Card-Sales Response to Merchant Contactless Payment Acceptance: Causal Evidence

David Bounie, Youssouf Camara

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Abstract

Disruptive innovations in digital payments are happening in a large number of countries around the world. While consumers may access to a wide variety of payment technologies, a natural question arises: does accepting a new payment technology allow merchants to increase their business sales? Using matching and difference-in-difference techniques on a unique sample of about 275,580 merchants in France, we find that accepting contactless payments in 2018 increases on average the card-sales amount by 17 percent (and by 20 percent the card-sales count) compared to merchants who do not accept contactless payments. We also find evidence that accepting contactless payments exerts a positive spillover of about 3 percent in the amount of contact card sales, and is also more profitable for small merchants and new entrepreneurs.

Keywords: Card acceptance, contactless cards, digital payments, difference-in-difference.

JEL Classifications: C21, E21, E42, O33.

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1 Introduction

New cashless payment technologies have emerged around the world, especially in Asia and Europe. Promoted by innovating banks and financial technology companies (called Fintech), digital payments have become a strong alternative to cash and cheques still widely used in developed countries, and their use is becoming increasingly popular (European Central Bank, 2018).

Accepting a new payment technology is however risky and not necessarily profitable for businesses, as consumers have already accessed a wide variety of payment technologies including debit cards and credit cards.[1] Consumer habit, consumer concern with security or financial privacy may impede acceptance and use, and increase the cost of accepting payments for merchants. But accepting a new payment technology may also allow merchants to attract new customers and to raise retail prices (Rochet and Tirole, 2006), to increase payments from old and loyal customers, or to better combat fraud and lower its related costs.

Although there is a growing economic literature on payment instruments, there are few empirical papers examining the relation between the merchant acceptance of a new payment technology and its business sales.[2] Given the increasing number of innovations in payments, a natural question arises: Does accepting a new payment technology allow merchants increasing their business sales? This paper provides an answer to this question by investigating whether the merchant acceptance of a new payment technology, namely contactless cards, impacts its business card-sales, but also how the impact changes with the business size (small, medium and large retailers), the business sector, and the use of other accepted payment technologies (e.g. contact cards).

At the beginning of 2010s, major banks in France decided to issue contactless payment cards with the domestic card scheme, Cartes Bancaires CB (also known as "CB"). Contactless payments allow customers to pay by tapping their cards or

[1] Bagnall et al. (2016) show for example that more than 90% of the population hold either a debit or a credit card in the Netherlands, Germany, Austria and Canada. For more details on payment innovations such as mobile payments, faster payments and digital currencies, see Rysman and Schuh (2016).

[2] There is an extensive literature on technology acceptance (see among others Davis, 1989; Venkatesh et al., 2003; Hall and Khan, 2003; C. Srivastava et al., 2010; Gerhardt Schierz et al., 2010), technology diffusion (Caselli and Coleman, 2001; Rogers, 2003; Comin and Hobijn, 2004) and payment choice (Bounie et al., 2016; Ching and Hayashi, 2010; Wang and Wolman, 2016).

mobile phones directly onto a contactless-enabled terminal, processing the payment in a few seconds. The contactless technologies are a faster alternative to contact card payments (by inserting the card in the terminal), and possibly also to other payment instruments like cash. Contactless payments by cards are capped to EUR 30 (since October 2017), whereas there is no limit for mobile phones - in this case customers are just required to put in their mobile code to authorise the payment. Contactless payments in France are mainly done by cards and aimed at providing an alternative to cash that is mainly used to purchase small-value items. According to the latest statistics provided by Cartes Bancaires CB, 2.1 billion of contactless CB payments have been realized in 2018 for a total amount of EUR 22.5 billion (CB, 2018). As of December 2018, one in five card payments are made using contactless cards in France.

In this paper, we measure the causal effect of accepting contactless payments on the annual card sales (amount, count, and average transaction amount). We use a unique sample of about 275,580 unique CB merchants[3] in France, and we mobilize matching and difference-in-difference methods to compare changes in the businesses that have adopted contactless payments in 2018 to similar businesses that still do not accept contactless payments. We find that the merchants who started accepting contactless payments experience an average increase of 17 percent in the annual card-sales amount - and 20 percent in sales count -, relative to their counterparts who do not accept. Accepting contactless payments drives therefore card business growth. We also find evidence that accepting contactless payments has a positive spillover effect on the annual contact card-sales amount of about 3 percent, but a negative one in the upper parts of the contact card-sales amount distribution (75th and 90th percentiles). Moreover, the benefits of acceptance are larger for small merchants. For example, the average card-sales amount of merchants with annual card sales less than EUR 25,000 increases by 36 percent, while the average card-sales amount for large retailers (more than EUR 500,000) increases by 11 percent. Unsurprisingly, we find that the benefits of accepting contactless payments are the largest for bakeries (32 percent) that typically sell small-value items and need to speed up transactions during peak hours. Finally, we also highlight that the spillover effect is much stronger

[3]Only aggregated data related to CB card transactions performed by CB merchants has been used.

for new entrepreneurial firms who have just started their business (80 percent).

This paper contributes to the economic literature on payment instruments by estimating the causal effect of the merchant acceptance of a new payment technology. In recent years, a growing body of the economic literature has focused on consumer adoption and usage of payment instruments (see for example Stavins, 2018). Thanks to the development of the two-sided market literature, supply-side constraints such as merchant card acceptance have been progressively included in empirical research (Arango et al., 2015, Bounie et al., 2017 and Jonker, 2011). Most of these studies use survey data and standard correlation models to study the impact of new payment technologies such as debit and credit cards, mobile and contactless cards on paper-based payment instruments (e.g. cash or cheques). Trütsch (2014) for example examines the impact of contactless payments on the spending ratio between debit and credit cards payments and all other payment methods. Using a national survey on consumer payment behavior in the US in 2010, the author shows that contactless payments increase the spending ratio at the point-of-sale for both debit and credit cards payment. Fung et al. (2012) use the 2009 Bank of Canada Method of Payment survey to measure the impact of contactless credit cards on cash usage. They find evidence that the use of contactless credit cards reduces in average the total value and volume of cash usage.

Agarwal et al. (2019) is the closest paper to our research. Using a difference-in-difference setting, they investigate the effect of a new mobile-payment technology (QR code) adoption in Singapore by comparing two groups of merchants who have already adopted the technology, small merchants and large ones. Merchants are all clients of the same bank in Singapore. They find a positive impact of mobile payment technology on promoting business growth, especially the small merchants. Our paper differs from their approach on two main points. First we provide a comparison between a group of merchants who have adopted the new payment technology and a group that did not adopt the technology. Second, we have aggregated information on all the CB card sales for each CB merchant as we have data from all banks members of CB card scheme in France. We can therefore provide strategic recommendations for banks and Fintech companies interested in promoting efficient payment technologies to merchants who have not yet adopted digital payment innovations.

