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Article

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An empirical analysis of debit card interchange fee regulation: Evidence from Brazil[☆]

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ABSTRACT

This paper presents an empirical analysis of the introduction, in October 2018, of maximum thresholds (“caps”) on debit card interchange fees for domestic payment cards in Brazil. We investigate the behavior of card issuers’ revenues from debit and credit card interchange fees, the merchant discount rate (MDR) of debit transactions, debit and credit card usage, and debit card scheme fees paid by card issuers and acquirers after the cap. We find a gradual and increasing reduction in the MDR, from 6.0% in 2018Q4 to 22.8% in 2020Q1. Additionally, we observe a statistically significant difference between debit and credit card MDR in 2019Q4 and 2020Q1. The cap reduces card issuers’ earnings from the debit card interchange fee proportionally to the cut but does not affect similar revenues from credit cards. Overall, there is no evidence that the regulation of the debit card interchange fee changes the dynamics of debit card usage or that it changes debit card scheme fees.

1. Introduction

This paper analyses the behavior of relevant variables after the implementation, in October 2018, of maximum thresholds (“caps”) on debit card interchange fees in the domestic payment card segment in Brazil. The regulation establishes limits of 0.5% for the average fee weighted by the value of transactions, measured on a quarterly basis, and 0.8% as the maximum fee to be applied to any transaction. We focus on four different variables: *i.* card issuers’ revenues from debit and credit cards, *ii.* merchant discount rate (MDR), *iii.* debit and credit card usage (volume and value of transactions), and *iv.* debit card scheme fees. We estimate the effects of the interchange fee regulation by applying event studies.

According to the Central Bank of Brazil (BCB), the Brazilian Secretariat of Economic Law, and the Secretariat for Economic Monitoring (2006), the pricing model in the payment card industry makes it especially difficult for consumers to perceive costs and benefits. Notably, this complexity in the definition of interchange fees and merchant discount rates (MDR) may intensify the infor-

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mation asymmetry among economic agents and undermine markets' self-discipline. In the face of market failures, such as incomplete information, regulatory interventions may be justified (Pindick and Rubinfeld, 2010).

Consequently, despite the efforts made in Brazil, such as permission to differentiate prices of payment instruments, information asymmetry still triggers the underutilization of cheaper means of payment. Therefore, the Central Bank of Brazil points out the following motivations for introducing a cap on debit card interchange fees: to encourage the use of debit cards in the country, to give end users more transparency regarding the pricing structures of payment instruments, to decrease cross-subsidies among payment instruments, and to inhibit the overuse of more expensive means of payment.

Brazil offers an interesting setup for this study because it has one of the largest payment card markets worldwide. Consequently, our findings may have important implications for policymakers who have implemented or intend to implement regulations to limit interchange fees, especially in emerging countries. In these jurisdictions, card costs are generally higher compared to those in developed countries (BIS, 2021), and theoretical-empirical literature is still scarce.

We provide a descriptive analysis of the payments market in Brazil using unique proprietary data extracted from a payments database provided by the Central Bank of Brazil. This dataset comprises information provided by credit card issuers and acquirers on interchange fees, merchant discount rates, the volume and value of debit transactions, and card scheme fees throughout the country. Our sample runs from 2016Q1 to 2020Q1, on a quarterly basis, which is sufficient to accommodate upward and downward economic cycles affecting the payment card market. Moreover, a longer period could make it difficult to assess the effects after the cap, as events not connected to the regulation, such as the pandemic, could influence the results.

Our study refers to the literature concerning the theoretical aspects of regulatory interventions in competitive markets. We analyze this subject from the specific lens of the payment card market. Previous empirical results show that the introduction of a threshold on interchange fees has an impact on the pass-through to the MDR (Ardizzi and Zangrandi, 2018) and on the use (number of acquired transactions in proportion to the number of point of sale [POS] terminals) of credit and debit cards. However, the increase of acquirers' profit margin and the rise of card scheme fees (Ernest & Young, 2020) may prevent the potential gains of this type of regulation.

We find a gradual and increasing reduction in the MDR, from 6.0% in 2018Q4 to 22.8% in 2020Q1. Our findings also indicate that the average MDR for debit is 13.8 p.p. and 12.5 p.p. lower than the MDR for credit in 2019Q4 and in 2020Q1, respectively. After the cap, card issuers' revenues from debit card interchange fees decreases proportionally to the cut, but credit card revenues do not change their trajectory.

Additionally, we find no evidence of change in the dynamics of debit card usage after the regulation of debit card interchange fees, as we do not observe evidence that the cap encourages demand for the cheaper payment instrument (debit) or that it changes debit card scheme fees. These findings may have important implications for policymakers who intend to evaluate whether the reduction of debit card interchange fees contributes to price differentiation among credit and debit instruments, increasing transparency and reducing possible cross-subsidies in this market.

The remainder of this paper is organized as follows. In [Section 2](#), we provide a review of the literature concerning the theoretical aspects of regulatory interventions in competitive markets, how it relates to the payment card market, and the empirical results of other experiences of regulating credit or debit card interchange fees. In [Section 3](#), we describe data sources, report descriptive statistics, and provide an overview of the data in Brazil. In [Section 4](#), we present methodologies and the respective results. [Section 5](#) is dedicated to the analysis of econometric tests. [Section 6](#) concludes.

2. Literature review

Theoretical analysis concerning pricing strategies in the payment card industry is generally based on two-sided markets ([Chakravorti, 2003](#)), defined by [Rochet and Tirole \(2006\)](#) as those in which platforms allow interactions between end users (merchant and cardholder). Platforms, in order to maximize financial benefits, face each side of the market. In this regard, the interchange fee paid by acquirers to card issuers, settled by scheme owners, is fundamental to balance the market's sides and optimize payment card transactions.

According to [Rysman \(2009\)](#), the platform provider tends to charge higher prices to users with less price elasticity of demand for the use of a given payment method (merchant and acquirer). It also reduces the price and/or offers benefits for the side that has high price elasticity of demand (card issuer and cardholder). The existence of network externalities in this industry, in which the greater the number of cardholders of a given scheme, the greater the demand for merchants who accept card transactions of this scheme, may encourage anti-competitive practices.

[Bolt and Chakravorti \(2008\)](#) contribute to the theoretical literature on payments by analyzing the decision of banks on payment instrument prices considering that consumers participating in payment card networks aim to insure themselves against three types of shock: income, theft, and type of merchant that they are matched to. Merchants accept payment instruments based on their production costs and greater profit opportunities, including their ability to pass payment processing costs to consumers. The structure of prices, according to the authors, depends on the level of the bank's cost to provide payment services, which comprises the aggregate credit loss, the probability of theft, and the timing of income flows. Their model predicts that, when merchants are restricted to charging a uniform price for goods that they sell, banks benefit while consumers and merchants are worse off.

