Pass-through Along the Fee Structure of Payment Cards

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Abstract

Starting in 2016, Argentina introduced a battery of regulation to further domestic bancarization. Payment card systems were targeted by this policy but also under the suspicion that parties involved in the market were abusing a dominant position; government antitrust inquiry culminated in the introduction of a cap on interchange fees in debit and credit card transactions, together with the ongoing divestment of the single payment processor of the leading credit card network by transaction volume. A model of network effects is discussed to highlight the relevance of the market's ownership structure in the determination of pass-through from interchange fees to other prices and of the overall efficacy of the designed regulation. Particularly, interchange fee regulation in a market with vertically integrated card service providers may lead to increased concentration and market power.

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Contents

1 Introduction

Payment card networks, especially those jointly operated and governed by numerous entities like VISA and MasterCard, have been the subject of extensive inquiry by antitrust agencies and researchers alike. The former are often concerned with the fact that would-be competitors, such as two banks issuing VISA cards to consumers, coordinate to decide part of the market's price structure [1], while the latter have repeatedly attempted to determine whether the outcomes of this process can be improved upon with simple regulation in a manner that is robust to modelling assumptions [2]. At the

[1] D. S. Evans and Schmalensee 2005 provides an extensive account of the history of payment card systems, some innovations at the turn of the 21st century, and a discussion of prevailing economic analysis and antitrust regulation at the time.

[2] Initial instances of work written in the key of modern two-sided market models include Rochet and Tirole 2002, Schmalensee 2001, Wright 2003

heart of these and related discussions is the interchange fee, a rate that the bank which issued a purchasing consumer's card charges to the bank (or a related entity) where the merchant awaiting payment holds its account. It is usually argued that this fee is necessary for intervening banks to internalize demand forces from both consumers and merchants, a balancing act common to all multi-sided markets.

Regulators were not deterred by this argument, however, and on occasion have mandated levels and caps for these fees. Regulation II of the Dodd-Frank Act halved the level of interchange fees for debit card transactions in the United States starting on 2010; the Reserve Bank of Australia similarly capped credit card interchange in 2002; and as late as 2015 the European Commission limited interchange fees for both credit and debit cards to 0.3% and 0.2% of transaction price respectively. As will be discussed below, only payment systems where the issuing and the acquiring bank differ entail the payment of an interchange fee: fully integrated networks, like American Express and Sears's Discover, need no such compensation. This has resulted in asymmetric effects across markets, ranging from the availability of different card types, the level of fees and rewards provided, and pass-through rates to consumer prices. The remainder of the introduction offers a quick overview of the typical market structure of a payment card system, together with some idiosyncrasies of the Argentinian market that present a case of an effectively closed loop network opening up.

1.1 Brief description of payment card networks

Economic analysis[3] of payment card markets commonly describes them as a four-party system, consisting primarily of a *consumer*, a *merchant* who engages in a transaction with her, an *issuer* who provides the consumer with a payment card and an *acquirer*[4] who facilitates the merchant's access to the card network and eventually finalizes the transfer of funds to a merchant's bank account. The revenue raised as a variable charge per transaction purely on account of financial intermediation (excluding, for example, charges associated with leverage provided to consumers by a bank issuing a credit card) is referred to as the *merchant discount rate* (MDR), since it is usually exacted directly from merchants, and is expressed as a percentage value of transaction price (plus a fixed fee if applicable, as is the case with debit cards in the United States).

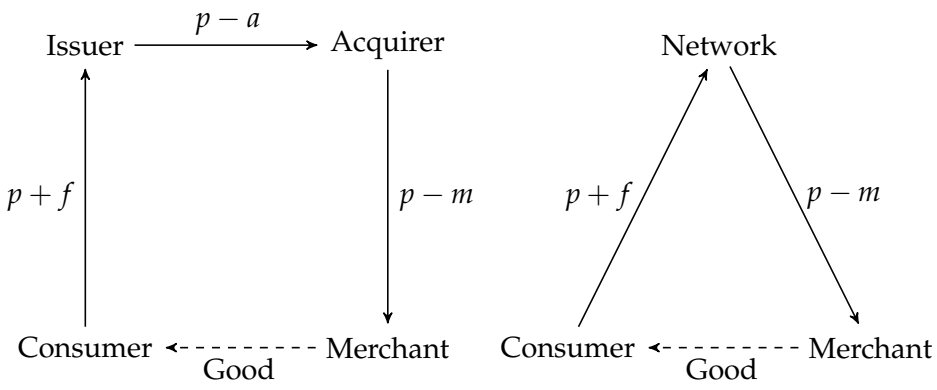
In the case of so called *closed loop* or three-party networks, such as the aforementioned examples of American Express and Discover, the issuer and acquirer are a single entity and no other significant charges are incurred on a per transaction basis. However, the biggest payment card networks, VISA and MasterCard, are *open loop* systems where

[3] A summary of existing literature at the point is provided by D. Evans and Schmalensee 2005

[4] In practice, this role is performed by different types of firms. It includes the *acquirer proper* or *gateway* who provides POS terminals for traditional cards and secure platforms in e-commerce, a *payment processor* who handles the routing of payments from issuer to merchant and *payment facilitators* who enable easier access to gateway services, especially to small merchants.

the network operator licenses multiple banks to function as either issuers or acquirers (or both). Since their inception, these networks have incorporated a centrally determined *interchange fee* as a tool for sharing MDR revenues among the two parties, and is paid by the acquirer to the issuer involved in a given transaction. This fee is simply voted for by the members participating in a given open loop network, with voting shares proportional to transaction volume [5]. Since these networks feature multiple banks and the acquiring end of the market is regarded to be very competitive[6], some authors refer interchangeably to the MDR and the interchange fee, although perfect pass-through does not necessarily occur in all markets under evaluation. Both parties may additionally charge fixed fees to access the network: in the case of acquirers, this involves the maintenance of the merchant's bank account together with the rental of the POS terminal used to swipe payment cards; issuers charge consumers for newly minted cards, account maintenance and renewal.

Figure 1: Sequence of payments in a four-party payment card network (left) and a three-party network (right). p is the transaction price of the good, a is the interchange fee and m is the merchant discount rate. f are any payments made by customers to banks on a per-transaction basis, or rewards if said value is negative (as is usually the case).



Lastly, *general purpose* (as opposed to store-based) payment cards may differ slightly in their function. The types most commonly seen are *credit cards*, which facilitate revolving credit to customers; *debit cards*, which draw funds immediately from a customer's checking account through one of different payment networks (signature debit cards operate through the same networks as credit cards do, while PIN cards operate through the same networks as ATMs and share their authentication protocol); *charge cards* work like credit cards, but balances must be paid in full at the end of every month.

[5] D. S. Evans and Schmalensee 2005 discusses the evolution of Visa and MasterCard's governance since their inception as four-party networks in the 1970's. Some significant changes will be mentioned in the Model section of the article.

[6] Rochet and Tirole 2002 is an example of several models that assume merchant acquisition to be a perfectly competitive activity, while Carbo Valverde, Chakravorti and Rodríguez Fernández 2016 reports a correlation of .94 between interchange fees and the MDR in a panel data of Spanish banks participating in the two major payment card networks over the course of a decade.