The remainder of the paper is structured in five sections. Section 2 describes the french card market. Section 3 presents a simple model of card-sales response to contactless card acceptance. Section 4 details the methodology and estimation strategy. Section 5 comments the estimation results. Section 6 concludes.

2 The French Card Market at a Glance

France is a country with a mature card market. One of the leading card schemes is Cartes Bancaires CB. Cartes Bancaires CB is a domestic scheme created by the French banks that counts in 2018 more than 100 french and foreign members (Payment Service Providers, banks and e-money institutions) operating in France, 1.77 million CB merchants, 70.4 million CB cardholders, and it was good for more than 12.7 billion CB transactions, and and EUR 593 billion (CB, 2018).[4]

The term "Cartes Bancaires CB" refers to all cards that carry the CB brand. CB cards can be "immediate" debit cards, but also deferred debit cards ("charge cards" that require the balance to be paid in full each month), and even "real" credit cards (cards with a credit line). A peculiarity of the French card market is that merchants who accept CB cards will make no distinction between debit cards and the other types. Therefore, CB merchant is a merchant affiliated to the CB scheme and CB transaction is the card transaction performed under the CB brand.

Starting from 2012, the CB banks have decided to massively issue cards with contactless technology in addition to standard contact technology. Contactless cards use the Near Field Communication (NFC) technology that allow cards (or mobile) and a payment terminal to communicate wirelessly to each other when they are very close together under certain security conditions. NFC is actually a subset of a technology called RFID (Radio-Frequency IDentification), a technology that enables to identify devices through radio waves.[5]

At the end of 2014, 45.9 percent of CB cards, i.e. 27.5 million of contactless CB cards, and 19.7 percent of CB merchants were equipped with the CB contactless

[4]Cardholder is the term used to refer to the user of a card. The number of cardholders affiliated to a domestic card scheme such as Cartes Bancaires CB can be greater than the number of people living in a country because a person may hold several cards for example.

[5]NFC technology allows secure data to be exchanged within 10 cm. Egger (2013) provides an overview of the NFC technology and its applications in the tourism industry.

technology; overall, 64.5 million of contactless CB transactions for a total amount of EUR 706.5 million were recorded by Cartes Bancaires CB. Three years later, at the end of 2017, 71 percent of CB cards and 44 percent of CB merchants were contactless, for a total activity of about 1.2 billion contactless CB transactions and EUR 12.4 billion. Finally, in 2018, the french contactless market was launched for good with 76 percent of contactless CB cards and 59 percent of contactless CB merchants. 2.1 billion contactless CB transactions for EUR 22.5 billion were registered.

The rapid uptake of contactless cards in the French market raise several interesting questions: what is the impact of contactless cards on merchant card sales? How does the merchant card acceptance change the way consumers use their payment instruments at point of sale: do we observe a substitution between contact and contactless card technologies? Is the impact the same according to sectors (e.g. restaurants, hotels), and the size of business (small versus large merchants)?

3 A Simple Model of Card-Sales Response to Merchant Contactless Payments Acceptance

In this section, we provide a very simple model to study how the merchant sales may change after the acceptance of a new payment technology. Suppose that at time t, two payment technologies are available on the market: technology 1 is a contact card technology denoted cc, and technology 2 is a non card technology denoted nc (such as cash and cheque). The total sales of merchant i at time t, $\pi_{i,t}$, is then composed of sales from technology 1, $\pi_{i,t}^{cc}$, and sales from technology 2, $\pi_{i,t}^{nc}$.[6] At time $t+1$, a new contactless card technology denoted cl is adopted by merchant i. The total sales of merchant i at time $t+1$ after the adoption of the new technology is thus:

$$\tilde{\pi}_{i,t+1} = \tilde{\pi}_{i,t+1}^{nc} + \tilde{\pi}_{i,t+1}^{cc} + \tilde{\pi}_{i,t+1}^{cl}.^{7} \tag{1}$$

Note that in the absence of technology adoption, the total sales of merchant i at time $t+1$ would have been:

$$\pi_{i,t+1} = \pi_{i,t+1}^{nc} + \pi_{i,t+1}^{cc}. \tag{2}$$

[6] Index i allows the sales to depend on several merchant characteristics, such as its sector of activity or its location.

[7] $\tilde{\pi}$ indicates the sales of merchant i after the adoption of the new technology.

Following equations (1) and (2), the adoption of a contactless card technology by merchant i may affect its total sales for two reasons. First, the acceptance of a new payment technology may attract new customers that will use the new card technology (Agarwal et al., 2019). Second, old and loyal customers may also use differently the payment instruments, for example by replacing contact card or non card payments by contactless card payments. Let $\tilde{\pi}^{*}_{i,t+1}$ denote the change of the total sales resulting from the adoption of the contactless card technology and defined as follows:

$$\tilde{\pi}^{*}_{i,t+1} = \tilde{\pi}^{nc}_{i,t+1} - \pi^{nc}_{i,t+1} + \tilde{\pi}^{cc}_{i,t+1} - \pi^{cc}_{i,t+1} + \tilde{\pi}^{cl}_{i,t+1}. \tag{3}$$

Equation (3) indicates that if $\tilde{\pi}^{*}_{i,t+1} = 0$, then accepting contactless cards has no impact on total sales. This situation may arise for example if cash/cheque sales and contact card sales are strictly offset by contactless card sales. Moreover if $\tilde{\pi}^{*}_{i,t+1} > 0$, then the acceptance of the contactless card increases total sales. New sales can be paid by new customers (Agarwal et al., 2019) or by loyal consumers who patronize more frequently the merchant equipped with the new payment technology.

In the empirical part which follows, we do not measure total sales, which is a limit. However, we measure total card sales, contact and contactless, and we can therefore first conclude on the substitution between card payment technologies, and second we can conjecture about the evolution of total sales given the significant increase in contactless card sales.

First, focusing the analysis on card sales, two comments can be made from equation (3). The first is related to the card-sales response to merchants contactless card acceptance. If $(\tilde{\pi}^{cc}_{i,t+1} + \tilde{\pi}^{cl}_{i,t+1}) - (\pi^{cc}_{i,t+1}) > 0$, then the sales from contact and contactless card technologies are higher than those that would have resulted without the adoption of the new payment technology. The adoption of the contactless payment technology increases therefore the card sales for the merchant by attracting new customers, encouraging consumers to use more intensively card technologies, or by displacing non card payments. The second is the contact card response to the merchant contactless card acceptance. If $\tilde{\pi}^{cc}_{i,t+1} - \pi^{cc}_{i,t+1} > 0$, then the adoption of a contactless card technology spills over contact card payments, and the positive externality implies higher contact card sales. A possible substitution may also occur with non card payments if consumers replace cash or cheque payments by contact and contactless card payments. However, if $\tilde{\pi}^{cc}_{i,t+1} - \pi^{cc}_{i,t+1} < 0$, a negative externality occurs, and the merchants will gain lower sales from contact card payments. There is therefore a cannibalization between contact and contactless card payments. Merchants still gain from the adoption of contactless payments if contactless card sales offset those of contact card payments, and possibly also the sales of non card payments.