[Rochet and Tirole \(2011\)](#) and [Wright \(2012\)](#) introduce the phenomenon of merchant internalization, in which the merchant, when accepting a card as a means of payment, provides convenience to the cardholder. Merchants may be induced to pay a higher interchange fee than the benefits provided by the card payment service, as long as they internalize the expected benefit of the consumer in their decision to adhere to the payment method. Moreover, part of the cost with the interchange fee is passed to consumers who

do not have a card (assuming that there is not enough price differentiation by payment instrument). Consequently, the scheme owner tends to establish interchange fees above the socially optimal.

Interestingly, [Farrel \(2006\)](#) shows that, even when keeping the sum of the interchange and the cardholders' fees equal, the composition still matters. A small increase in the interchange fee offset by a decrease in the cardholders' fee causes a competitive asymmetry, since part of the cost of the increase in the interchange fee is passed on to consumers who do not use a card.

[Verdier \(2011\)](#) surveys the literature on interchange fees in payment cards, focusing on theoretical studies, and concludes that it is possible that the interchange fee set out by card schemes may try to maximize profits or welfare and that competition among banks and among merchants plays a key role in the difference between the welfare-maximizing interchange fee and the profit-maximizing interchange fee. [Rysman and Wright \(2015\)](#) also survey the literature on payment cards, analyzing interchange fees, among other aspects. They also conclude that distortions in the setting of interchange fees may exist due to competitive asymmetries, merchant internalization, and the difficulty of merchants in steering consumers to use their (the merchants') favorite payment instrument.

Empirically, [Carbó Valverde, Chakravorti, and Rodriguez \(2016\)](#) find an increase in merchants' acceptance of cards in Spain in response to the imposition by the European Commission of caps on credit (0.30%) and debit (0.20%) cards' interchange fees. [Ardizzi and Zangrandi \(2018\)](#) evaluate the effect of caps on the acceptance of cards in the Italian market. Consistent with [Carbó Valverde et al. \(2016\)](#), [Ardizzi and Zangrandi \(2018\)](#) find that caps account for 30% to 40% of the drop in the MDR in Italy. Additionally, the authors find empirical evidence of an impact between 8% and 11% on card acceptance, measured by the number of transactions made per POS.

Finally, a study conducted by Ernst & Young and Copenhagen Economics Team [Members \(2020\)](#) at the request of the European Commission shows that regulation in Europe has reduced interchange fees and costs for merchants to accept card payments, leading to higher acceptance of these means of payment and, eventually, lower consumer prices in the future. Despite this, acquirers' margins and scheme fees associated with international cards have increased, partially reducing earnings. If these effects do not change, the benefits of regulation could be reduced or even eliminate social gains.

3. Data

3.1. Sources

Our datasets come from authorized credit card issuers and acquirers who provide information through a quantitative report, on a quarterly basis, to the Central Bank of Brazil. We consider observations from 2016Q1 to 2020Q1, which are sufficient to accommodate upward and downward economic cycles affecting the payment card market. Moreover, a longer period could hinder a descriptive assessment of variables after the cap, since events not connected to the regulation, such as the COVID-19 pandemic, could influence the results. We also exclude data of participants that entered the market more recently that are not available before the implementation of the cap. We exclude outliers, such as anomalies and discrepant information arising from the observation of the dataset and graphs, from our sample. Even so, our data still represents a significant part of the market.

The samples, based on the total value of transactions in 2020Q1, cover the following: *i.* 98.6% of debit transactions and 85.3% of credit transactions for the revenue study ([Section 5.1](#)), *ii.* 92.7% of debit transactions for the MDR study ([Section 5.2](#)), *iii.* 89.3% of debit transactions and 89.9% of credit transactions for the card usage study ([Section 5.3](#)), and *iv.* 87.7% of issuers' transactions and 77.3% of acquirers' transactions for the scheme fees study, which considers debit and credit functions together ([Section 5.4](#)).

In Brazil, the issuing and acquiring markets are highly concentrated, with relatively few players when compared with developed economies. For instance, Cielo, Rede, Getnet, and Stone, the largest acquirers, dominated more than 83% of the market in 2020Q1. The five largest issuers are responsible for an equivalent share in the issuing market (around 80% in 2020Q1). The number of acquirers and issuers in the Brazilian market are 27 and 61, respectively, during the sample period.

3.2. Summary statistics

[Table 1](#) presents descriptive statistics for the endogenous and exogenous variables employed in our research. Our sample for the interchange fee revenue study has 134 observations for debit cards and 272 for credit cards, since the number of card issuers offering credit cards is higher than the number of card issuers offering debit cards. The number of observations in both MDR and card usage studies is 130, as these data come from acquirers and all of them offer both credit and debit services. Concerning scheme fees, we have 283 observations for issuers and 114 for acquirers.

We observe that interchange fee revenues per card are higher for credit cards than the corresponding ratio for debit cards, reflecting both higher interchange fees and the greater value of credit card transactions. Similarly, the MDR for credit cards is considerably higher than the MDR for debit cards (1 p.p.). However, both rates present relatively large variability (standard deviation and maximum and minimum range), which implies different levels of rates both among acquirers and over time.

Regarding card usage, the value and quantity of transactions and the number of POS terminals also vary substantially, as our sample includes both large and small companies. The network size is greater for debit than for credit, basically reflecting the higher number of cards with the former function. For scheme fees, rates are usually higher for issuers than for acquirers.

We also present descriptive information concerning market concentration and competitiveness. Acquirers' market shares vary considerably, as we have information from large and small companies. We observe that the market for issuers is less concentrated than the market for acquirers. The schemes' Herfindahl-Hirschman index (HHI) shows that the scheme market is highly concentrated.

Table 1
Summary statistics.

| Study | Variable | Unit | Obs | Mean | SD ^a | Min | Max | |
|----------------------------|---|------------------------|-----|----------|-----------------|----------|-----------|-------|
| IC ^b fee income | Debit | R\$/card | 134 | 7.976 | 3.039 | 2.884 | 20.361 | |
| | Credit | R\$/card | 272 | 34.088 | 40.389 | 1.469 | 246.865 | |
| MDR | Debit MDR | % | 130 | 1.506 | 0.239 | 0.994 | 2.020 | |
| | Credit MDR | % | 130 | 2.574 | 0.277 | 2.099 | 3.212 | |
| | Debit acquirer's market share | % | 130 | 13.077 | 21.751 | 0.001 | 72.805 | |
| | Credit acquirer's market share | % | 130 | 13.077 | 20.173 | 0.001 | 66.205 | |
| | Debit acquirer's Lerner index ^c | | 130 | 0.162 | 0.318 | -1.060 | 0.781 | |
| | Credit acquirer's Lerner index ^c | | 130 | 0.193 | 0.228 | -0.474 | 0.699 | |
| Card usage | Value of debit transactions | R\$ Bi | 130 | 23.455 | 38.956 | 0.153 | 139.395 | |
| | Value of credit transactions | R\$ Mi | 130 | 34.751 | 53.563 | 0.161 | 191.618 | |
| | Debit network size | Mi | 130 | 111.263 | 10.510 | 97.340 | 133.618 | |
| | Credit network size | Mi | 130 | 85.933 | 4.660 | 80.508 | 94.213 | |
| | GDP | R\$ Tri | 130 | 1.527 | 0.037 | 1.461 | 1.598 | |
| | Number of POS terminals | 1,000s | 130 | 687.617 | 674.555 | 0.992 | 2,329.180 | |
| | Number of debit transactions | Mi | 130 | 400.073 | 651.436 | 0.028 | 2,293.343 | |
| | Number of credit transactions | Mi | 130 | 315.148 | 487.684 | 0.019 | 1,719.405 | |
| | Scheme fees | Issuer's scheme fees | % | 283 | 0.311 | 0.133 | 0.064 | 0.847 |
| | | Acquirer's scheme fees | % | 114 | 0.133 | 0.068 | 0.010 | 0.294 |
| Issuer's market share | | % | 283 | 6.007 | 8.988 | 0.019 | 31.735 | |
| Acquirer's market share | | % | 114 | 14.912 | 19.663 | 0.001 | 56.640 | |
| Schemes' HHI | | | 397 | 3767.504 | 84.811 | 3594.811 | 3937.558 | |