Figure 2: Cross-country variation in interchange fees for retail transactions of featured open loop credit card networks. Source: Kansas City Federal Reserve (2017)

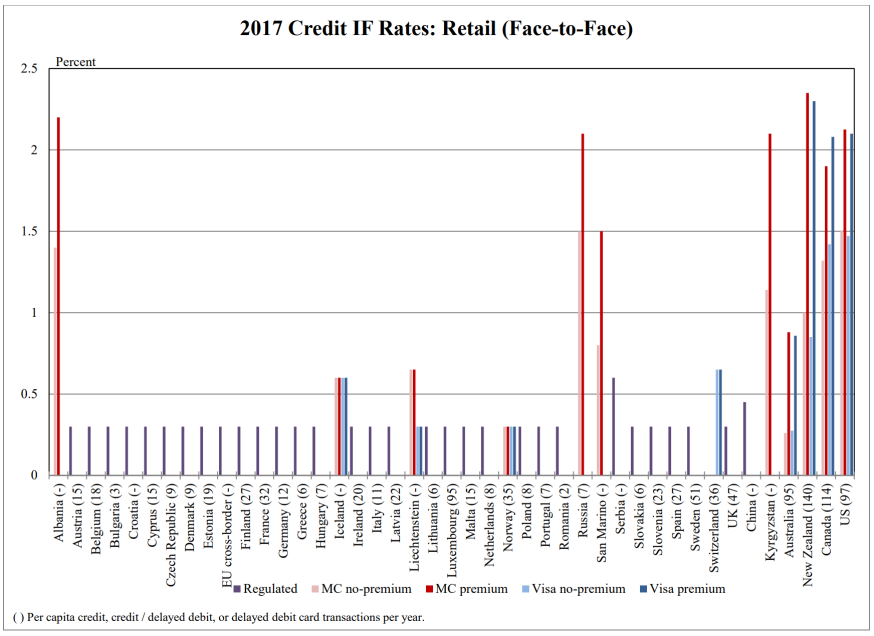
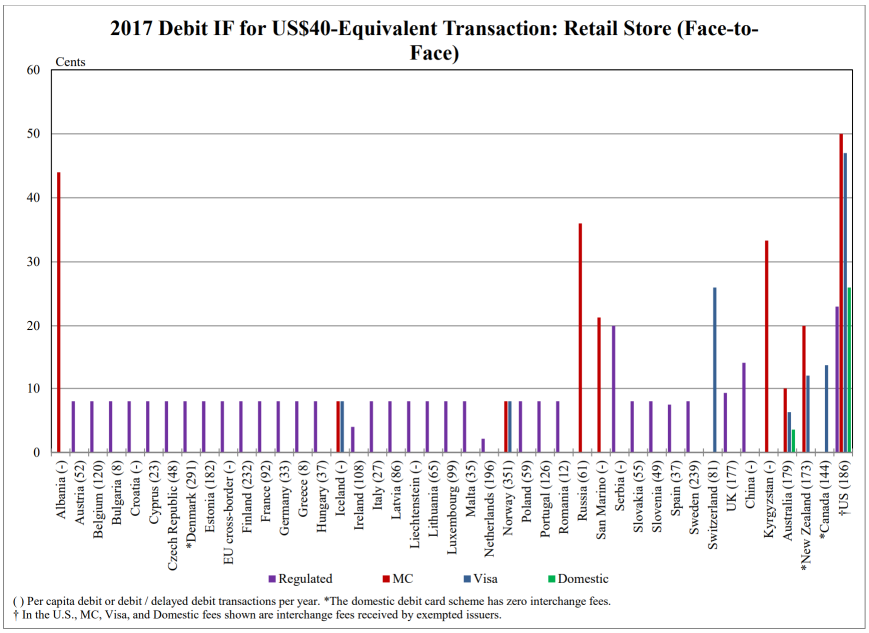


Figure 3: Cross-country variation in interchange fees of featured open loop debit card networks. Issuers exempt from US regulation are banks with less than USD 10 billion in assets. Source: Kansas City Federal Reserve (2017)



1.2 Payment card markets and regulation in Argentina

At the beginning of 2016, payment card markets in Argentina exhibited some noticeable differences from other cases around the world, mostly involving the acquisition end of

the platform[7]. VISA, the largest network in the country with over 60% market share by transaction volume, effectively operated like a closed loop system since a consortium of 14 private and public banks owned a firm, PRISMA, with an exclusive license to perform acquisition and payment processing services for VISA together with the maintenance of one of two ATM/ETF networks in the country. All networks are allowed to vary the MDR they charge down to the retail sector involved in a transaction, but until early 2017 most sectors were charged a statutory limit of 3% for credit cards and 1.5% for debit established in 1995. Interchange fees ranged from 2.7% to 2.9% depending on the network involved[8].

The regulators involved with this and closely related markets are the aforementioned antitrust agency (CNDC) and the local central bank (BCRA). The latter has introduced sweeping reforms throughout the financial services industry with the objective of promoting their use and thus reducing the presence of the informal economy in Argentina[9]. Some of the most relevant measures for this study include a mandate for all banks to offer, free of charge, debit cards and "savings accounts" (which in practice function as interest-bearing checking accounts, since they can serve as sources of funds for most electronic transfers) for all residents in Argentina, and the introduction of a new clearinghouse that provides immediate transfer of funds (as opposed to traditional systems that could delay transfers until the closing of the day, or 48 hours) through novel payment systems operated by the private sector, that are accessed through mobile POS terminals, P2P transfers (with users identified by debit card or bank account), and e-commerce gateways. Moreover, merchants with yearly revenues beyond a particular threshold must forcibly accept all debit cards as payment.

In its analysis of VISA's local operation, CNDC and local retail representatives also recommended antitrust policies with some precedent around the world. Chief among them is the progressive introduction of a cap on debit and credit card interchange fees for all networks, with the following schedule:

Date	Debit IF	Credit IF
04/2017	1.0%	2.0%
01/2018	0.9%	1.85%
01/2019	0.8%	1.65%
01/2020	0.7%	1.5%
01/2021	0.6%	1.3%

[7]A report by the local antitrust authority, CNDC 17/2016, currently in the public domain at https://www.argentina.gob.ar/sites/default/files/cndc_resol_invmerc_tarjetas_2.pdf, provides the lay of the land together with some descriptive statistics and a brief comparison with similar environments throughout the world.

[8]These include VISA and MasterCard, who together command over 80% of transactions by volume. Other networks include American Express and local closed loop networks Tarjeta Naranja and Nativa

[9]A more comprehensive list of reforms is provided by the central bank at http://www.bcra.gob.ar/Institucional/Medidas_adoptadas.asp

The other aspect of regulation involves vertical integration in VISA's operation. During September 2017, the shareholders of PRISMA agreed to divest themselves of the company with provisions that will discourage future vertical integration, including restrictions on local network operators from purchasing firm shares, forcing PRISMA to extend some of its processing services to other networks and discontinuing others, such as giving the option to merchants of receiving advance payment 48 hours after transaction, in order to encourage entry by other participants.

On an aggregate level, transactions by payment card are deeply rooted in Argentina's retail market. Salas and Demo 2017 documented that domestic retail sales amounted to roughly 62 billion USD in 2015, of which 45% was paid for with credit cards, 25% with debit and the remainder with cash. Debit cards constitute 54% of general purpose payment card issue, with the remainder composed of credit cards. Among the latter, 64% are issued by financial entities (essentially banks) who account for nearly 75% of total issue; other issuers include nonfinancial companies, who usually concentrate their operation within a single region (some of these are subsidiaries owned by parent banks, and are differentiated in some key characteristics such as lower fees and rewards). Roughly half of all credit card transactions are paid in a single installment, and the stock of credit card debt amounts to 20% of all banks' assets. The variable fees paid to payment intermediaries that will be analyzed in this paper totalled about 1 billion USD in 2015, mostly composed of the 3% maximum merchant discount rate for credit card transactions mentioned above.

2 Literature Review

2.1 Theoretical analysis

Several works summarize the current state of research on payment cards at the moment of publication. Rysman and Wright 2014 takes stock of the existing theoretical literature, with a particular focus on models of payment systems as *platform* or *two-sided* markets with consumers and merchants respectively. This body of work stresses the existence of different types of network externalities, which refers to the role adoption rates by each side of the market play in the demand from both of them for intermediation. Models differ mainly in the set of assumptions they adopt and the phenomena they are able to accommodate: starting from an environment where a monopolist offers one payment system with a single outside option for merchants and consumers, some papers like Rochet and Tirole 2002 incorporate *merchant internalization*, that is to say that merchants consider the strategic effects that card acceptance induces when competing with other suppliers; Bedre-Defolie and Calvano 2013 allow for two-part cardholder pricing, which consists of a fixed usage or access fee and a variable charge and highlights the asymmetry between consumers, who ultimately decide whether a transaction will be realized with a payment card or not, and merchants whose decision is limited to accept-

ing those payments (or not); Guthrie and Wright 2007 incorporates multiple platforms and shows the role *multihoming* - the adoption of multiple platforms by a given user, be it consumer or merchant - plays in determining how competition between systems affects equilibrium interchange fees. A key factor distinguishing these models from other work on two-sided markets is the fact that the platforms under consideration are operated by multiple parties, so that internalization of forces across both sides of the market (an elementary example of which is provided in Rochet and Tirole 2003 for a monopolistic, fully integrated platform) does not occur automatically, and is enabled by the introduction of interchange fees.