Second, as we have information on the evolution of contactless and contact card sales, we can conjecture about the substitution between payment technologies and the evolution of total sales. Indeed, in a scenario where the change in card sales is significantly positive and high, i.e. $\tilde{\pi}^{cc}_{i,t+1} - \pi^{cc}_{i,t+1} + \tilde{\pi}^{cl}_{i,t+1} >> 0$, then we can conjecture about a sharp substitution between card and non card payment technologies.[8] The significant increase in card sales is probably indeed far greater than total sales on average, and as long as $(\tilde{\pi}^{cc}_{i,t+1} - \pi^{cc}_{i,t+1} + \tilde{\pi}^{cl}_{i,t+1}) - \tilde{\pi}^{*}_{i,t+1} > 0$, we can conjecture that card technologies replace other payment technologies. Recent statistics provided by the European Central Bank (2018) about a fall of cash and cheque usage in Europe, tend to support this conjecture. Second, as long as $(\tilde{\pi}^{cc}_{i,t+1} - \pi^{cc}_{i,t+1} + \tilde{\pi}^{cl}_{i,t+1}) - (\tilde{\pi}^{nc}_{i,t+1} - \pi^{nc}_{i,t+1}) > 0$, then we can also conjecture about a positive effect of the acceptance of contactless cards on total sales.

Using card transactions data, matching and difference-in-difference methods, we propose in the next section to study the card-sales response that would have prevailed in the absence of the acceptance of contactless cards by a large sample of merchants.

4 Data and Estimation Strategy

In this section, we investigate the causal effect of contactless payments on merchant card sales (amount, count or amount per transaction). We use a standard difference-in-difference method to compare the changes in the average (quantile) card sales between the CB merchants who have accepted the contactless payments in 2018 (the "treatment group"), and the CB merchants who do not still accept contactless payments in 2018 (the "control group"). However, the acceptance of con-

[8]See Section 5 for a more detailed discussion. We find that this conjecture is very likely as we observe both an increase in card-sales amount (+17 percent) and a positive externality on contact card sales (+3 percent).

tactless payments is not a random experiment, i.e. the treatment is not randomly assigned, as the merchant decides when adopting the new payment technology. To avoid possible selection bias, we use in a first step a propensity score matching setting to compare merchants who are similar in all relevant pre-treatment characteristics.

4.1 Sample Design

Thanks to a research partnership with Cartes Bancaires CB, we have access to a unique data set on the merchant card activity. Data is available from 2015 to 2018. For monitoring purpose, Cartes Bancaires CB collects CB transactions aggregated amount and count for every CB merchant associated with their Merchant Business identification number, creation date,[9] type of activity (offline business and/or online business), geographical location. It is worth noting however for a clear understanding of the paper that before 2017, Payment Service Providers (PSPs) had no obligation to separately report contact and contactless payments to Cartes Bancaires CB. As a consequence, it is only possible to separate the sales that come from CB contact and contactless payments after 2017. This is why we measure the impact of contactless payments starting from 2018. Nevertheless, we will use data from 2015 to 2017 to check a crucial assumption of the difference-in-difference estimation, that is the common trend evolution of sales before the contactless payment acceptance by the treatment group.

To investigate the causal effect of contactless payments on merchant card sales, we therefore focus the analysis on merchants who decided to accept contactless payments in 2018 and who did not accept therefore contactless payments in 2017 (the "treatment group"), and compare this group to merchants who did not still accept contactless payments in 2018, and therefore who did not accept contactless payments in 2017 (the "control group").

As we consider 2018 as the treatment period, we therefore exclude from the sample the merchants who already accepted contactless payments in 2017. We also exclude from the sample, the online CB merchants who do not use contactless payments, and also vending machines. The remaining sample includes 346,240 unique offline CB merchants, with 72,571 in the treatment group, and 273,669 in the con-

[9] The creation date of the merchant corresponds to the first card transaction date registered in the CB system.

trol group. Finally, as we want to estimate the counterfactual and verify that the control and treatment groups had the same evolution of average card sales before the acceptance of contactless payments, we keep in the sample all the businesses that have existed since at least 2015, and exclude the others. After this step, we are left with 275,580 businesses: 57,830 in the treatment group and 217,750 in the control group.

4.2 Propensity Score Matching

Inference about the impact of acceptance of contactless payments on merchant card sales involves speculation about how this merchant would have performed had he not accepted contactless payments. To estimate the effect of a such treatment, i.e. accepting contactless payments, Rosenbaum and Rubin (1983) proposed a framework named *propensity score matching* (PSM). PSM is a simple statistical matching technique to obtain unbiased estimation of causal treatment effects by adjusting for the covariate confounding. Based on the observable characteristics of two groups, the control and the treatment group, it is possible to estimate the counterfactual, i.e. the situation that would have prevailed in the absence of the treatment. To summarize, PSM attempts to replicate the properties of a randomized trial by creating a sample of units that received the treatment that is comparable on all observed covariates to a sample of units that did not receive the treatment.

We use PSM to match merchants in the control group to merchants in the treatment group such that the effect of the treatment can be estimated from the resulting matched sample. To do that, we use a standard logistic regression to estimate the probability that a merchant i adopts the contactless technology conditional on observable characteristics. The probability of accepting the contactless technology ($score_i$) can be written as follows:

$$Score_i = P(Treated_i = 1|X_i) = \frac{exp(f(X_i))}{1 + exp(f(X_i))}, \tag{4}$$

with X_i the vector of observable characteristics that are the sector of activity, the geographical location[10] and the age of business (plus the age squared). $f(X)$ is a linear combination of variables in X_i.

[10]Geographical location is defined by the longitude and latitude of the merchant's city.

Using the *caliper matching* (Raynor, 1983 and Dehejia and Wahba, 2002), each NFC equipped merchant is then assigned a twin of the control group. In other words, we select an untreated merchant who has the closest score to a treated merchant. Formally, merchants i and j are matched under the condition that $\min_j |Score_i - Score_j| < h$, with i a merchant of the treatment group, j a merchant of the control group, and h the tolerable maximum score distance between i and j.[11] As standard in the literature, we use $h = 0,02$.[12]

PSM is based on two main assumptions. The first is the *conditional independence assumption (CIA)* or *unconfoundedness assumption* that relies on the sufficient existence of observable variables for which an independence of treatment assignment can be verified.[13] The second assumption named *common support assumption (or overlap assumption)* refers to a common region where the distribution of propensity scores of the treatment and control groups are the same. The common support assumption ensures that merchants with the same X_i have positive probability of both accepting and not accepting contactless payments such that $Score_i \in]0, 1[$. An important step is therefore to check the region of common support between treatment and control groups. Among the several ways suggested in the literature, the most straightforward one is a visual analysis of the density distribution of the propensity score in both groups (Caliendo and Kopeinig, 2008). We will use this approach in the next sections.