Note: ^a Standard deviation ^b Interchange ^c Also employed in the card usage study.

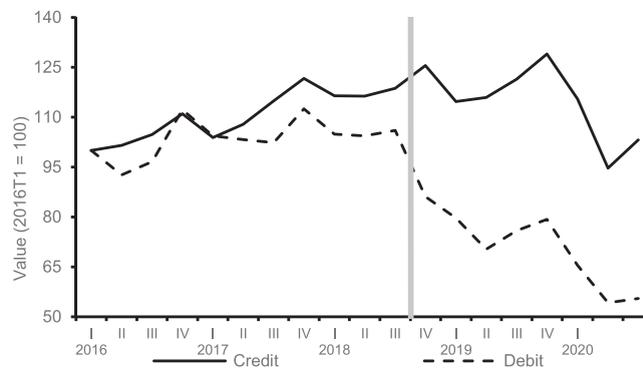


Fig. 1. Mean real interchange fee revenues per card.

When it comes to competitiveness, acquirers' Lerner index (Turk-Ariss, 2010) indicates, for both debit and credit, that acquirers operate with losses in some quarters, while the mean value suggests that the activity is profitable overall. Furthermore, the average competitiveness between acquirers in debit is higher than the average competition between acquirers in credit, whereas the variability of competitiveness in debit is also higher.

3.3. Data overview

We provide an overview of the progress of the main variables employed in this research. Fig. 1 shows an immediate decrease in issuers' debit card interchange fee revenues after the introduction of the cap, while the corresponding revenues for credit cards do not show such a variation.

Fig. 2 shows that the average MDR had been falling before the cap, for both functions, roughly in parallel. After the regulation, the slope of the MDR curve for debit card dropped slightly more than the slope of the MDR for credit cards, as the reduction in the interchange fee for debit cards, according to the hypothesis, is progressively passed to the respective MDR.

Fig. 3 presents the nominal value of card transactions. It shows that the cap does not seem to have an effect on market dynamics for debit or for credit. We do not visually observe a difference in the debit or credit card usage growth rate after the debit card interchange fee regulation. On the other hand, the introduction of the cap does not seem to reduce the use of debit cards, which could have happened if the restriction of interchange fees had induced card issuers to discourage the use of this means of payment.

Fig. 4 presents the progress of card usage measured by quantity, which exhibits an evolution similar to the usage measured by value.

Finally, Fig. 5 shows that scheme fees are usually higher for card issuers than for acquirers. Furthermore, the trend of both curves does not seem to change significantly after the intervention.

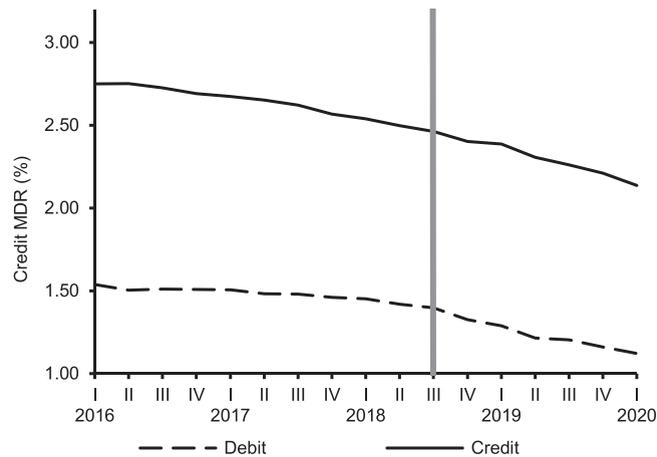


Fig. 2. Mean market MDR by function.

4. Econometric tests

We performed empirical tests of stationarity (Fisher test) and heteroscedasticity (Wald test) in all regressions of this study, followed by the respective correction of robust errors and a test for fixed or random effects (Hausman test). The results of the econometric tests are related to the variables with logarithmic transformation used in regressions, as this smooths the variance of series.

4.1. Stationarity analysis

Since our analysis relies on the regression of time series variables, we ran stationarity tests. Otherwise, a high coefficient of determination (R^2) may reflect a spurious relationship. A stationary stochastic process occurs if the mean and the variance are constant over time and the value of the covariances between two periods depends only on the lag between them.

Maddala and Wu (1999) and Choi (2001) propose the test developed by Fisher (1932), which is based on the combination of p -value and augmented Dickey-Fuller (ADF) values for each cross-section unit. In this non-parametric test, we assume that all panels contain a unitary root in the null hypothesis (H_0). The results indicate the rejection of H_0 for the dependent variables, which corroborates the alternative hypothesis of panel stationarity.

4.2. Fixed and random effects panel model analysis

We performed the Hausman specification test (1978) to evaluate the adjustment of fixed and random effects models. The null hypothesis reflects no correlation between the effects (individual or temporal), supporting the specification of random effects. Under H_0 , the fixed effects estimator is consistent (asymptotically convergent to the real values of the population parameters) but inefficient (no minimum variance), whereas the random effects estimator is consistent and efficient. Under the alternative hypothesis, only the fixed effects estimator remains consistent because there is correlation between the effects and the independent variables. The null hypothesis was not rejected in all regressions estimated. Despite this fact and given that we do not have enough explanatory variables to saturate random effects models, we chose to analyze the results presented in this study using fixed effect models.

4.3. Heteroscedasticity analysis

We also performed Wald tests to account for heteroscedasticity in the regressions. Our results indicated that the null hypothesis of homoscedasticity is rejected. Therefore, correction for robust errors was implemented in all regressions to obtain heteroscedasticity-resistant variance estimators.

5. Methodology and empirical results

We estimate whether the interchange fee regulation promotes significant differences in four different variables: *i.* card issuers' revenues from debit and credit cards, *ii.* merchant discount rate (MDR), *iii.* debit and credit card usage (volume and value of transactions), and *iv.* debit card scheme fees. We estimate the effects of the interchange fee regulation by applying mainly event studies.