2.2 Analysis of previous regulation

While some empirical models have tried to directly address some of the concerns raised by the previously mentioned theoretical models, many others have focused on the effects of interchange fee variation on the various parties a payment network caters to. The article with the most comprehensive data available is probably Carbo Valverde, Chakravorti and Rodríguez Fernández 2016, which tracks a rich panel of 45 Spanish banks from 1997 through 2007. With a system of equations for consumer and merchant adoption on the extensive (card penetration) and intensive margins (transaction volume), they document the existence of network externalities as measured by a positive coefficient of merchant adoption on consumer demand for payment cards (and viceversa), as well as a negative effect of interchange fee raises on merchant acquisition.

Other analyses draw directly from interchange fee regulation policies. Chang, Evans and Garcia Swartz 2005 follows the case of Australia, which similarly to Argentina placed a cap on credit card interchange fees that effectively halved their level to 0.55% of transaction value. The express purpose of the Reserve Bank of Australia was to lower credit card issue but, although roughly 40% of the reduction in issuers' income was passed onto fixed card usage fees for consumers, adoption was not significantly affected and the corresponding reduction in merchant discount rates was not passed through to consumer prices. Manuszak and Wozniak 2017 studies the introduction of Regulation II of the Dodd-Frank Act in the United States, which starting in 2011 restricted debit card fees to half their effective level but only for banks with over USD 10 billion in assets. They document the availability of free checking accounts in terms of minimum balances required and the fees attached to accounts that were not. The main finding of the article is that, although banks covered by the regulation passed the interchange fee reduction on to higher consumer fees as suggested by theory and similar past examples, so did exempt banks increase these usage charges, even though several of them kept interchange rates above the cap.

3 Data

3.1 Description

The data available for analysis consists of a bank-level panel of financial entity[10] characteristics and consumer charges for a host of payment cards and related services (such as deposit account maintenance costs and charges associated to mortgages, secured loans and personal credit). All data is currently provided by the Central Bank of Argentina, with bank characteristics published monthly in the *Blue Book*[11] and usage charges published through a provision of the Transparency Regime for consumer products[12].

The observed consumer charges consist of fixed access fees, which are the sum of a monthly maintenance fee and an annual renewal fee[13], as well as interest rates on outstanding balances. They are reported on a bank and tier-level basis, according to a classification of five credit card types: national cards, which can only be used in domestic transactions, international cards, and three categories of premium cards, which usually command higher maintenance fees but also offer greater rewards per transaction, as well as a larger credit line. However, there is no distinction made between the multiple networks that a bank may operate with, and thus only one item is reported per category in each observation. The panel spans observations of 52 banks from October 2016 to September 2017. Summary statistics of the data are described below, with all values reported in nominal local currency units (for reference, the exchange rate varied from 15.12 to 16.97 ARS/USD in this time frame).

Table 1: Consumer charges for national cards

Statistic	N	Mean	St. Dev.	Min	Max
Total access fee	516	1,288.589	406.911	348.480	2,479.430
Renewal (yearly)	516	487.965	288.082	0.000	1,363.670
Maintenance (monthly)	516	66.719	17.132	19.360	126.460
Interest rate	511	67.560%	21.984	36.880	153.690

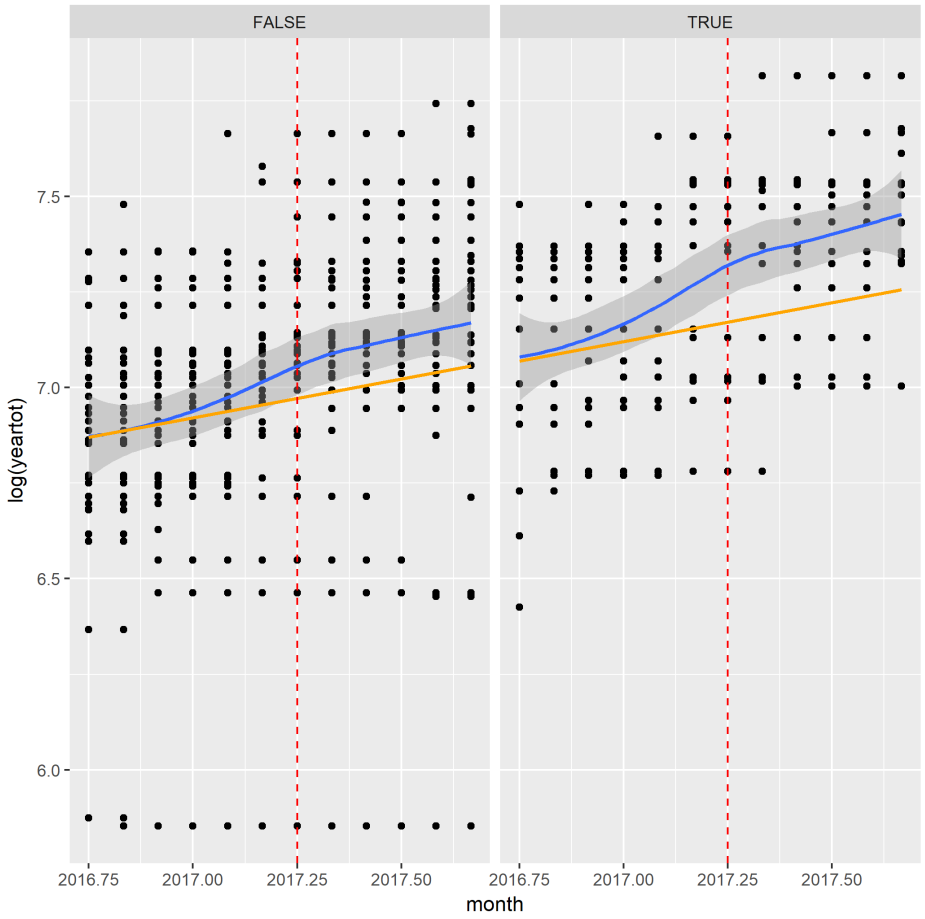
[10]Notably, this excludes some credit cards who are not financial entities and thus outside the oversight of the Central Bank's Transparency Regime

[11]Online at http://www.bcra.gob.ar/SistemasFinancierosYdePagos/Sistema_financiero.asp?opcion=1&tit=1

[12]Data for the current month is publicly available at http://www.bcra.gob.ar/BCRAyVos/Comisiones_cargos.asp

[13]It is worth noting that this fee, while relatively high (the sample average is 75 USD when converted with end-of-period exchange rate), is commonly waived by consumers. Conditions for doing so include tying wage deposits to a checking account associated with a credit card, or maintaining a balance beyond a threshold in said account.

Figure 4: Scatter plot of total yearly fees charged by each bank in the sample for each month observed in the data. Observations are split into those of banks with equity in PRISMA, displayed on the right panel, and banks who are not integrated in the left panel. The dashed vertical red line indicates the first stage of the programmed decrease in interchange fees, dated April 2017. The blue line is a local linear regression of fees with a time trend component, and the orange line displays CPI inflation during the same time period (with the same intercept as the blue line). CPI inflation averages to 20.3% in this time period, while a linear regression of log fees with dummies for regulatory intervention and PRISMA ownership yields a time trend of 37.7%. Output of this simple regression is reported in table 6 in the appendix.