4.3 Difference-In-Difference Method

To difference out remaining heterogeneity, we use, on the matched sample, the difference-in-difference (DID) estimation strategy (Heckman et al., 1997).[14] The DID method consists in our case in comparing the evolution of the average sales (amount, count or amount per transaction) of the treatment group before and after treatment (denoted ATT for Average Treatment effect on the Treated) with that of

[11]Merchant j is drawn with replacement. It can be paired with different merchants in the treatment group.

[12]For more details about the tolerance level, see Smith and Todd (2005).

[13]The conditional independence assumption cannot be directly tested.

[14]There are a lot of papers that use the DID method to estimate the effect of a program (see Bertrand et al. (2004), Hastings (2004), Gaynor et al. (2013), Greenstone and Hanna (2014), Schmeiser et al. (2016), Bose and Das (2017), Dague et al. (2017), Zimmerman (2019), Cengiz et al. (2019) among others).

the control group.

The first difference in DID method is, for each group, the evolution of the average card sales before and after treatment. The latter eliminates systematic differences (unobserved heterogeneity) between the treated merchants and other merchants. The second difference eliminates the temporal evolution, assumed to be identical for both groups in the absence of the program. Indeed, comparing only the average sales of the groups after treatment does not consider other factors that may explain variations in sales over time, independently of the program effects. For example, sales may heavily depend on the state of the economy, according to whether it is more favorable or not.

The DID estimator assumes that the sales of the two groups would have changed in the same way in the absence of the intervention (*common trend assumption*). Any difference observed after the treatment could only come from the program, i.e. the acceptance of contactless payments. The common trend assumption can be verified by plotting the evolution of the average sales of the two groups before processing.

However, as the Average Treatment effect on the Treated (ATT) only captures the impact on the average card sales but not the impact on the entire distribution, we will also measure the quantile treatment effect on the treated (denoted QTT). QTT describes more precisely the impact of the treatment on the merchants' card sales than ATT. It models the entire conditional sales distribution. With the DID method, the q-th QTT corresponds to the difference between the evolution of q-th quantile of the treatment group's sales before and after program, and the equivalent quantile of the other group.

In quasi-experiments, when there is a self-selection, conventional quantile regression methods are not adapted to correctly estimate the QTT (Koenker and Bassett, 1978). In fact, QTT cannot be measured by comparing the quantile of the sales of the two groups before and after the intervention. Several methods have been developed to control this type of unobserved heterogeneity (Athey and Imbens, 2006; Firpo, 2007; Lamarche, 2010; Fan and Yu, 2012; Callaway et al., 2018). Firpo (2007) proposes a method for estimating QTT subject to observable characteristics. This method is based on identification assumptions comparable to those found in propensity score matching methods. This method is implemented using standard quantile regressions, weighting the observations by the estimated weight corresponding to the propensity score. We estimate QTT by considering the method developed by Firpo (2007).

Often the CIA does not hold. In this case, it is possible to focus on the DID method. This involves making the Distributional difference-in-difference Assumption. The latter is a direct extension of the parallel trend assumption made in the traditional difference-in-difference literature. Under this condition, it is possible to estimate QTT. When only two periods are available, Fan and Yu (2012) shows that Distributional difference-in-difference Assumption can partially identify the QTT. Thus, it is also necessary to estimate the bounds. Callaway et al. (2018) recommend a new assumption that the dependence (the copula) between the change in untreated potential outcomes and the initial level of untreated potential outcomes is the same for the treated and untreated merchants.

Following what has been said, we can write the model for estimating ATT and QTT on the matched sample as:

$$log(Y_{i,t}) = \beta_0 + \beta_1 * \mathbb{1}(T = 1) + \beta_2 * \mathbb{1}(t = 2018) + \beta_3 * \mathbb{1}(t = 2018) * \mathbb{1}(T = 1) + \epsilon, \quad (5)$$

with $log(Y_{i,t})$, the log of annual total sales amount (or count, or amount per transaction) of merchant i at time t. The dummy variable $\mathbb{1}(T = 1)$ is equal to one if the merchant i belongs to treatment group (i.e accepts the contactless payments) and captures constant differences in composition between the two groups (here is the group fixed effect). The dummy variable $\mathbb{1}(t = 2018)$ is equal to one for contactless card acceptance period in 2018 and captures the time effects. On the matched sample, using linear regression, β_3 corresponds to the average treatment effect for the treated (ATT), while using quantile regression with the Firpo (2007) strategy, it represents the quantile treatment effect for the treated (QTT).[15]

[15]ATT (QTT) represent the average (quantile) card-sales response to the contactless technology adoption in 2018. ATT can be written as: $ATT = [\mathbb{E}(log(Y)|T = 1, t = 2018) - \mathbb{E}(log(Y)|T = 1, t = 2017))] - [\mathbb{E}(log(Y)|T = 0, t = 2018) - \mathbb{E}(log(Y)|T = 0, t = 2017)]$. Similarly, the q-th QTT can be written as: $QTT_q = [Q_q(score * log(Y)|T = 1, t = 2018) - Q_q(score * log(Y)|T = 1, t = 2017)] - [Q_q(score * log(Y)|T = 0, t = 2018)) - Q_q(score * log(Y)|T = 0, t = 2017)]$ where *score* represents the probability to be treated conditioning to the observable characteristics (see equation (4)).

5 Estimation Results

We first discuss in this section the impact of the acceptance of contactless cards on merchant card sales, and next how it changes with the size of the merchant, the sector, the date of creation of the business, and finally how it spills over other payment instruments.

5.1 Causal Impact on Merchant Card Sales

We investigate in this section whether the acceptance of contactless payments directly affects merchant card sales. Following the model and Equation (3) in particular, we expect a positive and significant effect on card sales if merchants attract new consumers that use contactless payments or if old consumers replace non card payments by card payments, especially contactless payments.

To estimate the average (and quantile) card-sales response to the merchant adoption of contactless payment technology, we first use the PSM method described in Section 4.2, and check whether there is a region of common support between treatment and control groups. Figure 1 confirms the existence of such a region, and therefore the possibility of using the matched sample for an estimation.[16]