5.1. Card issuers' revenues

We compare issuers' revenues from debit and credit cards' interchange fees individually, before and after the cap. Regarding debit cards, we assess whether a potential increase in the volume of transactions with this means of payment offsets, totally or partially, the

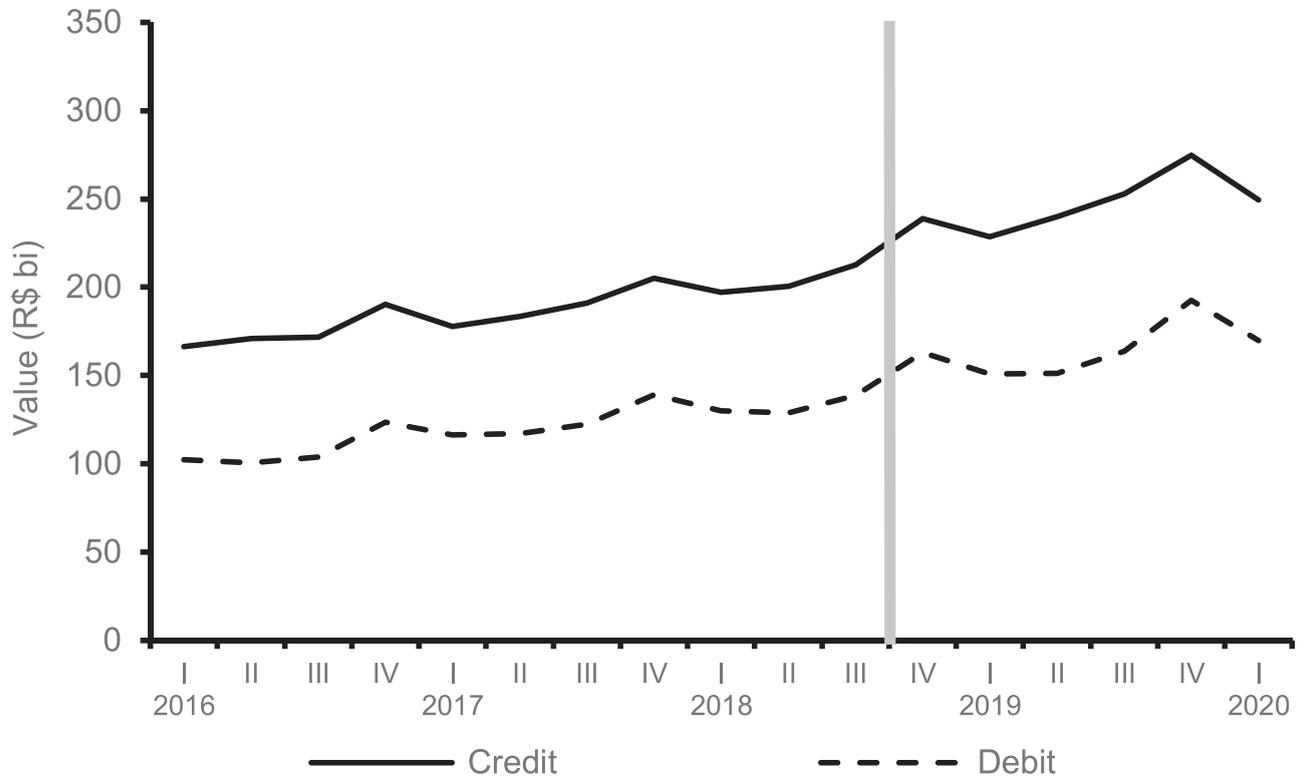


Fig. 3. Value of transactions by function.

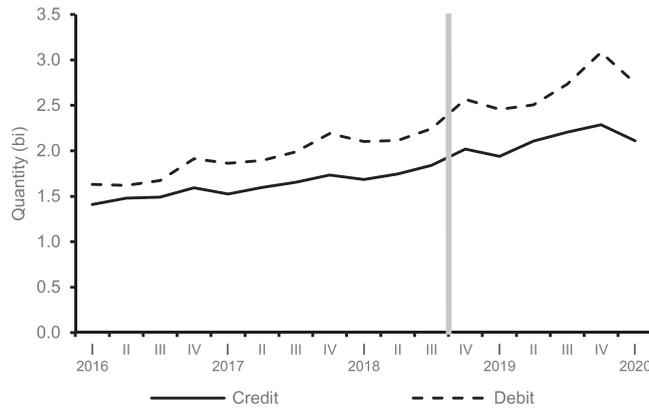


Fig. 4. Quantity of transactions by function.

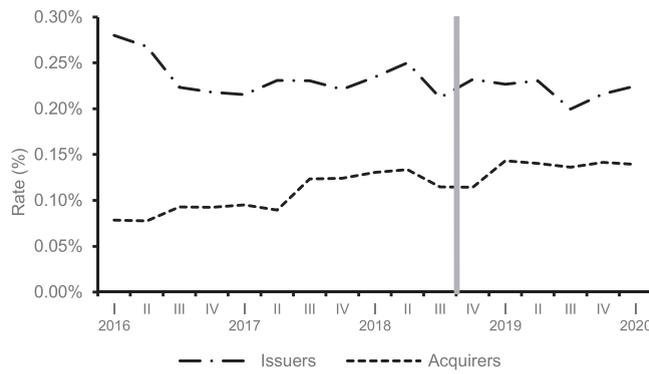


Fig. 5. Scheme fees by participant's role.

cut. Concerning credit cards, we evaluate whether there could be an indirect effect, either an increase to compensate for the lower revenues from debit cards or a decrease triggered by a migration of users to debit cards.

Our basic specifications are as follows:

$$\ln(Y_{i,t}) = \beta_1 cap_t + \lambda_i + \tau_t + t + \varepsilon_{i,t} \tag{1}$$

$\ln Y_{i,t}$: the logarithm of the average deflated revenue from debit card interchange fees for card issuer i (financial or payment institution) in period t , per active card; cap_t : dummy variable equal to 1 from 2018Q4 onwards and to 0 in the remaining periods;

- λ_i : card issuers' fixed effects;
- τ_t : seasonality for the 4th quarter of each year;
- t : time trend; and
- $\varepsilon_{i,t}$: the error term.

In

$$(Y_{i,t}) = \beta_1 cap_t + \lambda_i + \tau_t + t + \varepsilon_{i,t}, \tag{2}$$

$\ln Y_{i,t}$ the logarithm of the average deflated revenue from credit card interchange fees for card issuer i (financial or payment institution) in period t , per active card;

- cap_t : dummy variable equal to 1 from 2018Q4 onwards and to 0 in the remaining periods;
- λ_i : card issuers' fixed effects;
- τ_t : seasonality for the 4th quarter of each year;
- t : time trend; and
- $\varepsilon_{i,t}$: the error term.