The bank characteristics include detailed balance sheets with over a thousand items reported on a monthly basis, as well as additional variables reported on a quarterly basis. The balance sheet items include the stock of credit card debt, as well as other assets held by banks against the private sector and consumer deposits. Some key variables among the additional characteristics include the stock of credit and debit cards issued by each bank, as well as the count of uniquely identified credit card holders. The entities covered in both panels are the same as in the fee dataset described above; however, the time period stretches only until June 2017.

The next figure depicts systematic differences in the consumer base between PRISMA owners and non-integrated issuers. On average, the former enjoy a much larger presence in the market:

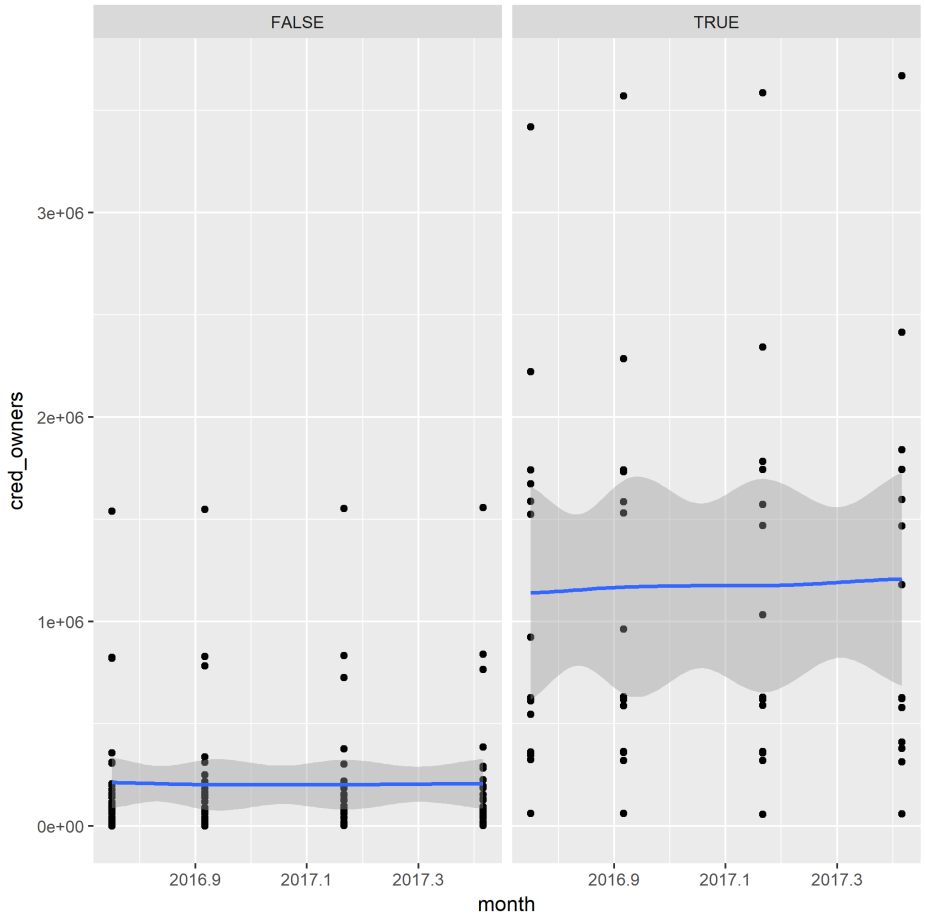
Table 2: Balance sheet summary statistics

Statistic	N	Mean	St. Dev.	Min	Max
Assets (in ARS millions)					
Mortgages	139	1,486,445	3,071,465	8	15,767,150
Overdrafts	340	2,044,697	3,048,500	3,323	11,941,148
Signature credit lines	300	3,148,967	5,279,595	101	22,668,647
Personal loans	385	5,203,692	7,132,541	25,073	40,193,483
Credit card debt	385	5,308,736	8,791,125	5,746	43,483,205
Liabilities (in ARS millions)					
Checking accounts	335	6,285,971	10,005,637	67,387,924	9,709
Savings accounts	358	3,831,127	9,518,063	1,588	64,211,680

Table 3: Additional variables, summary statistics

Statistic	N	Mean	St. Dev.	Min	Max
Credit cardholders	169	527,974	754,784	430	3,669,772
Credit card issue	168	826,453	1,405,410	1,259	7,148,170
Debit card issue	155	1,001,001	1,447,299	0	7,404,933

Figure 5: Scatter plot of credit card issue across banks in the sample period. The right panel includes banks with equity in PRISMA; the left panel includes the remainder.



3.2 Exploratory analysis

Tables 4 and 5 included in the appendix report some bare empirical analysis of the available data. Since the observed data distinguishes between banks rather than the complete menu of cards, I formulated a model of consumers faced with the discrete choice of a *bank* to intermediate in all transactions by payment card. Since payment cards often come bundled with other financial services, a selection of balance sheet items was included as a vector of characteristics x_i (including credit card debt) in the equation specified below for each i of n banks in the sample:

$$\log(s_i) - \log(s_0) = \alpha F_i + x_i'\beta + \xi_i \tag{1}$$

s_i is the market share of bank i in the market of credit card holders (or issued credit cards, in an alternate specification on panel 2 in table 4). s_0 is the share of the outside option, defined as the remainder of subtracting total credit card issue from the amount of debit cards existing in the market: I propose this as a measure of market size since as of April 2016 banks are mandated to offer a savings account bundled with a debit card free of charge to any consumer who would require one. Therefore, this should be an adequate indicator of the sum total of bancarized individuals in the economy (the main issue is that the resulting market may be *too large*, as consumers can hold more than one debit card and unique debit card holders are not identified in this data set). F_i is the yearly total access fee charged by bank i. Month fixed effects were included for this estimation.

Table (5) includes the estimates of this 'demand' equation with instruments for F_i and the stock of credit card issue, the two most obviously endogenous variables in the equation above. The instruments were drawn from the usual set of BLP instruments as described by Nevo 2000, although a supply equation was not included in this estimation. The next section borrows from the theoretical literature to suggest a set of equations that satisfactorily accounts for banks' pricing decisions, as well as the variables that I would need to observe in order to conduct a complete estimation.

4 Model

4.1 Setup

The model used for extending the previous analysis is a variation of Bedre-Defolie and Calvano 2013. It includes the decision of a measure 1 of consumers choosing whether or not to purchase a payment card from a particular issuer within a single network and the allocation of consumption amongst the available payment instruments, the decision of a measure 1 of merchants choosing whether or not to accept card payments from a network, and the choice of some fees (the ones that are bank-specific) by members of the payment card network, according to their role. These banks may belong to a three or four-party network; in the latter, they may specialize in issuing or provide issuing and acquisition service simultaneously.

The surplus derived purely from the consumption of a single good consists of an exogenous monetary value v, while monopolistic merchants choose a single list price p to be charged to all consumers, regardless of the payment method employed (this is referred to as *price coherence* or *no surcharging* in the literature). In addition to consumption surplus, a patron also has a net benefit b_B from using a payment card in a given transaction, drawn from a distribution $G(b_B)$ satisfying the increasing hazard rate property. The merchant similarly enjoys a benefit b_S from accepting a card payment which is drawn from a distribution $K(b_S)$ satisfying the same assumptions. Consumption surplus v is assumed to be sufficiently high that the merchant does not wish to screen consumers based on their preference for card usage, which is a particular form of *merchant internalization* analyzed by Guthrie and Wright 2007 among others[14].

When considering the choice of a bank for payment intermediation, both merchants and consumers have a fixed surplus of B_S and B_B respectively derived from subscribing to a bank's services. Acquisition services are assumed to be homogeneous so B_S consists of a scalar-valued random variable even when multiple banks offer services to merchants. However, banks' issuing services are assumed to be heterogeneous, with a joint distribution over the membership surplus from each of n banks $B_B = (B_{B,1}, ...B_{B,n})$. Assumptions on this distribution are discussed when computing the demand function for card adoption.