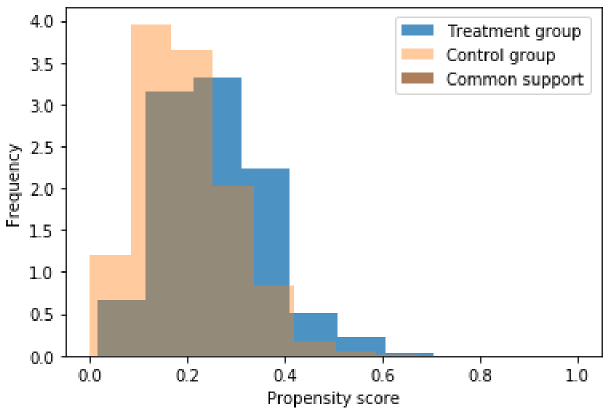


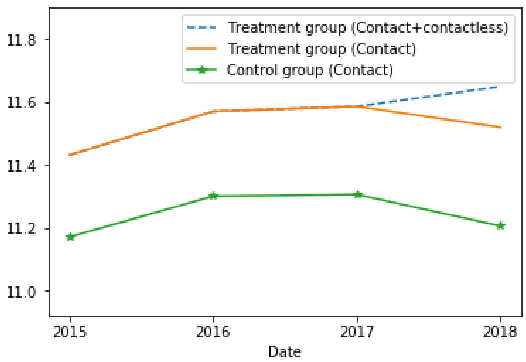
Figure 1: Region of Common Support

We use a difference-in-difference method on the matched sample (231,272 ob-

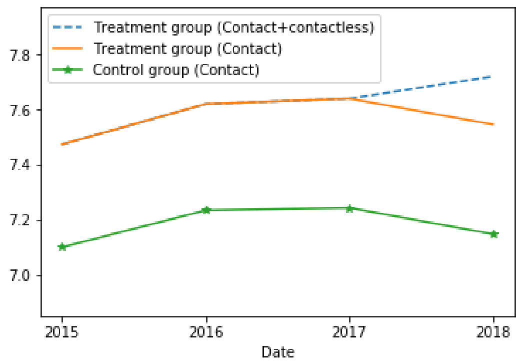
[16]To further check the robustness of the matching, we have also computed the difference between the average age of the treatment and control groups. In theory, we should no longer observe any statistical significant differences between the control and treatment groups. This is exactly what we find (see section 7.1).

servations) to estimate the average (and quantile) treatment effect on the treated, ATT (and QTT). We show first that the common trend assumption is not violated and thus that we can measure the causal effect of contactless card acceptance using the DID method. Figure 2 precisely illustrates that the treatment and control groups have the same evolution of the average log of card-sales amount (a), sales count (b) and amount per transaction (c) before 2018 (period of contactless payment adoption).

(a) log (total sales amount)



(b) log (total sales count)



(c) log (amount per transaction)

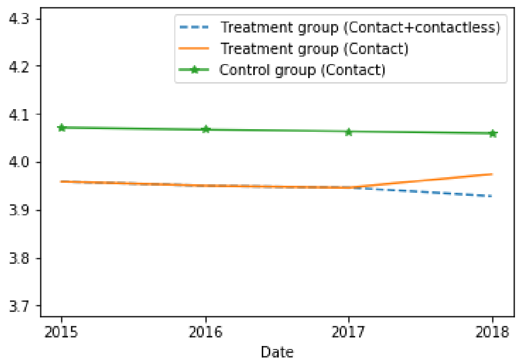


Figure 2: Test of Common Trend Assumption

Table 1 summarizes finally the estimation results. The intersection between row i and column j represents the average (or quantile) response of the column j to the acceptance of contactless payment technology. We find that the merchants who decided to accept contactless payments in 2018 compared to those who still do not increase their annual card-sales amount by 17 percent.[17] The average sales

[17] The estimated ATT for log of card-sales amount of Table 1 is 0.16, which is equivalent to a percentage increase of 17 percent ($= \exp(0.16) - 1$). All following ATT or QTT interpretations for log dependent variables will use the same formula.

count also increases by 20 percent. The effects are statistically significant at the 1 percent level. Accepting contactless payments therefore contributes to increase total card sales by attracting more consumers and/or by displacing non card payments such as cash and cheque payments. Moreover, we note that the average amount per transaction decreases by 1 percent: this result is in line with expectations as contactless cards are mainly used for small-value purchases (up to EUR 30).[18]

[18] Another way to test the assumption of common trend is to perform a placebo test. We first apply the placebo test on the previous periods where there is no contactless card adoption. We do not expect to find any significant impact. For example, we do not find a significant effect of contactless card adoption in 2016 for the merchants who really adopt the new technology in 2018. In addition, we apply a difference-in-difference setting when the period 2015-2017 is considered as the pre-treatment period. We also find no statistical difference in ATT with respect to the baseline case where 2017 is the pre-treatment period (see section 7.2 in Appendix).

Table 1: Contactless Acceptance and Business Card Sales

		Log(Sales amount) (1)	Log(Sales count) (2)	Log(Amount per transaction) (3)
ATT		0.16***	0.18***	-0.01***
		(0.004)	(0.004)	(0.001)
	q=10	0.26***	0.28***	-0.0
		(0.025)	(0.029)	(0.01)
	q=25	0.17***	0.18***	-0.01*
		(0.016)	(0.022)	(0.008)
QTT	q=50	0.12***	0.14***	-0.01*
		(0.015)	(0.018)	(0.007)
	q=75	0.08***	0.13***	-0.01
		(0.017)	(0.019)	(0.012)
	q=90	0.06***	0.11***	-0.02
		(0.022)	(0.023)	(0.012)
Observations			231,272	

Notes: This table reports the average (and quantile) card-sales response of merchants who accept contactless payments in 2018 compared with matched merchants who do not accept contactless payments, ATT (and QTT). On the matched merchants, using linear regression, β_3 of equation (5) corresponds to the ATT, and to QTT when using quantile regression. The dependent variable is the log of card-sales amount in column (1), the log of card-sales count in column (2) or the log of card amount per transaction in column (3). All regressions include group and time fixed effects. Robust standard errors clustered at the merchant level (for ATT) and bootstrapped standard errors (for QTT) are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

Interestingly, we also observe that the effect of treatment is heterogeneous across the card sales distribution, and benefits in particular to the lowest ones. For example, the 10th percentile card-sales amount of merchants who accept contactless payments increases by 30 percent (p-value< 0.01) compared to merchants who do not accept contactless payments. However, in the middle and upper parts of the distribution, the effect decreases to reach 6 percent (p-value< 0.01) for the 90th percentile. This result is similar for the sales count.

5.2 Contact Cards Spillover Effects

An interesting related question is how the acceptance of a new payment technology impacts the use of other payment technologies already accepted by the merchant at point-of-sale. In particular, we are interesting in exploring how contactless payments carried out by cards spill over to contact card sales. We compare the contact card response of the treated merchants who accept contactless payments with those who do not accept contactless cards but contact cards. Accepting a new card technology mainly dedicated to small-value transactions (up to EUR 30) may indeed increase incentives to cardholders to use more card technologies.

Following the methodology described in the previous section, we have applied the PSM and checked that the identifying assumptions of matching (common support assumption) and difference-in-difference (common trend assumption) are not violated.[19] Table 2 summarizes the results. We find indeed evidence that the merchants who accept contactless payments experience an average increase of 3 percent in the annual contact card-sales amount. Consumers that use more often contactless payments in equipped retailers tend also to use more on average their contact card. We also note that the average amount per transaction increases by 3 percent. The intuition of the result is simple: as the contact card is mainly used to pay medium and large-value purchases, the average amount of card sales increases.

[19]We also proceed in the same way for all the subsequent sections, but the results of the tests are not reproduced in the paper. They are available upon request.