The coefficient of interest is β_1 in both equations, which denotes the percentage change in average deflated revenues from debit and credit cards' interchange fees, respectively, after the introduction of the cap . We included card issuers' fixed effects to control

Table 2
Interchange fee revenues regression.

| | LN (Deflated interchange fee revenues per debit card) | | | LN (Deflated interchange fee revenues per credit card) | | |
|-------------------------|---|----------------------|----------------------|--|------------------|-------------------|
| | (1) | (2) | (3) | (1) | (2) | (3) |
| CAP | -0.235*** (0.038) | -0.268*** (0.036) | -0.324*** (0.055) | 0.067 (0.060) | 0.061 (0.064) | 0.091 (0.112) |
| TREND | | | 0.003* (0.001) | | | -0.001 (0.005) |
| Observations | 134 | 134 | 134 | 272 | 272 | 272 |
| Adjusted R ² | 0.507 | 0.598 | 0.608 | 0.017 | 0.033 | 0.034 |
| Seasonality | No | Yes | Yes | No | Yes | Yes |

Note: as explained in Section 5, empirical tests of stationarity (Fisher test) and heteroscedasticity (Wald test) were performed at all regressions of this study, followed by the respective correction of robust errors and a test for fixed or random effects (Hausman test). Standard errors in parentheses. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

for the possible impacts of unobservable variables among these institutions and seasonality dummies in the 4th quarter of each year, the period with the highest volume of purchases. In non-reported results, we separately teste a set of market and macroeconomic variables that are likely to affect issuers and cardholders, such as volume of retail sales and gross domestic product (GDP), but we do not find empirical relevance. Then, we add a trend term in order to reflect an expansion in debit and credit card usage over time or another unspecified residual trend.

Table 2 presents the outcomes of Equations (1) and (2) for debit and credit card. We find a reduction of 32.4% in the average deflated revenue per active card from debit card interchange fees after the cap. This result represents 91.5% of the unconditional reduction in debit card revenues from interchange fees observed in the same period. It suggests that an increase in the volume of debit card transactions slightly compensates for part of the cap. There is no evidence, however, that the cap increases or decreases credit card revenues from interchange fees.

The statistical relevance of the trend term coefficient at the level of statistical significance of 10% may reflect a continuous expansion in debit card usage over time. Given the non-significance of the macroeconomic factors tested, we consider the hypothesis that the card market has its own dynamics that are independent, to some extent, of the evolution of the macrovariables. For instance, the number of card transactions in Brazil grew even in recession periods, such as 2015/2016, as acquirers continued to distribute POSs and included new merchants in their network. Merchants may also have increased card acceptance in order to enhance sales. On the consumer side, it is worth noting the greater financial inclusion in recent years.

5.2. MDR

We then calculate a proxy for the pass-through of the debit card interchange fee reduction to the respective MDR. First, we evaluate the average change from the intervention in the MDR. In order to capture the change in MDR over time, because acquiring contracts are not quickly renegotiable, we measure point differences of debit cards' MDR between each quarter and 2018Q3 instead of running a model with a single dummy variable. As controls, we use time-varying factors that might affect the market position of acquirers: market share (proposed by Ardizzi & Zangrandi, 2018) and competition between acquirers, measured by the Lerner index. Our model for estimating conditional means is the following:

$$\ln(Y_{i,t}) = \sum_{t=1}^{16} \beta_t Q_t + \beta_{17} \ln(L_{i,t}) + \beta_{18} \ln(Mks_{i,t}) + \lambda_i + \varepsilon_{i,t} \tag{3}$$

- $\ln Y_{i,t}$: logarithm of the merchant discount rate (MDR) in debit card transactions charged by acquirer i in quarterly period t ;
- Q_t : dummy variables for each of the 16 quarters except for 2018Q3, which is used as a basis for comparison;
- $L_{i,t}$: competition index for acquirer i , represented by the Lerner index, which measures a company's market power by the difference between what it charges and its marginal cost and is measured in proportion to the price;
- $Mks_{i,t}$: market share of acquirer i in the value of card transactions;
- λ_i : fixed effects per acquirer; and
- $\varepsilon_{i,t}$: the error term.

Then, we compare debit card MDR to credit card MDR, quarter-to-quarter, in order to assess whether these differences are statistically significant, according to Equation (4). Although the payment instruments compared, debit and credit cards, are different segments, visual inspection of the pre-cap trends presented in Fig. 2 infers parallel trends before the cap and a change in the slope of debit card MDR after the regulatory intervention, while the credit card line maintains the same trajectory. We did not observe any other shock on the card market beyond regulatory action in the time frame.

Additionally, the incoming of new players, basically the same, was taking place in both the credit and debit card markets, increasing competition and reducing MDR. Therefore, the trajectory of the MDR for credit cards constitutes an adequate counterfactual of what would have occurred with the MDR for debit cards if the event had not occurred. Equation (3), a pooled regression, specifies our

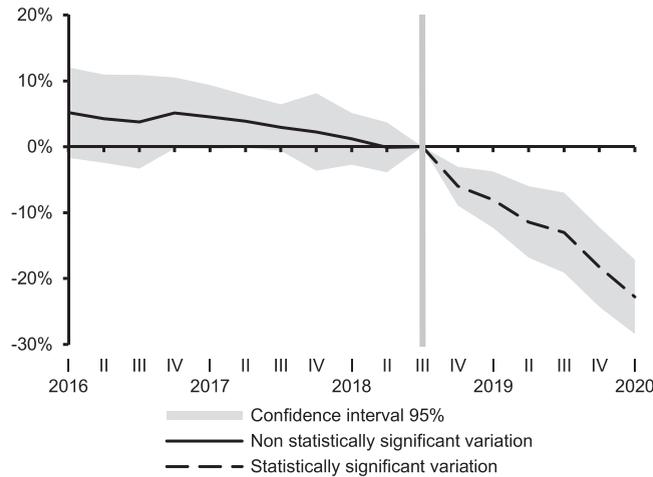


Fig. 6. Debit MDR variation over 2018Q3.

Table 3
Debit MDR variation (2018Q3 as basis).

| | Coef. | Std. Err. | t | P> t |
|-------------------------|--------|-----------|--------|-------|
| 2016Q1 | 0.052 | 0.034 | 1.510 | 0.136 |
| 2016Q2 | 0.043 | 0.034 | 1.270 | 0.209 |
| 2016Q3 | 0.038 | 0.036 | 1.060 | 0.292 |
| 2016Q4 | 0.051 | 0.027 | 1.890 | 0.062 |
| 2017Q1 | 0.045 | 0.024 | 1.870 | 0.066 |
| 2017Q2 | 0.039 | 0.020 | 1.930 | 0.058 |
| 2017Q3 | 0.029 | 0.018 | 1.650 | 0.103 |
| 2017Q4 | 0.022 | 0.029 | 0.760 | 0.450 |
| 2018Q1 | 0.012 | 0.020 | 0.620 | 0.540 |
| 2018Q2 | -0.001 | 0.019 | -0.050 | 0.964 |
| 2018Q4 | -0.060 | 0.015 | -4.050 | 0.000 |
| 2019Q1 | -0.080 | 0.021 | -3.760 | 0.000 |
| 2019Q2 | -0.114 | 0.027 | -4.200 | 0.000 |
| 2019Q3 | -0.130 | 0.030 | -4.280 | 0.000 |
| 2019Q4 | -0.182 | 0.030 | -5.990 | 0.000 |
| 2020Q1 | -0.228 | 0.028 | -8.060 | 0.000 |
| Ln_Market Share | 0.047 | 0.016 | 2.870 | 0.005 |
| Ln_Lerner | 0.028 | 0.012 | 2.390 | 0.020 |
| Observations | 94 | | | |
| Adjusted R ² | 0.934 | | | |

model:

$$\ln(Y_{f,i,t}) = \sum_{t=1}^{16} \beta_t Q_t + \beta_{17} \ln(L_{i,t}) + \beta_{18} \ln(Mks_{i,t}) + \lambda_i + \varepsilon_{i,t} \tag{4}$$

