137)	(0.145)	(0.132)	(0.146)	(0.131)	(0.133)
Merchant's age	-0.0223**	-0.00604	-0.0232**	-0.00603	-0.0228**	-0.00583	-0.00614
	(0.0108)	(0.00946)	(0.00993)	(0.00883)	(0.00971)	(0.00879)	(0.00880)
PRODUCT ASSORTMENT							
Food, Beverages	-0.159	-0.153	-0.104	-0.133	-0.125	-0.136	-0.138
	(0.150)	(0.134)	(0.151)	(0.132)	(0.150)	(0.132)	(0.132)
Durables	0.915***	0.598**	0.962***	0.525**	0.907***	0.527**	0.528**
	(0.327)	(0.282)	(0.287)	(0.259)	(0.287)	(0.259)	(0.258)
Clothes	0.0476	0.153	0.00718	0.0920	-0.00188	0.0917	0.0986
	(0.207)	(0.187)	(0.204)	(0.181)	(0.204)	(0.181)	(0.182)
CITY SIZE							
More than 1 mln	-0.258	0.0249	0.670	0.125	0.594	0.137	0.200
	(0.542)	(0.223)	(0.523)	(0.207)	(0.523)	(0.206)	(0.223)
From 500 thous. to 1 mln	-0.147	0.0682	0.467	0.0873	0.479	0.106	0.172
	(0.424)	(0.189)	(0.408)	(0.181)	(0.407)	(0.177)	(0.196)
Less than 100 thous.	0.0664	-0.253	-0.504*	-0.268	-0.280	-0.270	-0.289
	(0.286)	(0.212)	(0.286)	(0.210)	(0.270)	(0.210)	(0.216)
Regional Center	-0.488	-0.300	-0.221	-0.156	-0.482	-0.165	-0.146
	(0.327)	(0.233)	(0.320)	(0.227)	(0.305)	(0.225)	(0.228)
REGIONAL CHARACTERISTICS							
GRP per cap, log	0.401*	-0.0411	-0.221	-0.155	0.151	-0.155	-0.0881

	(0.216)	(0.180)	(0.242)	(0.178)	(0.203)	(0.178)	(0.208)
Volume of cashless transactions per cap., log	-0.408*	-0.146	0.172	-0.0556	-0.00710	-0.0554	-0.0152
	(0.216)	(0.133)	(0.214)	(0.127)	(0.205)	(0.127)	(0.141)
Volume of retail trade per cap. in region, log	0.318	0.518	-0.112	0.374	-0.326	0.338	0.0931
	(0.512)	(0.417)	(0.489)	(0.414)	(0.483)	(0.407)	(0.625)
Average size of additional fees resulting from checks (thous. RUR), log							0.0527
							(0.122)
Number of economic crimes in region, log							0.137
							(0.214)
Constant	-7.610**	-4.475*	1.672	-2.757	0.951	-1.096	-0.685
	(3.654)	(2.717)	(3.528)	(2.645)	(3.481)	(2.552)	(3.291)
Observations	642	785	642	785	642	785	785
Pseudo R2	0.208	0.189	0.163	0.130	0.150	0.129	0.130

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

After analyzing the direct and indirect network externalities separately, I include both of the explanatory variables simultaneously to measure the total effect of the network externalities on the probability of merchant's card acceptance. Table 5 reveals the outcomes of this analysis.

In model (12) direct externalities are measured by the merchant's perceptions about his competitors' acceptance share, while indirect externalities are presented in the form of regional average usage of cards. The effect of direct network externalities remains to be significant ($p < 0.01$) and positively affect the dependent variable, while indirect externalities become insignificant at any reasonable significance level. When I use the federal Region average usage of cards instead of regional one in model (13), the indirect network externalities once again become significant at 5% significance level and positively affect the probability of card acceptance by the merchant. Model (13) leaves the direct network externalities measure as in the previous model changing only the measure of the indirect externalities. Direct externalities effect remains positive and significant ($p < 0.01$). Such a result can be explained by the sample specificity, as it is representative for federal regions rather than lower level regions. The effect of control variables remains the same as in baseline model.