Finally, banks have a cost of performing issuing and acquisition services on a per transaction basis of c_I and c_A respectively. An acquirer perceives gross income of $m - a$, where m is the merchant discount rate and a is the interchange fee. Issuers'

[14] If there exist lower bounds for b_B,b_S, this assumption can be stated as

$$v \geq c - \underline{b_B} - \underline{b_S} + \frac{1 - G(\underline{b_B})}{g(\underline{b_B})}$$

gross income consists of $f + a$, where f is the per transaction usage fee (or reward, if it assumes a negative value) paid by consumers who use a card. Subscription or access fees for consumers and merchants are respectively F_i and M.

Strategic interaction between players and their information processes unfold according to the following timeline:

$t = 0$ Network-wide m,M and a are predetermined. They could be mandated by the owners of the central network[15], a regulator, or result from bargaining between consumers, merchants and intermediaries.

$t = 1$ After observing m and a, a fixed stock of n banks chooses its fee structure, consisting of (f_i, F_i) for the consumer side.

$t = 2$ Consumers and merchants realize their subscription benefits B_B, B_S and choose up to one bank to patronize, if any.

$t = 3$ Merchants set retail prices. Consumers and merchants realize per transaction benefits b_B, b_S and *consumers decide whether to purchase a single good or not*. Once they have decided to purchase a good, they decide to do so with cash or card.

Heterogeneity in b_B serves the role of introducing a margin for usage-based fees and rewards to affect payment card transaction volume, and the timing of the information flow makes it so that consumers are homogeneous in terms of usage surplus: the services offered by different banks will be valued differently based purely on B_B.

4.2 Equilibrium

A subgame-perfect Nash equilibrium of this game consists of a price level for merchants p, a fee structure for each participating bank $\{(f_i, F_i)\}_{i=1}^n$, the merchant acceptance rate D_S of card payments, shares in the card membership market $Q = \{Q_i\}_{i=1}^n$ and the share of card owners from a given bank who prefer to pay by card when possible, $D_B = \{D_{B,i}\}_{i=1}^n$. To map D_B to a more readily observable variable, D_B and D_S are aggregated through a matching function to produce the total number of transactions by payment cards, $\mathcal{M}(D_B, D_S)$. In the original model, $\mathcal{M}(D_B, D_S) = D_B D_S$, so as to represent the probability of randomly (and independently drawn) drawing a consumer and merchant such that the former wanting to pay by card and the latter willing to

[15]The incentives of network owners such as VISA and MasterCard have historically varied widely. In the case of VISA, it operated as a non-profit franchise until 2003, with member banks holding ownership stakes in the company; they also voted (with shares proportional to ownership) on the components of fee structure common to the entire network, the bulk of which is the interchange fee. Fees paid directly to the network by member banks included a fixed subscription fee and an assessment fee. Since then, VISA became a publicly-traded company, with member banks relinquishing control over *some* of its operations, such as Canada and the U.S.. Notably, European operations continued under the oversight and collective governance of relevant member banks. This is mentioned in Bedre-Defolie and Calvano, with a more extensive discussion provided by D. S. Evans and Schmalensee 2005

accept such a payment.

Given the assumptions on consumption surplus v, merchants will price their good at p and the entire market will be supplied. Therefore, any fluctuation in payment card transaction volume will happen independently of fixed aggregate consumption. Rysman and Wright 2014 discusses a range of models where interaction between card and total transaction volume is accounted for as part of a broader analysis of merchant internalization.

When it comes to payment card transactions, merchants only choose on the 'extensive' margin of whether to accept card payments from any and all consumers willing to use it. They will do so when the static benefits of doing so are positive:

$$D_B(b_S - m) + B_S \geq 0 \tag{2}$$

This is a simple computation based on the average surplus from each transaction and reflects a fundamental asymmetry between merchants and consumers in the model, since the latter make the 'intensive' decision to pay by card or not single-handedly. The authors of the original model argue that this decision rule accommodates a normalization without loss of generality of $B_S = 0$, such that the above rule condenses to a merchant accepting card payments when $b_S > m$[16] and the merchant acceptance rate can be computed as:

$$D_S(m) = Pr(b_S > m) = 1 - K(m) \tag{3}$$

The decision of a consumer who has subscribed to card services is also simple. Given that banks are homogeneous in the surplus they provide consumers on a per transaction basis (other than the usage-based fees/rewards f_i), all the heterogeneity across cardholders from different banks reduces to the thresholds for card usage:

$$D_B(f_i) = Pr(b_B > f_i) = 1 - G(f_i) \tag{4}$$

[16]I will also adopt that normalization, given that I lack data on merchant acceptance and its drivers in Argentina for the relevant time period. The European *Survey on merchants' costs of processing cash and card payments* 2015 has strived to assess the level of cost savings from accepting card payments in order to design cost-based benchmarks for interchange and other fees. The cited report includes survey-based and econometric inference on fixed and variable cost savings, with long-run estimates of total cost savings ranging from 0.2 to 0.4% of transaction price, including fraud prevention and labor savings in front and back-office payment processing.

Since cardholders make a prior decision of acquiring a card, it is necessary to compute their surplus from the transaction stage, represented as ex ante expected surplus per transaction multiplied by transaction volume $\mathcal{M}(D_B, D_S)$. Bedre-Defolie and Calvano refer to this value as the *option value of card ownership*:

$$\phi_B(f_i, m) = E[b_B - f_i | b_B \geq f_i] D_B(f_i) D_S(m) \tag{5}$$

In the preceding period, consumers choose up to one card from the menu of existing banks to hold. They will choose the bank that maximizes their net payoff: $B_{B,i} + \phi_B(f_i, m) - F_i$. The resulting membership shares $Q = \{Q_i\}_{i=1}^n$ thus depend on *net* fees: $t_i = F_i - \phi_B(f_i, m)$. For the purposes of this model, market shares Q_i are assumed to be decreasing in a bank's own net subscription fee, increasing in others', and a jointly log-concave function. These assumptions will be shown to be compatible with the functional form assumptions used for identifying the model in the next section.

The last decision to model consists of a bank's choice of fee structure. Given that most banks in the sample function within a four-party network structure, their objective function will be discussed in more detail. Consider first a bank who is not integrated and thus offers issuing services exclusively: its revenue stems purely from fixed and variable income from the cards customers have purchased. The fixed margin is the access fee F_i; profits accrued on a per-transaction basis is the sum of revenue f_i net of costs $c_I - a$, and transaction count *per cardholder* is $D_B(f_i) D_S(m)$. The bank's problem is thus:

$$\max_{F_i, f_i} [(f_i + a - c_I) D_B(f_i) D_S(m) + F_i] Q_i(F_i - \Phi_B(f_i, m), F_{-i} - \Phi_B(f_{-i}, m)) \tag{6}$$

Bedre-Defolie and Calvano show that the solution to this problem consists of marginal cost pricing on the variable margin, and a Lerner rule on its residual card subscription demand:

$$f_i(m, a) = c_I - a$$
$$F_i(m, a) = -Q_i(F_i - \Phi_B(f_i, m), F_{-i} - \Phi_B(f_{-i}, m)) \left(\frac{\partial Q_i(F_i - \Phi_B(.), F_{-i} - \Phi_B(.))}{\partial F_i} \right)^{-1}$$

The intuition behind this result is straightforward. If variable fees exceed the issuing cost per transaction, they could be lowered on the margin so that the entire surplus on that margin is captured through an increase in F_i with card membership being kept constant. A similar result holds for integrated issuers, who additionally perceive revenues from merchant acquisition. This profit consists of the acquiring margin on

each transaction $m - c_A - a$, scaled by the membership share of all banks j, Q_j, and the transaction count for each issuer $D_B(f_j)D_S(m)$. The objective function resolves to:

$$\max_{F_i, f_i}[(f_i + a - c_I)D_B(f_i)D_S(m) + F_i]Q_i(.,.) + (m - c_A - a)\sum_{j=1}^{n} D_B(f_i)D_S(m)Q_j(.,.) \tag{7}$$