- $\ln(Y_{f,i,t})$: logarithm of merchant MDR charged by acquirer i in period t for function f (debit or credit);
- function_f: dummy variable that takes the value 1 for debit and 0 for credit;
- Q_t : dummy variables for each of the 16 quarters except for 2018Q3, which is used as a basis for comparison;
- $Q_t \times \text{function}_f$: interaction between each of the 16 quarters' dummies except for 2018Q3, which is used as a basis for comparison, and card function (credit or debit), for each acquirer i.
- $L_{f,i,t}$: competition index for acquirer i in each period t for function f, represented by the Lerner index;
- $Mks_{f,i,t}$: market share of acquirer i in each period t for function f, considering the value of card transactions (Ardizzi & Zangrandi, 2018);
- λ_i : fixed effects per acquirer; and
- $\varepsilon^{i,t}$: the error term.

Fig. 6 and Table 3 show the empirical results of Equation (3), which indicate a reduction from 6.0% (2018Q4) to 22.8% (2020Q1) in the debit card MDR compared to 2018Q3. This suggests that the reduction of the MDR tends to increase in magnitude over time.

Based on these results, we calculate a proxy for pass-through of the cap to the MDR, which rises from 16.9% in 2018Q4 to 64.4% in 2020Q1. To calculate the pass-through, we divided the estimated coefficients shown in Table 3 for each quarter (representing the

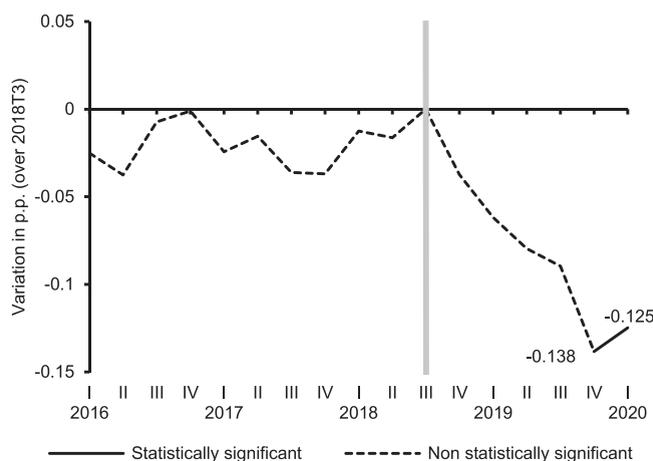


Fig. 7. Difference between credit and debit MDR.

Table 4
Difference between credit and debit MDR.

| | Coef. | Std. Err. | t | P> t |
|-------------------------|--------|-----------|--------|-------|
| 2016Q1 | -0.025 | 0.075 | -0.330 | 0.739 |
| 2016Q2 | -0.037 | 0.076 | -0.500 | 0.621 |
| 2016Q3 | -0.007 | 0.072 | -0.100 | 0.919 |
| 2016Q4 | -0.001 | 0.072 | -0.020 | 0.988 |
| 2017Q1 | -0.024 | 0.073 | -0.330 | 0.740 |
| 2017Q2 | -0.015 | 0.072 | -0.210 | 0.830 |
| 2017Q3 | -0.036 | 0.067 | -0.540 | 0.592 |
| 2017Q4 | -0.037 | 0.066 | -0.560 | 0.578 |
| 2018Q1 | -0.013 | 0.066 | -0.190 | 0.849 |
| 2018Q2 | -0.016 | 0.064 | -0.250 | 0.801 |
| 2018Q4 | -0.037 | 0.064 | -0.590 | 0.558 |
| 2019Q1 | -0.062 | 0.066 | -0.930 | 0.351 |
| 2019Q2 | -0.079 | 0.064 | -1.240 | 0.216 |
| 2019Q3 | -0.090 | 0.065 | -1.390 | 0.167 |
| 2019Q4 | -0.138 | 0.066 | -2.090 | 0.038 |
| 2020Q1 | -0.125 | 0.069 | -1.810 | 0.073 |
| Ln_Market Share | 0.015 | 0.012 | 1.220 | 0.226 |
| Ln_Lerner | 0.022 | 0.010 | 2.350 | 0.020 |
| Observations | 204 | | | |
| Adjusted R ² | 0.939 | | | |

percentage reduction in MDR from 2018Q3) by the unconditional reduction in debit card interchange fees of 35.4% after the cap. The incomplete pass-through of the cap in the interchange to debit MDR and the lagged effect compared to credit MDR may also suggest that part of the reduction in acquirers' costs could have been appropriated by these players. This interpretation is in line with Ardizzi & Zangrandi (2018) and Ernst & Young and Copenhagen Economics Team Members (2020).

The results of the log-log model also suggest that the Lerner index and the MDR are directly proportional. Therefore, an increase in competition between acquirers, that is, a reduction in the Lerner index, of 1% contributes to a reduction of 0.0281% in the discount rate for debit cards. Similarly, for every 1% reduction in market share of acquirers, the discount rate for debit cards is reduced by 0.0470%.

We present the outcomes of Equation (4) in Fig. 7 and Table 4. The results indicate that the differences between debit and credit card MDR show statistical significance as of 2019Q4 ($\beta = 13.8$ p.p. in 2019Q4 and $\beta = 12.5$ p.p. in 2020Q1), which is in line with the hypothesis of lagged pass-through of the cap to debit card MDR. This result means that the average MDR for debit is 13.8 p.p. and 12.5 p.p. lower than the MDR for credit in periods $t = 15$ (2019Q4) and $t = 16$ (2020Q1), respectively, because dummy variables in a log-level equation should be interpreted as differences in percentage points. Although debit card MDR present downward trend starting from 2017Q2, this drop is accentuated after the implementation of the cap and becomes statistically different from the credit card MDR only when a significant level of transference is reached. Our results also show the empirical relevance and the positive sign of the coefficient for the market power of each acquirer, considering debit and credit markets separately.

Our results suggest the effectiveness of the regulatory intervention introducing the cap, as the characteristics of the payment card market, as described by Farrell (2006), are insufficient to intrinsically produce such a cost reduction for merchants and acquirers.

However, we emphasize that our results may not have been able to completely isolate the effect of the policy, as the time dummies in [Equations \(3\) and \(4\)](#) may also reflect the macroeconomic environment.