In further models I change the variable proxying the direct network externalities and use the actual acceptance level instead of perceived one. First, I investigate the total network externalities effect on regional and federal region levels separately. The explanatory variables in Model (14) are: regional average acceptance level for direct externalities and

regional average usage of cards for indirect externalities. Once again, the direct externalities turn out to be significant at 1% significance level, while the indirect externalities are not significant at any reasonable significance level. Similarly, the indirect network effects are insignificant in model (15) when I use the same explanatory variables at federal region level. This can be explained by the problem of multicollinearity (correlation between these variables are, respectively, 50% and 77%). Multicollinearity can be resolved by introducing the principal component analysis (PCA), which was outlined in empirical set-up. The PCA used in this study includes just two variables: usage and holding rates at regional and federal region levels. The respective components are, then, constructed. Besides, the aggregated component will allow examining the aggregate effect of network externalities, which was partially investigated in previous literature in the context of other geographic markets. Further Models (16) – (18) use PCA of Region/Federal Region network effects as explanatory variables.

Model (16) exploits one common explanatory variable to reveal the total network effects – PCA of region network effects. Leaving the control variables unchanged, the model shows that network effects positively and significantly ($p < 0.01$) affect the probability of card acceptance by merchants. In Model (17) I use PCA of Federal Region network effects instead, which gives similar results to the regional level PCA. To check for the robustness of the results I also add controls for the economic crimes into the later specification in Model (18). The results have not changed after the introduction of the two controls for shadow economy.

As a result, when I test the H_1 and H_2 together I find that the indirect externalities can appear insignificant in some frameworks. The problem that leads to such an outcome is the presence of multicollinearity. When I overcome this econometric issue by introducing of the results of the principal component analysis, the result becomes positive and significant at 1% significance level. These findings are in line with previous studies (Loke, 2007; Bounie et al., 2016) as well as with the theoretical mechanisms outlined in this study.

Overall, models (2) – (11) show support for the mechanisms identified in the theoretical framework. Hypotheses H_1 and H_2 of the presence of direct and indirect network externalities respectively cannot be rejected. The presence of only direct, only indirect or both network externalities at the same time positively and significantly affects the probability of card acceptance as a method of payments by any particular merchant. The results are robust to the changes in control variables.

4.3 Marginal Effects

However, it should be understood that coefficients obtained in the probit model show only the sign of the effect, but not the strength of the influence on the dependent variable. In order to investigate the magnitude of the network effects I additionally calculate the marginal effects for the last three specifications presented in the previous sub- section.

Table 6 goes about here

Network externalities have strong significance in economic sense as well. The results of the marginal effects analysis at the average values of independent variables for the last three models are presented in Table 6. One standard deviation increase in component of

the regional network effects leads to a 10.50 percentage point increase in the probability of cards acceptance by a merchant. Similarly, one standard deviation increase in PCA of Federal Region Network effects leads to a 7.74 percentage point increase in the probability of cards acceptance by a merchant. When economic crimes are controlled for, the magnitude of the effect becomes smaller: one standard deviation increase in the factor reflecting average federal region usage rate leads to 6.7 percentage point increase in the probability of cashless payments acceptance by a merchant.

Overall, approximately 11.6% of the probability of card acceptance is explained by the network externalities effect. Thus, there are 88.4% remaining that are attributed to the social-demographic profile of the merchants, regional characteristics and other factors that may be directly affected by the CB and other market players via the obligatory changes in fee levels, acceptance subsidies, mandatory acceptance policies, taxes regulations and other stimulating mechanisms (e.g., Krivosheya et al. (2015) provides the list of stimulating measures for cashless economy development).The above analysis of the marginal effects confirms the economic significance of the network externalities. H_1 and H_2 cannot be rejected, as the results are not only statistically, but also economically significant.

5. Conclusion

This research examines the role of network externalities in card acceptance by merchants on the retail payments market in Russia. The main finding of this study is that the probability of cards acceptance by merchants increases with the presence of direct and indirect or both types of network externalities, controlling for a large set of control variables, including merchants' characteristics and other location-specific differences between retailers. The results are robust to the changes in measure of network externality. The effect persists when regional level explanatory variables are used instead of the federal region ones and after the introduction of controls for economic crimes. The findings are significant both statistically and economically. From the practical point of view, understanding the magnitude of influence of the network externalities might explain the extent to which the government, commercial banks, payment systems and other market participants can influence the probability of card acceptance by merchants.