Table 2: Contact Cards Spillover Effects

		Log(Sales amount) (1)	Log(Sales count) (2)	Log(Amount per transaction) (3)
ATT		0.03***	0.0	0.03***
		(0.004)	(0.004)	(0.001)
	q=10	0.12***	0.14***	0.04***
		(0.026)	(0.029)	(0.01)
	q=25	-0.0	0.06***	0.07***
		(0.015)	(0.021)	(0.008)
QTT	q=50	0.05***	-0.03	0.05***
		(0.016)	(0.018)	(0.006)
	q=75	-0.04**	-0.08***	0.01
		(0.017)	(0.019)	(0.012)
	q=90	-0.06***	-0.11***	-0.01
		(0.022)	(0.023)	(0.012)
Observations			231,272	

Notes: This table reports the average (and quantile) contact card-sales response of merchants who accept contactless payments in 2018 compared with matched merchants who do not accept contactless payments, ATT (and QTT). On the matched merchants, using linear regression, β_3 of equation (5) corresponds to ATT, and to QTT when using quantile regression. The dependent variable is the log of contact card-sales amount in column (1), the log of contact card-sales count in column (2) or the log of contact card amount per transaction in column (3). All regressions include group and time fixed effects. Robust standard errors clustered at the merchant level (for ATT) and bootstrapped standard errors (for QTT) are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

However, surprisingly, the positive spillover effect does not hold for all the distribution of contact card sales. For example, although the 10th percentile contact card-sales amount reaches 13 percent (p-value< 0.01), in the upper parts of the distribution (75th and 90th percentiles), the spillover effects are negative. Accepting contactless payments decreases by 4 and 6 percent the 75th and 90th percentiles contact card-sales amount, respectively. This result is similar for the sales count. Put differently, we observe a product cannibalization caused by the introduction of a contactless payment technology for the 75th and 90th percentiles card-sales amount of the retailers who have accepted contactless cards.

5.3 Card-Sales Response by Merchant Size

Contactless payments are intended to speed up small-value transactions at point-of-sale in fast-paced environments where customers have most of the time few cashier alternatives. For small businesses with high turnover rates, the reduction of complex transaction processes may lead to significant gains in efficiency and productivity, as well as to reduce cash management burden and hassles from running out of change. An interesting question to address is to evaluate the impact of contactless payments on the size of the business: do we observe differences between retailers of a similar size, and what is the magnitude of the impact between businesses of different sizes, i.e. between small and large businesses?

We explore these questions by cutting out businesses based on their annual sales. We define six categories of retailers based on the card sales observed in 2017: <EUR 25,000, EUR 25-50,000, EUR 50-100,000, EUR 100-200,000, EUR 200-500,000 and >EUR 500,000. Table 3 shows that accepting contactless payments is more profitable for small businesses compared to larger ones. For example, accepting contactless payments allows smallest merchants (less than EUR 25,000) to increase the average card-sales amount by 36 percent compared to merchants who do not still accept contactless payments, whereas the average benefits amounts to 11 percent for large retailers (>EUR 500,000).

Table 3: Average Card-Sales Response (ATT) by Merchant Size

	Merchants with total card sales between					
	25k€ <	25-50k€	50-100k€	100-200k€	200-500k€	> 500k€
	(1)	(2)	(3)	(4)	(5)	(6)
	Log(Sales amount)					
ATT	0.31***	0.16***	0.12***	0.13***	0.11***	0.1***
	(0.018)	(0.009)	(0.007)	(0.007)	(0.008)	(0.01)
	Log(Sales count)					
ATT	0.35***	0.18***	0.14***	0.15***	0.12***	0.11***
	(0.017)	(0.009)	(0.007)	(0.008)	(0.008)	(0.01)
	Log(Amount per transaction)					
ATT	-0.04***	-0.02***	-0.01***	-0.01***	-0.01***	-0.0***
	(0.006)	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)
Observations	29,652	32,664	49,128	47,772	41,420	30,200

Notes: This table reports the average card-sales response to the acceptance of contactless payments (ATT) by merchant size. For each merchant size in columns (1)-(6), on the matched merchants, using linear regression, β_3 of equation (5) corresponds to the ATT. The dependent variable is the log of card-sales amount, sales count or amount per transaction. All regressions include group and time fixed effects. Robust standard errors clustered at the merchant level are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

The benefits of accepting contactless cards are further strengthened by a positive spillover effect on contact card sales for small merchants. We indeed observe in Table 4 that the low-revenue merchants (< EUR 25,000) experience an average increase of about 14 percent in the annual contact card-sales amount compared with merchants who do not accept contactless cards. This effect amounts to 2 percent for merchants with card sales between EUR 100,000 and EUR 200,000, and negative and significant at the 10 percent level for larger merchants (> EUR 500,000). We also observe similar findings regarding the contact card-sales count. For example, accepting contactless payments allows smallest merchants (less than EUR 25,000) to increase the contact card-sales count by 12 percent compared to merchants who do not still accept contactless payments, whereas the sales count decrease by 5 percent for the largest retailers (> EUR 500,000).

Table 4: Spillover Effects and Average Contact Card-Sales Response (ATT) by Merchant Size

	Merchants with total card sales between					
	25k€ <	25-50k€	50-100k€	100-200k€	200-500k€	> 500k€
	(1)	(2)	(3)	(4)	(5)	(6)
	Log(Sales amount)					
ATT	0.13***	0.02**	0.01	0.02**	-0.0	-0.02*
	(0.018)	(0.01)	(0.007)	(0.008)	(0.008)	(0.01)
	Log(Sales count)					
ATT	0.12***	-0.01	-0.03***	-0.02*	-0.04***	-0.06***
	(0.017)	(0.01)	(0.007)	(0.008)	(0.008)	(0.01)
	Log(Amount per transaction)					
ATT	0.01	0.03***	0.03***	0.03***	0.04***	0.04***
	(0.006)	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)
Observations	29,652	32,664	49,128	47,772	41,420	30,200

Notes: This table reports the average contact card-sales response to the acceptance of contactless payments (ATT) by merchant size. For each merchant size in columns (1)-(6), on the matched merchants, using linear regression, β_3 of equation (5) corresponds to the ATT. The dependent variable is the log of contact card-sales amount, sales count or amount per transaction. All regressions include group and time fixed effects. Robust standard errors clustered at the merchant level are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

5.4 Card-Sales Response by Business Sector

The impact of contactless payments may vary with business sectors that are more concerned with limiting queues, saving times at the checkout, and enhancing the buying experience in stores. Some sectors are also more concerned with small-size transactions, the main target of contactless payments.

To capture heterogeneity between business sectors, we use the statistical classification of business activities in force since 2008 in France.[20] We focus particularly on nine categories: Bakery, Food, Health, Hotel, Leisure, Beauty care, Restaurant, Supermarket, and Taxi.[21] Table 5 displays the estimation results. Unsurprisingly, the benefits of accepting contactless payments are the largest for bakeries that typically

[20]The National Institute of Statistics (INSEE) uses the Nomenclature des Activites Francaises (NAF) to classify the business sectors.