It is shown in the appendix that the pricing rule for variable fees still consists of perfect pass-through. However, the per-transaction margin now consists of the issuing margin plus the acquiring margin: $m - c_A + c_I$. Notably, since the interchange fee represents pure revenue for the issuer and loss for the acquirer, it disappears from this expression. The first-order condition for fixed fees is also reported, which now balances the effect of changes in F_i on the bank's own issuing revenue with the effect on other banks, given that i perceives the acquiring margin on all transactions performed through the card network:

$$\begin{aligned} f_i(m, a) &= c_A + c_I - m \\ 0 &= Q_i(.,.) + F_i\frac{\partial Q_i(.,.)}{\partial F_i} + \sum_{j \neq i}(m - c_A - a)D_B(f_i)D_S(m)\frac{\partial Q_j(.,.)}{\partial F_i} \end{aligned}$$

The first-order conditions for all banks' fixed fees F can be stacked up and represented in a matrix form reminiscent of conventional Nash-in-prices supply models:

$$\mathbf{q}(\mathbf{F}, \mathbf{f}, m) + \Omega.D_F(\mathbf{F}, \mathbf{f}, m) = 0 \tag{8}$$

Where $D_F(.)$ is the Jacobian matrix of card membership demand and Ω is an ownership matrix, whose coordinate ij indicates whether the bank i in a given row internalizes the effect on bank j's demand, and to what degree. Since some banks *partially* own other banks' transactions, this matrix assumes the expression below. Let ι be an n-dimensional dummy vector that indicates whether a bank is integrated or not:

$$\begin{aligned} \Omega &= \text{diag}(F_1, ..., F_n) + \iota\Gamma(\mathbf{f}, m)) \\ \Gamma_{ik}(f_k, m)) &= (m - c_A - a)D_B(f_k)D_S(m) \\ f_k &= \begin{cases} c_I - a & \text{if } \iota_k = 0 \\ c_A + c_I - m & \text{if } \iota_k = 1 \end{cases} \end{aligned}$$

4.3 Identification

This model is identified through four moments analogous to others employed in the empirical literature, such as Carbo Valverde, Chakravorti and Rodríguez Fernández 2016, together with some functional form assumptions. In particular, I will look at the merchant adoption rate D_S, the intensity of payment card usage by consumers who have become cardholders D_B, market shares in the card subscription market Q_i, and all of n issuing banks' first-order conditions for access fees, depending on their type. The equilibrium characterization of these variables is summarized below:

$$\begin{aligned}
D_S(m) &= Pr(b_S \geq m) = 1 - K(m) \\
D_B(f_i) &= Pr(b_B \geq f) = 1 - G(f_i) && \forall i \\
Q_i(F_i - \Phi_B(f_i, m), F_{-i} - \Phi_B(f_{-i}, m)) &= Pr(i \in \arg\max_j U_j(F_j, f_j)) && \forall i \\
\mathbf{q}(\mathbf{F}, \mathbf{f}, m) + \Omega . D_F \mathbf{q}(\mathbf{F}, \mathbf{f}, m) &= 0
\end{aligned}$$

One of the more readily accessible functional forms for discrete choice problems is that of a multinomial logit, which results from each of b_S, b_B and $\{b_{B,i}\}$ being distributed as (independent) extreme value type I random variables, centered respectively on $\delta_S, \delta_b, \delta_{B,i}$. This functional form is compatible with the previous assumptions of increasing hazard rates and gives a closed form expression for three relevant variables: the function mapping fees to market shares in transaction and card membership markets, the gradient of said function and the option value of card usage, ϕ_B, as the difference between the expected value of the maximum of two EV random variables (centered on δ_b and 0), and a single one representing the outside option of paying with cash, whenever a consumer matches with a merchant who accepts card payments:

$$\begin{aligned}
D_S(m) &= Pr(b_S \geq m) = \frac{e^{\delta_S - m}}{1 + e^{\delta_S - m}} \\
D_B(f_i) &= Pr(b_B \geq f) = \frac{e^{\delta_b - f}}{1 + e^{\delta_i - m}} && \forall i \\
Q_i(F_i - \Phi_B(f_i, m), F_{-i} - \Phi_B(f_{-i}, m)) &= \frac{e^{\delta_{Bi} - F_i + \phi_B(f_i, m)}}{1 + \sum_{j=1}^{N} e^{\delta_{Bj} - F_j + \phi_B(f_j, m)}} && \forall i \\
\mathbf{q}(\mathbf{F}, \mathbf{f}, m) + \Omega . \nabla_F \mathbf{q}(\mathbf{F}, \mathbf{f}, m) &= 0 \\
\phi_B(f_i, m) &= D_s(m) \log\left(1 + e^{\delta_b - f_i}\right) \\
f_i &= \begin{cases} c_I - a & \text{if } \iota_i = 0 \\ c_A + c_I - m & \text{if } \iota_i = 1 \end{cases}
\end{aligned}$$

This model will be used for the simulations reported below; in addition, this system highlights the necessary variables for a complete estimation of the model: cardholding

shares, together with access fees, transaction volume and merchant adoption rates, allows for a recovery of $\delta_S, \delta_b, \{\delta_B\}_{i=1}^n, c_A$ and c_I if instruments are available. An immediate example of these instruments, mentioned in section 3.2, includes the standard set of BLP variables derived from product (or in this case, bank) characteristics.

5 Results

5.1 Simulation

The figures below depict some comparative statics of equilibria in the market of payment card issue when the interchange fee is shifted exogenously. The fundamental specification of this simulation consists of five homogeneous firms (that is, with the same values for δ_b and δ_B), from which three different benchmarks are drawn[17]. In the first one, named **homogeneous firms**, none of the five issuers offer acquisition services and the merchant discount rate m is priced to marginal cost of acquisition: $m = c_A + a$. In the two remaining benchmarks, two of the issuers are now integrated with the acquisition leg of the network and split equally the profits raised from this end. The first of these two benchmarks, **perfect pass-through**, keeps the acquiring margin constant since m is lowered in the same proportion as a (however, a strictly positive margin ε is added in order for integrated issuers to behave differently from nonintegrated ones) as it goes down. The final benchmark, **no pass-through**, keeps the merchant discount rate constant as the interchange fee goes down. Therefore, the acquisition margin from other banks *increases* for issuers at the same time that the margin on banks' own transaction remains constant (as the change in interchange fees merely reflect a payment 'from the bank to itself', and thus own margins $f + m - c$ are unchanged). The reason for the inclusion of these two benchmarks is that when interchange fees dropped from a variable starting point of $2.7 - 2.9\%$ to 2% in April 2017 several market participants, including PRISMA shareholders and associations grouping merchants and other credit card issuers, collectively negotiated the reduction of the MDR from 3% to 2.5%, a case of incomplete pass-through that falls between the two extremes described above. Since the model described above does not account for an endogenous determination of the MDR, both cases are mentioned.

These comparative statics depend chiefly on the functional form assumption of logit demand and elasticities, as well as broader economic trade-offs in play.

[17]Parameter setup is as follows: $\delta_{B,i} = 1.5 \ \forall i, \delta_S = 0.03, \delta_b = -0.01, c_A = 0.001, c_I = 0.01$. Lastly, I add a parameter N that represents the volume of transactions per customer (so that the measure of customers sums to N instead of 1) I worked with a value for N of 100 for this simulation.

Figure 6: Comparative statics of access fees F_i for a varying range of interchange fees a. The colored lines *above* the black line represent the fee structure of *integrated* issuers, while the ones below correspond to the non-integrated firms.