The article contributes to the small but rising literature on the determinants of card acceptance demand by merchants (C. Arango & Taylor, 2008a; Bounie et al., 2016; Carbó- Valverde et al., 2012; Hayashi, 2006; Krivosheya & Korolev, 2018; Loke, 2007; Rochet & Tirole, 2011). The role of the network externalities have been established in the theoretical studies and have often been hypothesized to influence the cashless payments usage and acceptance, but there is a lack of empirical studies evaluating the magnitude of the network effects at the retail payments market. Moreover, to the best of my knowledge, none of the studies separate between the direct and indirect the network effects. Also, there is a lack of empirical studies regarding cashless payments acceptance on Russian market, where the role of cash has historically been high and the end-users behavior habits are yet forming. This article fills these gaps by providing the empirical analysis based on the survey of 800 traditional (offline) merchants from all Russian regions, and shows estimates of the effect of both direct and indirect network

externalities for the merchants' card acceptance probability at Russian retail payments market.

This research complements recent empirical studies by Bounie et al. (2016) and Arango-Arango et al. (2018), which focuses on the role of network externalities at the retail payments market. The former study focuses on the merchant side of the retail payments card market and explains the card acceptance probability in France. Previous studies, however, could not efficiently separate the effect of direct network externalities from the indirect ones due to data limitations (Bounie et al. (2016) have different time periods for individuals and merchants samples). Apart from other gaps, this study fills this gap by investigating the indirect network externalities and the total network effect alongside the direct network effects in the context of Russian market. I also implement more control variables to avoid the potential omitted variable bias following the set of control variables established by Krivosheya and Korolev (2018) for the Russian retail payments market that arise not only from merchant but also from the geographical and economic specificities.

For each type of the network externalities I show evidence for both regional and federal region level proxies. Empirically, all of the introduced explanatory variables appear to be statistically significant, thus, increasing the probability of cards acceptance by merchants. Due to the fact that (federal) regional usage and acceptance levels might correlate I also introduce the principal component of different network effects variables to analyze the aggregate effect of both network externalities on the card acceptance probability. The PCA variables for the total network effects provide the same results at both Regional and Federal Region levels in Russia. These results are in line with the findings of previous literature that investigated the aggregate network effects influence on card acceptance probability at the developed retail payments markets (Bounie et al., 2016; Carbó-Valverde et al., 2012).

All of the results are robust to changes in measures and are also economically significant. One standard deviation increase in average federal region card acceptance increases the probability of acceptance by each particular merchant by 7.4 percentage points. Indirect externalities have similar effect: a standard deviation increase in average federal region usage rate of payment cards increases merchant acceptance probability by 7.04 percentage points. Combined, one standard deviation increase in the PCA factor reflecting both network externalities at the federal region level increases the merchant acceptance probability by 7.74 percentage points. In comparison, additional year of operations contribute to less than 1 percentage point increase in merchant acceptance probability.

From the practical point of view the results of this analysis unveil the extent to which different stimulating measures can affect merchants' card acceptance probability. Network externalities can be perceived as a multiplier for the policies that are aimed at the retail payments market stimulation. The magnitude of the effect of the network externalities reflects the degree towards which an increase in payment activity of cardholders and other merchants influences the acceptance rates by merchants. Hence, any stimulating measure is able to influence the payments market in two ways: directly influencing the acceptance or usage of payment services and indirectly influencing the

merchant acceptance via the network externalities. The effect of network externalities cannot be changed immediately by any existing stimulating measures. Therefore, the magnitude of the effect of the network externalities shows the share of the merchants' demand that cannot be altered by any financial market policies implemented by market participants such as the commercial banks, payment systems and central banks.