Going one step forward and investigating the impact of the regulation on the behavior of consumer prices was not possible because of the complexity of the analysis and the lack of data. This study could be particularly interesting, as long as price differentiation by term and means of payment is allowed in Brazil, but we do not have empirical evidence on its adoption in practice. Ernst & Young and Copenhagen Economics Team [Members \(2020\)](#), when analyzing the EU interchange fee regulation, suggested a potential effect on the reduction of consumer prices.

5.3. Debit and credit card usage

In order to observe whether regulation could inhibit the overuse of more expensive payment instruments, we then assess the behavior of debit and credit card usage before and after the cap individually. Debit card usage could have been either reduced, if the cap had induced issuers to discourage their use (and encourage the use of credit cards), or increased, if merchants had started to offer this option more often at a lower price. To account for these possibilities, we run the following specifications using the volume and the value of transactions per POS of each means of payment as proxies for debit and credit card usage.

We introduce economy-wide controls that potentially affect cardholder and merchant behaviors, suggested by [Ardizzi & Zangrandi \(2018\)](#): size of payment network and real GDP growth. We expect that network size and GDP have a positive impact on card usage. We control for acquirer's market power, measured by the Lerner index, to assess whether larger acquirers contribute to increasing card transactions. In addition, all specifications consider a linear trend term in order to control for potential market-wide residual trends in the data. We run two models, each one specifically for each function, as shown in [Equations \(5\) and \(6\)](#) below:

$$\ln(Y_{i,t}) = \beta_1 cap_t + \beta_2 \ln(L_{i,t}) + \beta_3 \ln(N_t) + \beta_4 \ln(GDP_t) + \lambda_i + \tau_t + t + \varepsilon_{i,t} \quad (5)$$

$\ln(Y_{i,t})$: logarithm of the volume or value of debit card transactions per POS for acquirer i in period t ;
 cap_t : dummy variable equal to 1 from 2018Q4 onwards and to 0 otherwise;
 $L_{i,t}$: competition among acquirers, represented by the Lerner index;
 N_t : network size ([Ardizzi & Zangrandi, 2018](#));
 GDP_t : deflated and adjusted gross domestic product ([Ardizzi & Zangrandi, 2018](#));
 λ_i : acquirers' fixed effects;
 T_t : seasonality for the 4th quarter of each year;
 t : time trend; and
 $\varepsilon_{i,t}$: the error term.

$$\ln(Y_{i,t}) = \beta_1 cap_t + \beta_2 \ln(L_{i,t}) + \beta_3 \ln(N_t) + \beta_4 \ln(GDP_t) + \lambda_i + \tau_t + t + \varepsilon_{i,t} \quad (6)$$

$\ln(Y_{i,t})$: logarithm of the volume or value of credit card transactions per POS for acquirer i in period t ;
 cap_t : dummy variable equal to 1 from 2018Q4 onwards and to 0 otherwise;
 $L_{i,t}$: competition among acquirers represented by the Lerner index;
 N_t : network size ([Ardizzi & Zangrandi, 2018](#));
 GDP_t : deflated and adjusted gross domestic product ([Ardizzi & Zangrandi, 2018](#));
 λ_i : acquirers' fixed effects;
 τ_t : seasonality for the 4th quarter of each year;
 t : time trend; and
 $\varepsilon_{i,t}$: the error term.

[Table 5](#) presents the results. We do not find empirical evidence that the demand for debit and credit cards changes after the cap. There is, therefore, no evidence that the regulation has influenced the use of the cheaper means of payment (debit), regardless of the proxy employed. We also run [Equations \(5\) and \(6\)](#) with dummies for each quarter to account for a possible lagged impact, but the coefficients are still statistically insignificant.

This result differs from that suggested by [Ardizzi and Zangrandi \(2018\)](#), who show the impact, between 8% and 11%, of the reduction in interchange on the number of transactions carried out per POS between 2015 and 2017 in the Italian market. [Carbó Valverde et al. \(2016\)](#) also find strong effects on merchant acceptance in Spain in response to reduced interchange fees.

One possible reason why the use of debit cards does not change after the cap implementation may be the effectiveness of price differentiation. Both discounts on cash purchases and surcharges on purchases made with a credit card are allowed. Even though opinion polls show that price differentiation is fairly common in Brazil, it is not clear whether this possibility is regularly offered or whether the amount of price differentiation is sufficient to make the consumer choose the instrument desired by the merchant. In this regard, it is worth remembering the conclusion of [Rysman and Wright \(2015\)](#), who highlight the difficulty of merchants in steering consumers to use their (the merchants') favorite payment instrument.

Table 5
Usage of cards regression.

| | LN (Value) | | LN (Quantity) | |
|-------------------------|-------------------|-------------------|-------------------|-------------------|
| | Debit | Credit | Debit | Credit |
| Cap | 0.235 (0.168) | 0.186 (0.233) | 0.265 (0.185) | 0.196 (0.225) |
| LN_GDP | 0.405 (1.937) | 0.928 (0.950) | 0.924 (2.119) | 2.160 (1.172) |
| LN_NETWORK_SIZE | -1.608 (2.286) | 0.337 (3.778) | -1.471 (2.084) | 0.651 (3.798) |
| LN_LERNER | -0.210 (0.156) | -0.048 (0.057) | -0.199 (0.160) | -0.056 (0.059) |
| Trend | 0.005 (0.017) | -0.010 (0.011) | 0.006 (0.018) | -0.011 (0.011) |
| Observations | 94 | 110 | 94 | 110 |
| Adjusted R ² | 0.035 | 0.037 | 0.041 | 0.038 |

Note: Standard errors in parentheses. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

5.4. Scheme fees

Changes in the interchange fee rate may affect other pricing dimensions, such as scheme fees. The payment card market, notably, contains multiple fees to be paid among its players. In this regard, the regulator is concerned with the possibility of new fees being introduced or increased to offset potential losses. Scheme owners may try, for instance, to maintain the attractiveness of their scheme to card issuers by reducing fees for these participants in order to compensate card issuers' losses from the cap, while increasing the scheme fee charged to acquirers. This might be especially harmful because the elasticity of the acquirers' demand for a given card scheme is usually low, which makes them prone to join the scheme regardless of the fee. On the other hand, card issuer demand for a scheme is more elastic. This possibility may cause significant asymmetries in the card payment market.

Concerning the possible collateral effects of the cap on other fees, we focus on those charged by the scheme owners because, in Brazil, charging fees for the provision of debit cards to individuals is not permitted. Brazilian regulations establish that this is an essential banking service which cannot be subject to fees.

We run two different specifications to evaluate the behavior of scheme fees before and after the capone for the fees charged to issuers (Equation 7) and another for the fees charged to acquirers (Equation 8).

In the case of scheme fees charged to card issuers, the estimated regression econometric model considers the issuer's market power and the level of concentration in the scheme sector. The specification includes a time trend variable to control for residual linear market-wide trends.

$$\ln(Y_{i,t}) = \beta_1 \text{cap}_t + \beta_2 \ln(Mks_{i,t}) + \beta_3 \ln(HHI_t) + \lambda_i + t + \epsilon_{i,t} \quad (7)$$

$\ln(Y_{i,t})$: logarithm of the cost of issuer i (a financial or payment institution) in quarterly period t from the scheme in relation to the traded value, as a proxy for the scheme fee;

cap_t : dummy variable equal to 1 from 2018Q4 onwards and 0 otherwise;

$Mks_{i,t}$: market share of issuers, considering the value of card transactions;

HHI_t : Herfindahl-Hirschman index in the card schemes sector;

λ_i : issuers' fixed effects;

t : time trend; and

$\epsilon_{i,t}$: the error term.