[21]We use the following NAF codes: Restaurant (561XX and 563XX), Hotel (551XX and 552XX), Taxi (4932Z), Supermarket (471XX), Leisure (90XXX, 91XXX, 93XXX and 476XX), Health (862XX and 4773X), Bakeries (1071C, 1071D and 4724X), Beauty care (9602X and 9604X), and Food (4721X, 4722X, 4723X, 4725X and 4729X).

sell small-value items and need to speed up transactions during peak hours. Indeed the average benefits respectively increase by 32 percent (card-sales amount) and 43 percent (card-sales count) for bakeries who have adopted contactless card payments compared with bakeries that do not. Estimation results also confirm a large and significant benefit for retailers in the Leisure sector (30 percent respectively), as well as for taxis. The latter for example register a significantly higher increase in card-sales count (32 percent) but also in card-sales amount (28 percent) relative to their counterparts.

Table 5: Average Card-Sales Response (ATT) by Business Sectors

	Bakery (1)	Food (2)	Health (3)	Hotel (4)	Leisure (5)	Personal-care (6)	Restaurant (7)	Supermarket (8)	Taxi (9)
					Log(Sales amount)				
ATT	0.28***	0.18***	0.08***	0.18**	0.26***	0.11***	0.23***	0.23***	0.25***
	(0.029)	(0.024)	(0.008)	(0.04)	(0.025)	(0.011)	(0.012)	(0.032)	(0.042)
					Log(Sales count)				
ATT	0.36***	0.2***	0.09***	0.23***	0.27***	0.11***	0.25***	0.26***	0.28***
	(0.03)	(0.025)	(0.007)	(0.038)	(0.024)	(0.011)	(0.012)	(0.031)	(0.04)
					Log(Amount per transaction)				
ATT	-0.07***	-0.01***	-0.01***	-0.05***	-0.01	-0.0**	-0.01***	-0.03***	-0.03
	(0.005)	(0.004)	(0.002)	(0.018)	(0.007)	(0.001)	(0.003)	(0.009)	(0.017)
Observations	5,336	7,832	29,664	1,776	8,460	20,260	36,512	6,924	3,228

Notes: This table reports the average card-sales response to the adoption of contactless payments by business sector. For each business sector in columns (1)-(9), on the matched merchants, using linear regression, β_3 of equation (5) corresponds to the ATT. The dependent variable is the log of card-sales amount, sales count or amount per transaction. All regressions include group and time fixed effects. Robust standard errors clustered at the merchant level are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

Accepting contactless payments exerts also large positive and negative spillover effects on contact card payments that significantly vary according to sectors. Table 6 shows for example that the food sector benefits the most from the adoption of contactless contact card activity: accepting contactless payments increases the average contact card-sales amount by almost 13 percent whereas they decrease by 15 percent in the taxi sector. The decline indicates a switch from contact card to contactless payments in taxis. Also interesting is the cannibalization effect in bakeries: accepting contactless payments, comparing to merchants who do not, significantly decreases the sales count on average by 13 percent. Consumers therefore prefer to use their contactless card instead of their contact card to pay small-value items. This conclusion is also true for taxis who experienced a significant drop in the sales count (13 percent), indicating again a switch between contact and contactless payments.

Table 6: Spillover Effects and Average Contact Card-Sales Response (ATT) by Business Sector

	Bakery (1)	Food (2)	Health (3)	Hotel (4)	Leisure (5)	Personal-care (6)	Restaurant (7)	Supermarket (8)	Taxi (9)
					Log(Sales amount)				
ATT	-0.04	0.07***	-0.01	-0.09**	0.12***	0.04***	0.02	0.04	-0.14***
	(0.029)	(0.024)	(0.008)	(0.045)	(0.025)	(0.011)	(0.013)	(0.032)	(0.043)
					Log(Sales count)				
ATT	-0.14***	0.01	-0.04***	-0.06	0.07	0.0	-0.03*	-0.02	-0.11*
	(0.03)	(0.025)	(0.007)	(0.038)	(0.024)	(0.011)	(0.012)	(0.031)	(0.04)
					Log(Amount per transaction)				
ATT	0.1***	0.06***	0.03***	-0.04*	0.06***	0.04***	0.05***	0.06***	-0.03*
	(0.005)	(0.004)	(0.002)	(0.019)	(0.007)	(0.002)	(0.003)	(0.009)	(0.017)
Observations	5,336	7,832	29,664	1,776	8,460	20,260	36,512	6,924	3,228

Notes: This table reports the average contact card-sales response to the adoption of contactless payments by business sector. For each business sector in columns (1)-(9), on the matched merchants, using linear regression, β_3 of equation (5) corresponds to the ATT. The dependent variable is the log of contact card-sales amount, sales count or amount per transaction. All regressions include group and time fixed effects. Robust standard errors clustered at the merchant level are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

5.5 Extension: Card-Sales Response of New Entrepreneurs

In the previous sections, we analyzed the case of merchants who had started their business at least since 2015 (see discussion about the sample design in Section 4.1). In this last section, we limit the sample to new entrepreneurial firms who have started their business in 2017. We aim at studying whether new entrepreneurs who adopt contactless payments in 2018 have higher card sales than new entrepreneurs who do not still accept the contactless payment technology.

Table 7 provides the results. We observe that new entrepreneurs who adopted contactless payments double in 2018 their annual card-sales amount and count (108 and 111 percent, respectively) compared to those who do not still accept contactless payments. Similarly to what we observe in the previous section on other firms, the effect of treatment is higher in the lowest part of the sales distribution (QTT).

Table 7: Card-Sales Response (ATT) of New Entrepreneurs

		Log(Sales amount) (1)	Log(Sales count) (2)	Log(Amount per transaction) (3)
ATT		0.73***	0.75***	-0.02*
		(0.026)	(0.024)	(0.008)
	q=10	1.44***	1.38***	-0.0
		(0.089)	(0.081)	(0.02)
	q=25	0.9***	0.91***	-0.01
		(0.059)	(0.067)	(0.028)
QTT	q=50	0.52***	0.61***	-0.03
		(0.046)	(0.058)	(0.027)
	q=75	0.36***	0.47***	-0.03
		(0.052)	(0.065)	(0.044)
	q=90	0.41***	0.37***	-0.09**
		(0.067)	(0.074)	(0.037)
Observations			35,068	

Notes: This table reports the average (and quantile) card-sales response of matched merchants who accept contactless payments in 2018 compared with matched merchants who do not accept contactless payments (ATT and QTT) of new entrepreneurs. On the matched merchants, using linear regression, β_3 of equation (5) corresponds to the ATT, and QTT when using quantile regression. The dependent variable is the log of card-sales amount in column (1), the log of card-sales count in column (2) or the log of card amount per transaction in column (3). All regressions include group and time fixed effects. Robust standard errors clustered at the merchant level (for ATT) and bootstrapped standard errors (for QTT) are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 8 also confirms a strong positive spillover effect of the contactless card adoption on contact card sales: accepting contactless payments increases by 80 percent the sales driven from contact cards compared to firms that do not accept contactless payments. The spillover effect is much stronger for new entrepreneurial firms than that of older firms who have started accepting contactless payments since 2015, and estimated about 3 percent (see Section 5.2).