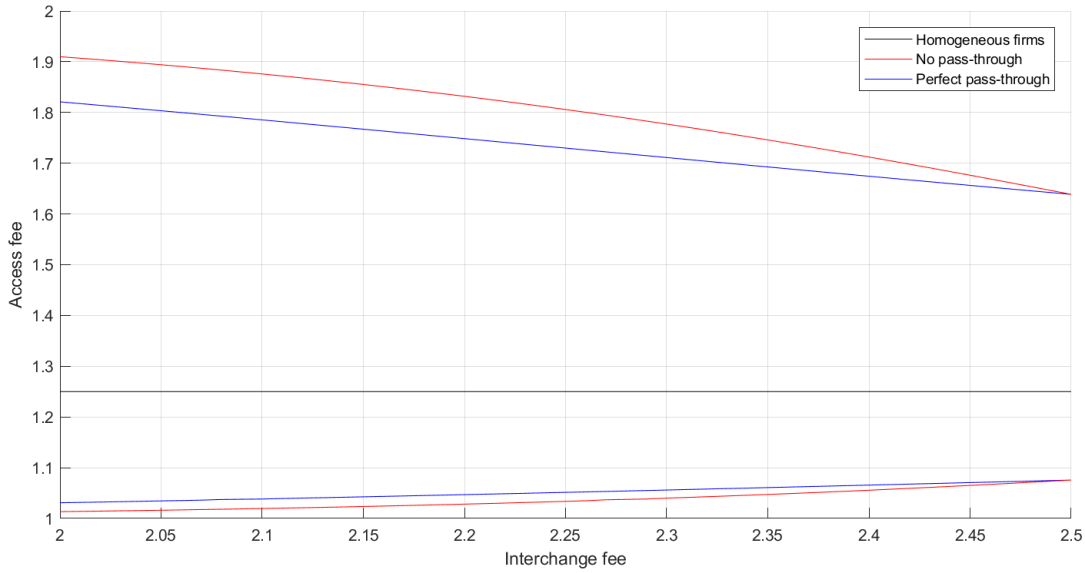


Figure 7: Comparative statics of cardholder market shares Q_i for a varying range of interchange fees a. As before, it is the integrated banks who have more subscribers than the homogeneous firms benchmark.

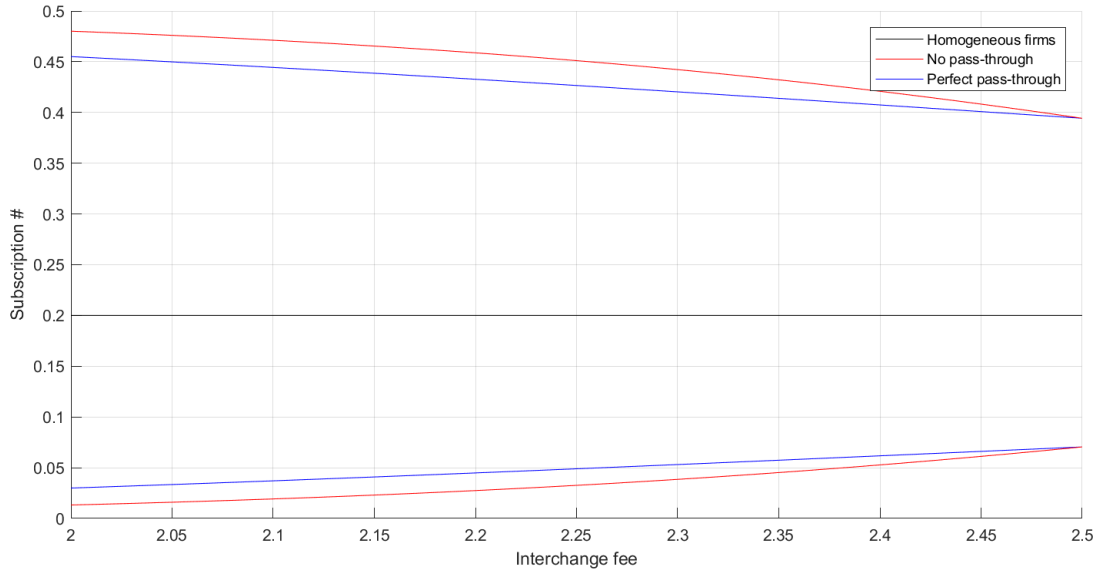
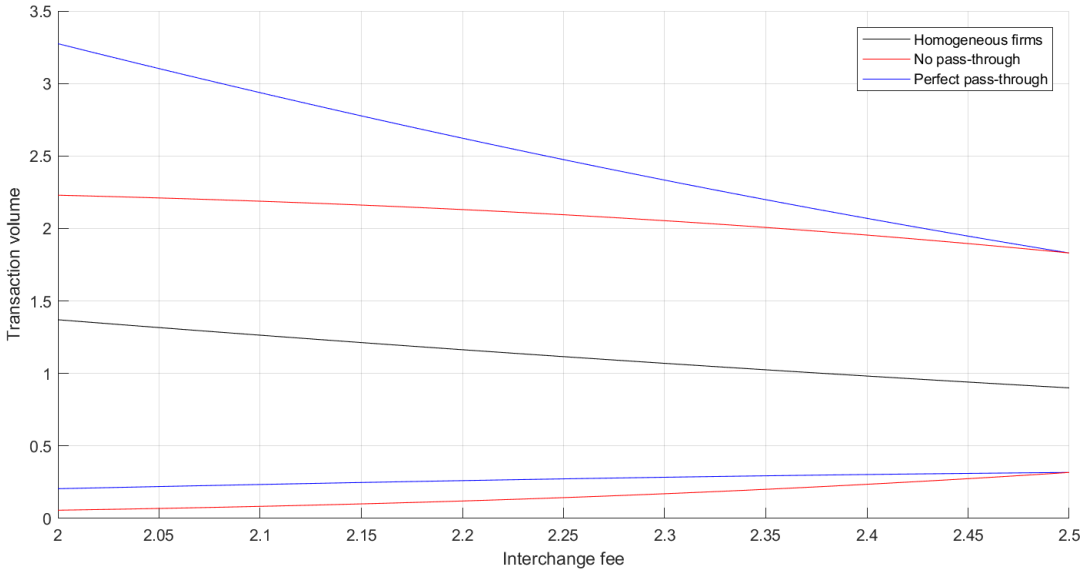


Figure 8: Comparative statics of transaction volume by payment card: $Q_i(.)D_S(m)D_b(f_i)$ for a varying range of interchange fees a. As before, it is the integrated banks who command more transactions than the homogeneous firms benchmark.



The parameters were chosen so that transaction volume and cardholders' transaction surplus increase as the interchange fee goes down in the homogeneous firms benchmark: this can happen because along the locus of fees where costs are perfectly passed through to price (in this benchmark, $m + f = (c_A + a) + (c_I - a)$, a trade-off occurs when a is reduced: consumers receive less money on each transaction as rewards are curtailed, but more merchants accept cards as the reduction in the interchange fee is passed through to the merchant discount rate. However, access fees and cardholding volume are constant as a and m diminish in tandem. This need not always be the case, and is a consequence of the logit specification for transaction demand as well as *every consumer choosing a card* for the parameters supplied. F_i own-elasticity of cardholding demand in this model is:

$$\frac{\partial Q_i}{\partial F_i}\frac{F_i}{Q_i} = -F_i(1 - Q_i)$$

Even though the transaction volume and ϕ increase as a decreases, the shock is common to all banks. Therefore, since nobody opts away from holding a card at all, then market shares are invariant in the shift of the interchange fee/MDR and the optimal F_i is constant too.

The above argument breaks down with integrated firms since the gain in transaction surplus is asymmetrically distributed across the market: since integrated firms own a wider margin of each transaction, they have more money to throw back at consumers

despite the intrinsic value of holding any card and using it for any transaction being equal. In both benchmarks with partial vertical integration, the integrated firms use this to their advantage and mark up their prices: notably, it is in the no pass-through benchmark, where margins on an integrated issuer's own transactions remain constant but those on acquiring foreign transactions increase, where the increase in access fees is the greatest. It is also this benchmark that sees the greatest decrease in transaction surplus, since there is no longer an increase in merchant adoption to offset the reduction in rewards, given that m stays constant as a decreases.