Similarly to Equation (7), to assess the behavior of scheme fees charged to acquirers before and after the cap, we control the level of concentration in the scheme sector measured by HHI, the acquirer's market share, and overall residual market trends, as shown by the specification below:

$$\ln(Y_{j,t}) = \beta_1 \text{cap}_t + \beta_2 \ln(Mks_{j,t}) + \beta_3 \ln(HHI_t) + \text{Cred}_{j=X,t} + \lambda_j + t + \epsilon_{j,t} \quad (8)$$

$\ln(Y_{j,t})$: logarithm of the cost of acquirer j in quarterly time t from the scheme in relation to the traded value, as a proxy for the scheme fee;

cap_t : dummy variable representing the cap, equal to 1 from 2018Q4 onwards and equal to 0 in the remaining cases;

HHI_t : concentration in the card schemes sector, represented by the Herfindahl-Hirschman index (HHI);

$Mks_{j,t}$: market share of the acquirer in the value of card transactions;

$\text{Cred}_{j=X,t}$: dummy variable to capture specific increases for a given acquirer from 2017Q3 onwards;

λ_j : fixed effect per acquirer;

t : time trend; and

$\epsilon_{i,t}$: the error term.

Table 6
Impact of the cap on scheme fees.

| | LN (SCHEME_FEE) | |
|-------------------------|--------------------|-------------------|
| | Issuers | Acquirers |
| Cap | -0.070 (0.070) | 0.055 (0.145) |
| Trend | 0.006 (0.005) | -0.005 (0.008) |
| LN_MKT_SHARE | -0.152* (0.078) | 0.007 (0.039) |
| LN_SCHEMES_HHI | 1.683 (1.978) | -3.292 (2.036) |
| Observations | 283 | 114 |
| Adjusted R ² | 0.058 | 0.004 |

Note: Standard errors in parentheses. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

We do not find evidence that card issuers' and acquirers' scheme fees behave differently before and after the cap in the time frame considered (2018Q4 to 2020Q1), as Table 6 shows. Hence, there is no empirical support to infer that the cut in the debit card interchange fee caused a compensatory decision in favor of card issuers to the detriment of acquirers. These findings diverge from those conducted by Ernst & Young and Copenhagen Economics Team Members (2020), which suggest an increase in scheme fees associated with international cards after regulation in Europe.

Our results also show that issuer individual market power as proxied by the share of acquired transactions have a negative and significant coefficient at the level of statistical significance of 10%. This suggests that issuers with greater market power contribute to reduction of scheme fees. In addition, we also run the econometric models in Equations (7) and (8) with quarterly dummies instead of single ones to account for potential gradual and delayed effects, in unreported results. The outcomes likewise do not show statistical significance.

6. Conclusion

The results presented in this paper indicate that the introduction of maximum thresholds for debit card interchange fees contributes to a lagged reduction in the debit card MDR in the Brazilian payment card market. Consequently, this regulation favors a greater transparency of the price structure of payment methods for end users, which may decrease cross-subsidies between card functions, and encourages merchants to reduce prices charged to consumers for debit card purchases. It should be noted that, apart from the effect of the policy, the coefficients of the dummy variables applied in our MDR analysis may be capturing other effects of the respective quarter that have no variation across the panel.

On the other hand, our results suggest that the intervention reduces issuers' revenues from debit, which must be considered by policy makers. We do not find empirical evidence that the cap affects debit and credit card usage, and it does not impact scheme fees charged to card issuers and acquirers.

Our findings, consequently, may have a useful implication for policymakers who implemented or intend to implement regulations to limit interchange fees, especially in emerging countries. In light of the economic debate that unfolds, the relevance of this paper may also be observed in the broad and useful econometric analysis which encompasses the effects of the measure on the various economic agents directly affected. Future research could explore specific policy issues, such as the promotion of competition through interchange fee regulation.

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The data for interchange fee revenues and costs with scheme fees are presented in an aggregated format, with no detail on whether they come from debit or credit cards. Each quarter, issuers and acquirers inform the Central Bank of how much, in BRL, they have earned or spent, respectively, with interchange fees and scheme fees. In the study regarding the impact of the cap on card issuers' revenues (Section 5.1), we estimate the breakdown of the aggregated value made up of the revenues of each issuer by function (debit or credit) based on the average market interchange fee rate (data sent by acquirers) and on the value of transactions. In the section concerning scheme fees (section 5.4), we do not estimate it by function since we do not have reasonable parameters to run these estimations.

Up to 2018Q3, only participants operating since the beginning were asked to send the information used in these studies to the BCB. After 2018Q4, all participants of card schemes authorized by the BCB were required to send information.

$$N_t = \left[\left(\sum \text{number of cards}_t \right)^2 + \left(\sum \text{number of POS}_t \right)^2 \right]^{1/2}, \quad Mks_{it} = \left(\frac{\text{Value of processed transactions}_{it}}{\sum_i \text{Value of processed transactions}_{it}} \right)$$

The HHI may present values between 0 (no concentration) and 10000 (fully concentrated). Estimates between 1000 and 1800 represent moderate concentration, and estimates above 1800 represent high concentration: $HHI = (S_1)^2 + (S_2)^2 + \dots + (S_k)^2$ Measured by the difference between an organization's charges and its marginal cost in proportion to the price. The results are in continuous

dimensions ranging from null competition ($L_{it} = M$) to full competition ($L_{it} = l$). However, if an organization has other objectives, its Lerner index may be negative, even if it shows profit.

$$L_{it} = \left(\frac{P_{it} - C_{marg_{it}}}{P_{it}} \right); \text{ Proxy } L_{it} = \left(\frac{\text{Average revenue per transaction}_{it}}{\text{Average cost per transaction}_{it}} \right)$$

At a p -value < 0.10 level of significance.

Released by the Monthly Survey of Commerce (PMC) of the Brazilian Institute of Geography and Statistics (IBGE).

$$\text{pass-through}_t \text{ proxy} := \frac{\beta_t}{\Delta \text{ nominal interchange fee}}$$

In addition to these (the number and value of transactions), four other proxies were used to represent the demand for the instruments: total volume and total value per acquirer, for both debit and credit.

$$\text{pass-through}_t \text{ proxy} := \frac{\beta_t}{\Delta \text{ nominal interchange fee}}$$

$$N_t = \left[\left(\sum \text{ number of cards}_t \right)^2 + \left(\sum \text{ number of POS}_t \right)^2 \right]^{1/2}$$

The results with data provided by card issuers (financial or payment institutions) indicate similar results.

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The results with data provided by card issuers (financial or payment institutions) indicate similar results.

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