Table 8: Spillover Effect and Contact Card-Sales Response (ATT) of New Entrepreneurs

		Log(Sales amount) (1)	Log(Sales count) (2)	Log(Amount per transaction) (3)
ATT		0.59***	0.57***	0.02
		(0.026)	(0.024)	(0.008)
	q=10	1.23***	1.19***	0.04**
		(0.09)	(0.082)	(0.019)
	q=25	0.76***	0.78***	0.07**
		(0.059)	(0.067)	(0.028)
QTT	q=50	0.42***	0.47***	0.02
		(0.046)	(0.057)	(0.027)
	q=75	0.23***	0.28***	-0.02
		(0.052)	(0.063)	(0.043)
	q=90	0.28***	0.13*	-0.08**
		(0.066)	(0.073)	(0.037)
Observations			35,068	

Notes: This table reports the average (and quantile) contact card-sales response of matched merchants who accept contactless payments in 2018 compared with matched merchants who do not accept contactless payments (ATT and QTT) of new entrepreneurs. On the matched merchants, using linear regression, β_3 of equation (5) corresponds to the ATT, and QTT when using quantile regression. The dependent variable is the log of contact card-sales amount in column (1), sales count in column (2) or amount per transaction in column (3). All regressions include group and time fixed effects. Robust standard errors clustered at the merchant level (for ATT) and bootstrapped standard errors (for QTT) are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

6 Conclusion

In recent years, cashless payments have become a strong alternative to cash and their use is becoming increasingly popular around the world. Our paper provides support for this thesis by investigating the impact of the acceptance of a new cashless payment instrument, namely contactless cards, on merchants card sales by using a novel and unique card transactions data of 275,580 french merchants in 2018.

Mobilizing matching and difference-in-difference techniques, we first find that the acceptance of contactless payments by merchants significantly increase their average annual card-sales amount and count compared to those who do not accept (by 17 percent for sales amount and by 20 percent for sales count). Accepting contactless payments contributes therefore to increase total card-sales amount and count, both by attracting more consumers and by displacing non card payments. We also find evidence that the acceptance of contactless cards has a positive spillover effect on contact card payments of about 3 percent on average, but a negative one in the upper parts of the contact card-sales amount distribution (75th and 90th percentiles).

As contactless payments are intended to speed up small-value transactions at point-of-sale in fast-paced environments where customers have most of the time few cashier alternative, we analyze the impact of contactless technology adoption by business size and business sectors. We find evidence that the card-sales response of contactless payments acceptance are larger for small merchants ($<$ EUR 25000) and businesses that make small amount per transaction such as bakeries. However, accepting contactless cards has contrasted impacts on contact card sales in some sectors. While we observe a positive spillover on contact card sales in Bakeries, we find support of a cannibalization between contactless and contact card sales in the sector of Taxis.

Finally, we investigate the impact of the contactless technology adoption of new entrepreneurs who have started their business in 2017. We observe that such entrepreneurial firms double their annual card sales compared to those who do not still accept contactless payments, and benefit from a much more stronger positive spillover effect on contact card sales.

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7 Appendix

7.1 Matching, Mean of Age and T-test for Difference in Means

Table 9: Mean of Age and T-test for Difference in Means

Before matching

	Treatment group (1)	**Control group (2)**	**Difference in means (1)-(2) (3)**
Mean of age	9.17	8.76	0.41***
	(5.25)	(5.29)	(0.025)
Observations	57,830	217,750	

After matching

	Treatment group (1)	**Control group (2)**	**Difference in means (1)-(2) (3)**
Mean of age	9.17	9.16	0.01
	(5.25)	(5.29)	(0.031)
Observations	57,818	57,818	

Notes: This table reports the mean of age of the treatment group in column (1) and control group in column (2) before and after matching. Column (3) represents the difference in means of age. Standard deviations are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

7.2 Placebo Test and an Alternative Specification

Table 10: Placebo Test: Contactless Acceptance and Business Card sales

		Log(Sales amount) (1)	Log(Sales count) (2)	Log(Amount per transaction) (3)
ATT		0.01**	0.01***	-0.0***
		(0.004)	(0.004)	(0.001)
	q=10	0.01	-0.02	0.0
		(0.025)	(0.013)	(0.013)
	q=25	0.01	0.01	-0.01
		(0.016)	(0.022)	(0.008)
QTT	q=50	0.01	0.01	-0.01
		(0.015)	(0.018)	(0.006)
	q=75	0.01	0.02	0.0
		(0.018)	(0.02)	(0.012)
	q=90	0.01	0.0	0.0
		(0.022)	(0.023)	(0.012)
Observations			231,272	

Notes: This table reports the average (and quantile) card-sales response of merchants who are supposed to have accepted contactless payments in 2016 (while they really accepted it in 2018) compared with matched merchants who do not accept contactless payments, ATT (and QTT). On the matched merchants, using linear regression, β_3 of equation (5) corresponds to the ATT, and to QTT when using quantile regression. The dependent variable is the log of card-sales amount in column (1), the log of card-sales count in column (2) or the log of card amount per transaction in column (3). All regressions include group and time fixed effects. Robust standard errors clustered at the merchant level (for ATT) and bootstrapped standard errors (for QTT) are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 11: An Alternative Specification: Contactless Acceptance and Business Card sales

		Log(Sales amount) (1)	Log(Sales count) (2)	Log(Amount per transaction) (3)
ATT		0.17***	0.19***	-0.01***
		(0.004)	(0.004)	(0.001)
	q=10	0.3***	0.28***	0.01
		(0.021)	(0.024)	(0.009)
	q=25	0.19***	0.17***	-0.01**
		(0.013)	(0.018)	(0.006)
QTT	q=50	0.13***	0.15***	-0.01**
		(0.012)	(0.015)	(0.005)
	q=75	0.1***	0.16***	-0.01
		(0.014)	(0.016)	(0.01)
	q=90	0.08***	0.1***	-0.02**
		(0.018)	(0.019)	(0.01)
Observations			462,544	

Notes: This table reports the average (and quantile) card-sales response of merchants who in 2018 compared with matched merchants who do not accept contactless payments, ATT (and QTT). We define here 2015 to 2017 as before the treatment period. On the matched merchants, using linear regression, β_3 of equation (5) corresponds to the ATT, and to QTT when using quantile regression. The dependent variable is the log of card-sales amount in column (1), the log of card-sales count in column (2) or the log of card amount per transaction in column (3). All regressions include group and time fixed effects. Robust standard errors clustered at the merchant level (for ATT) and bootstrapped standard errors (for QTT) are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.