As any other analysis, this study has certain limitations that can be used to set up the directions for further research. First of all, the sample used in this study does not account for the online merchants. Online retailing market increased actively during the past decades both in Russia and in the world. Merchants have more incentives to accept cards as a method of payments in digital space because online markets have specific nature of competition, which is not dependent on the merchant's physical location, and which is usually more intense compared to offline retail (Au & Kauffman, 2008; Krivosheya & Korolev, 2018). It can, thus, be expected that the effect of the direct network externalities will intensify due to the increased competition. Besides, the increasing stimulating measures by bank-issuers, such as cash-back and discounts incentivize consumers to prefer online card payment rather than cash-on-delivery. Thereby, the inclusion of online- merchants may as well intensify the indirect network effects. Secondly, the sample used includes the data on 2013-2014 period only. Although the correlations between the network effects and the acceptance probability are unlikely to change, it would be interesting to see how the effects of new regulation and technologies have altered the degree of influence of network externalities in Russia. Finally, global retail payments markets can be added to the analysis to assess the differences in the extent to which network externalities affect developed, developing and underdeveloped countries. Besides, international comparison allows including more insights on the cross-border payments, which may unveil different mechanisms behind network effects because of lower degree of communication between foreign merchants and individuals.

6. References

Национальное агентство финансовых исследований (НАФИ) (2014), Барьеры — в голове. Российская Бизнес-газета - No951 (22) [Online].

Национальное агентство финансовых исследований (НАФИ) (2017), Доверие банкам, страховым компаниям и НПФ заметно снизилось. Аналитика от 8 сентября 2017. [Online].

Центральный Банк Российской Федерации (2014), Платежные и расчетные системы. Анализ и статистика», выпуск 42. [Online].

Центральный Банк Российской Федерации (2016), Платежные и расчетные системы. Анализ и статистика», выпуск 50. [Online].

Ali, R., Barrdear, J., Clews, R., & Southgate, J. (2014). Innovations in Payment Technologies and the Emergence of Digital Currencies. Bank of England Quarterly Bulletin 2014 Q3.

Arango, C., Huynh, K. P., & Sabetti, L. (2015), Consumer payment choice: Merchant card acceptance versus pricing incentives. Journal of Banking & Finance, 55, 130-141.

Arango, C. A., Huynh, K. P., & Sabetti, L. (2011). How Do You Pay? The Role of Incentives at the Point-of-Sale. ECB Working Paper No. 1386.

Arango, C., & Taylor, V. (2008). Merchants' Costs of Accepting Means of Payment: Is Cash the Least Costly? Bank of Canada Review, 2008–2009(Winter), pp. 17–25.

Arango-Arango, C. A., Bouhdaoui, Y., Bounie, D., Eschelbach, M., & Hernandez, L. (2018). Cash remains top-of-wallet! International evidence from payment diaries. Economic Modelling, Volume 69, January 2018, pp. 38-48.

Armstrong, M. (2005). Competition in Two-Sided Markets. The RAND Journal of Economics, Volume37, Issue3, September 2006, pp. 668-691.

Au, Y. A., & Kauffman, R. J. (2008). The economics of mobile payments: Understanding stakeholder issues for an emerging financial technology application. Electronic Commerce Research and Applications, 7(2), pp. 141–164.

Bagnall, J., Bounie, D., Huynh, K. P., Kosse, A., Schmidt, T., Schuh, S. D., & Stix, H. (2014), Consumer cash usage: A cross-country comparison with payment diary survey data. International Journal of Central Banking, 2016, vol. 12, issue 4, 1-61.

Baxter, W. F. (1983). Bank Interchange of Transactional Paper: Legal and Economic Perspectives. The Journal of Law & Economics, 26(3), pp. 541–588.

Bayero, M. A. (2015). Effects of Cashless Economy Policy on Financial Inclusion in Nigeria: An Exploratory Study. Procedia - Social and Behavioral Sciences, 172, pp. 49–56.

Bedre-Defolie, Ozlem, & Calvano, E. (2013). Pricing Payment Cards. American Economic Journal: Microeconomics, 5(3), pp. 206–231.

Block, F. L., & Keller, M. R. (2015). State of Innovation: The U.S. Government's Role in Technology Development. Routledge.

Bolt, W. (2012). Retail Payment Systems: Competition, Innovation, and Implications (DNB Working Paper No. 362). Netherlands Central Bank, Research Department. De Nederlandsche Bank Working Paper No. 362.