6 Concluding remarks

The model presented in this article provides a framework for incorporating a particular source of market power in payment card markets, which results from the vertical integration of some issuers with services usually provided by acquirers within a four-party payment card network. In this context, typical interchange fee regulation consisting of a cap or a mandated value has an asymmetric effect on market participants, given that only non-integrated issuers earn that fee on consumer payments, while the margin of integrated issuers is unaffected - in fact, they may benefit from this regulation as the acquisition margin they earn on other banks' payments processed by them potentially increases as interchange fees are regulated downward. Therefore, said regulation may result in undesired effects: the model highlights that, despite the existence of marginal cost pricing to merchants and consumers on a per-transaction basis, the nonlinear fees associated with payment cards in most markets lead to other avenues through which financial intermediaries can exploit market power. The case of Argentina, while extreme in the sense that a major four-party card network relies on one firm to provide acquisition services, may serve to analyze the countervailing effects of interchange fee regulation when some parties can circumvent the payment of that fee. For example, in an assessment of its own interchange fee regulation [18], the Reserve Bank of Australia noted that local banks that were previously issuers in four-party networks formed agreements with three-party networks such as American Express in order to offer cards with greater reward schemes, unfettered by regulation on the revenue banks can raise in order to redistribute to consumers[19].

The model used for analysis, while empirically tractable, relies on a host of simplifying assumptions. Some of them allow to account for variables that are generally missing from datasets available to researchers, such as rewards offered on a transactional basis. However, other results presented rely on the inflexible functional form I adopted for cardholding demand, as well as unrealistic restrictions on the functioning of the market (there is, for example, cursory evidence of surcharging card payments in Argentina,

[18] Cited as Australia 2016

[19] As a result, the RBA recommended a wider definition of 'interchange-like' payments between vertically related intermediaries within a payment card platform as a target for regulation.

as well as credit card rewards that are funded not only by MDR revenue but also by merchants directly). Since the associated demand elasticities are crucial to a nonlinear pricing decision, it is worth considering richer demand models, such as a conventional BLP specification.

Finally, the retail banking sector of Argentina has been concurrently targeted by other policies aside from antitrust regulation directed at credit card service providers. New clearinghouses may provide mobile banking on a more accessible basis, which allows consumers to pay merchants immediately through a channel separate from conventional payment cards, greatly reducing their market power. A more complete empirical analysis that attempts to link the data with the model I presented should account for these and other developments, including not only decisions by households but also by merchants, for whom the decision of bancarization is tied to leaving the informal sector of the economy and to facing some idiosyncrasies of the local taxation regime[20]

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[20]Including but not limited to accruing gross receipt tax from multiple states with card payments involving consumers and merchants from different states.

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7 Appendix

Tables

Table 4: Naive discrete choice model

	Dependent variable:	
	Cardholders(credit)	Credit card issue
	(1)	(2)
Total access fees	0.002^{***}	0.002^{***}
	(0.0003)	(0.0003)
Overdraft	$-2.7531e-8$	$4.9271e-8$
	$(5.2351e-8)$	$(4.9131e-8)$
Signature credit line	$9.7911e-9$	$3.4701e-8$
	$(3.3131e-8)$	$(3.1101e-8)$
Personal loans	$7.1221e-8^{***}$	$6.5791e-8^{***}$
	$(2.0321e-8)$	$(1.9071e-8)$
Credit card loans	$6.1401e-8^{***}$	$5.8791e-8^{***}$
	$(2.0151e-8)$	$(1.8911e-8)$
Savings deposits	$-9.6101e-9$	$-3.6761e-9$
	$(1.4241e-8)$	$(1.3361e-8)$
Observations	171	171
R^2	0.639	0.727
Adjusted R^2	0.618	0.712
Residual Std. Error (df = 161)	1.151	1.080
F Statistic (df = 9; 161)	31.616^{***}	47.717^{***}
Quarter FE	*X*	*X*
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 5: Instrumental variable discrete choice

	Dependent variable:
	Cardholders(credit)
Total access fees	-0.0004
	(0.001)
Overdraft	$4.8231e-7$
	$(1.1201e-6)$
Signature credit line	$2.1781e-7$
	$(3.1021e-7)$
Personal loans	$6.9301e-8$
	$(1.5621e-7)$
Credit card loans	$-1.4961e-7$
	$(6.9131e-7)$
Savings deposits	$4.8541e-8$
	$(5.2961e-8)$
Observations	171
R^2	0.179
Adjusted R^2	0.144
Residual Std. Error	1.724 (df = 163)
BLP IV	*X*
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 6: Trends and fixed effects on access fees

	Dependent variable:
	log(Total access fee)
month	0.377^{***}
	(0.095)
$\mathbf{1}\{t \geq \text{Apr 2017}\}$	-0.011
	(0.059)
$\mathbf{1}\{\text{Bank owns PRISMA}\}$	0.232^{***}
	(0.039)
PRISMA $\times \mathbf{1}\{t \geq \text{Apr2017}\}$	0.041
	(0.061)
Constant	-754.452^{***}
	(190.945)
Observations	516
R^2	0.204
Adjusted R^2	0.197
Residual Std. Error	0.318 (df = 511)
F Statistic	32.657^{***} (df = 4; 511)
Note:	*p<0.1; **p<0.05; ***p<0.01

Choice of fee structure for an integrated issuer

I want to show an integrated issuer prices transactional services on a marginal cost basis. Its problem in period 1 is:

$$\begin{aligned}\max_{f_i,F_i}&[(m+f_i-c_A-c_I)d(f_i,m)+F_i]Q_i(F_i-\phi(f_i,m),F_{-i}-\phi(f_{-i},m))+\\&+\sum_{j\neq i}(m-c_A)d(f_j,m)Q_j(F_j-\phi(f_j,m),F_{-j}-\phi(f_{-j},m))\end{aligned}$$

Where $d(f,m)$ is shorthand for transaction volume: $d(f,m)=D_S(m)D_b(f_i)$. First order conditions for this firm are:

$$\begin{aligned}(f_i)\ :&Q_i(.,.)[d(f_i)+d_f(f_i)(m+f_i-c_A-c_I)]-\\&\overbrace{Q_{i,1}(.,.)}^{\frac{\partial Q_i(x,y)}{\partial x}}\frac{\partial\phi}{\partial f_i}(f_i,m)[(m+f_i-c_A-c_I)d(f_i,m)+F_i]-\\&\sum_{j\neq i}(m-c_A)Q_{j,i}(.,.)\frac{\partial\phi}{\partial f_i}(f_i,m)=0\\(F_i)\ :&Q_i(.,.)+Q_{i,1}(.,.)[(m+f_i-c_A-c_I)d(f_i,m)+F_i]+\sum_{j\neq i}(m-c_A)Q_{j,i}(.,.)=0\end{aligned}$$

Isolating Q_i from the first order condition for F_i, we get an expression equal to the factor multiplying $\frac{\partial\phi}{\partial f_i}$ in the first order condition for f_i. Therefore, the first equation simplifies to:

$$(f_i):Q_i(.,.)\left(d(f_i)+d_f(f_i)(m+f_i-c_A-c_I)+\frac{\partial\phi}{\partial f_i}(f_i,m)\right)=0$$

$D_S(m)$ drops out from all the terms in the inner sum to produce

$$D_b(f_i)+D_b'(f_i)(m+f_i-c_A-c_I)+\frac{\partial}{\partial f_i}\left(E[b_B-f_i|b_B>f_i]D_b(f_i)\right)=0$$

$$\begin{aligned}\frac{\partial}{\partial f_i}\left(E[b_B-f_i|b_B>f_i]D_b(f_i)\right)&=\frac{\partial}{\partial f_i}\left(\int_{f_i}^{\bar{b}_B}(b_B-f_i)g(b_B)db_B\right)\\&=-\int_{f_i}^{\bar{b}_B}g(b_B)db_B+0g(f_i)\\&=-D_b(f_i)\end{aligned}$$

Therefore, the FOC for f_i reduces to $m+f_i-c_A-c_I=0$.