Bolt, W., & Chakravorti, S. (2008). Economics of payment cards: a status report. Economic Perspectives, (Q4/2008), pp. 15–27.

Bolt, W., & Mester, L. J. (2017). Introduction to Retail Payments: Mapping Out the Road Ahead. Journal of Financial Services Research, 52(1–2), pp. 1–3.

Bolton, R. N., Kannan, P. K., & Bramlett, M. D. (2000). Implications of Loyalty Program Membership and Service Experiences for Customer Retention and Value. Journal of the Academy of Marketing Science, 28(1), pp. 95–108.

Bounie D., François A., & Van Hove L. (2015), Consumer payment preferences, network externalities and merchant card acceptance: An empirical investigation. Review of Industrial Organization, 51(3), 257-290.

Bounie D., Francois A., & Van Hove L. (2016), Merchant acceptance of payment cards:'must take' or 'wanna take'?. Review of Network Economics, Vol. 15, No. 3, p. 117-146.

Carbó-Valverde, S., & Liñares-Zegarra, J. M. (2011). How effective are rewards programs in promoting payment card usage? Empirical evidence. Journal of Banking & Finance, 35(12), pp. 3275–3291.

Carbo-Valverde, S. и Linares-Zegarra, J. (2012), Payment Card Interchange Fees: Assessing the Effectiveness of Antitrust Investigations и Regulation in Europe. Available at SSRN 2052056.

Carbó- Valverde, S., Liñares Zegarra, J., Rodríguez Fernández, F., (2012), Feedback Loop Effects in Payment Card Markets: Empirical Evidence, Review of Network Economics, vol. 11, Issue 2, article 2.

Chakravorti, S., & Roson, R. (2006). Platform competition in two-sided markets: The case of payment networks. Review of Network Economics, 5(1).

Chernikova, L. I., Faizova, G. R., Egorova, E. N., & Kozhevnikova, N. V. (2015). Functioning and Development of Retail Banking in Russia. Mediterranean Journal of Social Sciences, Vol. 6. No. 6., pp. 274–284.

Chiang, T. C., & Zheng, D. (2010). An empirical analysis of herd behavior in global stock markets. Journal of Banking & Finance, 34(8), pp. 1911–1921.

Ching, A. T., & Hayashi, F. (2010). Payment card rewards programs and consumer payment choice. Journal of Banking & Finance, 34(8), pp. 1773–1787.

Chizhikova, E. S. (2013). The Current Payment System of the Russian Federation. Middle-East Journal of Scientific Research, 14(2), pp. 244–247.

Darban, M., & Amirkhiz, H. (2015). Herd Behavior in Technology Adoption: The Role of Adopter and Adopted Characteristics. In 2015, 48th Hawaii International Conference on System Sciences (pp. 3591–3600).

Doyle M. A., Fisher, C., & Yadav, A. (2017), How Australians Pay: Evidence from the 2016. Consumer Payments Survey. Reserve Bank of Australia.

33. Economides N. (1996), Network Externalities, Complementarities, and Invitations to Enter. European Journal of Political Economy, Vol. 12(2), pp. 211-2

Evans, D., and Schmalensee, R. (1999), Paying with Plastic: The Digital Revolution in Buying and Borrowing. MIT Press: Cambridge, MA.

Guthrie, G., & Wright, J. (2007). Competing Payment Schemes. The Journal of Industrial Economics, 55(1), pp. 37–67.

Hasan, I., Schmiedel, H., & Song, L. (2012). Returns to Retail Banking and Payments. Journal of Financial Services Research, 41(3), pp. 163–195.

Hayashi, F. (2006). A Puzzle of Card Payment Pricing: Why Are Merchants Still Accepting Card Payments? Review of Network Economics, Vol. 5, Issue 1.

Hunt, R. M. (2003). An Introduction to the Economics of Payment Card Networks. Review of Network Economics, Vol. 2(2).

Jonker, N., (2011), Card Acceptance и Surcharging: the Role of Costs и Competition, Review of Network Economics, 10 (2).

Kabakova, O., Plaksenkov, E., & Korovkin, V. (2016). Strategizing for Financial Technology Platforms: Findings from Four Russian Case Studies. Psychology & Marketing, 33(12), pp. 1106– 1111.

Kim, C., Tao, W., Shin, N., & Kim, K.-S. (2010). An empirical study of customers' perceptions of security and trust in e-payment systems. Electronic Commerce Research and Applications, 9(1), pp. 84–95.

Krivosheya, E., & Korolev, A. (2016). Benefits of the retail payments card market: Russian cardholders' evidence. Journal of Business Research, 69(11), pp. 5034–5039.

Krivosheya, E., & Korolev, A. (2018). Benefits of the retail payments card market: Evidence from Russian merchants. Journal of Business Research, 88, pp. 466–473.

Krivosheya, E., Korolev, A., & Plaksenkov, E. (2015). Measures for stimulating a cashless economy in Russia. Moscow School of Management SKOLKOVO working paper.

Plaksenkov, E., Korovkin, V., & Krivosheya, E. (2015). Cashless economy in Russia: Tendencies, perspectives, opportunities. Moscow School of Management SKOLKOVO Working Paper.

Krivosheya, E., Semerikova, E., Korolev, A. & Tarusova, E. (2017). Cashless economy in Russia 2030: Scenarios for market and industry. Moscow School of Management SKOLKOVO Working Paper.

Loke, Y. J., (2007), Determinants of Merchant Participation in Credit Card Payment Schemes, Review of Network Economics, 6 (4).

Malphrus, S. (2009). Perspectives on Retail Payments Fraud. Economic Perspectives, Vol. XXXIII, No. 1, 2009.

Milne, A. (2006). What is in it for us? Network effects and bank payment innovation. Journal of Banking & Finance, 30(6), pp. 1613–1630.

Promothesh C. and Randall L. (2012), Do Payment Mechanisms Change the Way Consumers Perceive Products? Journal of Consumer Research, 38(6).

Rauch, D. E., & Schleicher, D. (2015). Like Uber, But for Local Governmental Policy: The Future of Local Regulation of the "Sharing Economy". George Mason Law & Economics Research Paper No. 15-01.

Reinartz, W., Dellaert, B., Krafft, M., Kumar, V., & Varadarajan, R. (2011). Retailing Innovations in a Globalizing Retail Market Environment. Journal of Retailing, Vol. 87, Supplement 1, pp. S53– S66.

Rochet, J.-C., & Tirole, J. (2002). Cooperation among Competitors: Some Economics of Payment Card Associations. The RAND Journal of Economics, 33(4), pp. 549–570.

Rochet, J.-C., & Tirole, J. (2003). Platform Competition in Two-sided Markets. Journal of the European Economic Association, 1(4), pp. 990–1029.

Rochet, J.-C., & Tirole, J. (2011). Must-Take Cards: Merchant Discounts and Avoided Costs. Journal of the European Economic Association, 9(3), pp. 462–495.

Rysman, M. (2007), An Empirical Analysis of Payment Card Usage. The Journal of Industrial Economics, 55 (1): 1-3

Scharfstein, D. S., & Stein, J. C. (1990). Herd Behavior and Investment. The American Economic Review, 80(3), pp. 465–479.

Todd, S., & Lawson, R. (2003). Consumer preferences for payment methods: a segmentation analysis. International Journal of Bank Marketing, 21(2), pp. 72–79.

Trueman, B. (1994). Analyst Forecasts and Herding Behavior. Review of Financial Studies, 7(1), pp. 97–124.

Vickers, J. (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, May 4-6, 2005) pp. 231– 247.

Visa USA Research Services (2006), Visa Payment Panel Study: Payment Trends Summary.

Wakamori N., Welte A. (2017), Why Do Shoppers Use Cash? Evidence from Shopping Diary Data. Bank of Canada.

Weiner, S., & Wright, J. (2005). Interchange Fees in Various Countries: Developments and Determinants. Review of Network Economics, 4(4), pp. 1–34.

Weitzel T., Wendt O., Falk G. von Westarp and Konig W. (2003), Network Effects and Diffusion Theory: Network Analysi International Journal of IT Standards and Standardization Research 1(2), pp. 1-21

Wright, J. (2004). The Determinants of Optimal Interchange Fees in Payment Systems. The Journal of Industrial Economics, 52(1), pp. 1–26.