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An Application of the Tourist Test to Colombian Merchants

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Una aplicación del Test del Turista a los comerciantes colombianos

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Resumen

En Colombia el efectivo continúa usándose ampliamente, incluso entre los comerciantes que aceptan tarjetas de pago. De hecho, el 60% de los comerciantes utilizan estrategias disuasivas para que sus clientes paguen en efectivo, reflejando que los cargos de los servicios por tarjetas (MSC) para los comerciantes no son óptimos. Este documento presenta estimaciones del MSC compatibles con el Test del Turista (Rochet y Tirole, 2007, 2011), donde el nivel de costos debe ser tal que los comerciantes sean indiferentes entre recibir pagos en efectivo o con tarjeta. Las estimaciones para Colombia muestran que el efectivo es menos costoso que las tarjetas para valores promedio de transacción en ventas minoristas, por lo tanto, no hay un MSC óptimo positivo para estos valores. Para el ticket promedio de transacción con tarjeta, el MSC óptimo sería positivo pero muy por debajo de las tarifas cobradas por la industria (0,74% en el corto plazo). El incentivo adicional generado por la evasión de impuestos a las ventas en efectivo, sin embargo, disminuye el cálculo del MSC de acuerdo con el test del turista a 0,44%. Las estimaciones para escenarios a largo plazo arrojan un MSC óptimo aún más bajo. Una reducción en los precios basada en un nivel medio de estas tarifas desalentaría las estrategias comerciales que buscan disuadir a los consumidores de pagar con tarjetas. Es de mencionar que estos resultados deben tomarse como una guía, ya que las estimaciones dependen de los supuestos subyacentes en el modelo y solo consideran el lado comercial de la industria de las tarjetas.

Palabras clave: Efectivo, tarjetas débito y crédito, test del turista, tarifas de intercambio.
Clasificación JEL: D23, D40, G20, G21, G28, E41, E58

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An Application of the Tourist Test to Colombian Merchants

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Abstract

Cash is still widely used in Colombia, even among merchants that accept payment cards. Indeed, 60% of these merchants use dissuasive strategies to make their clients pay with cash. This shows that merchant service costs (MSC) for cards are not optimal in the sense of the Tourist Test. We present estimates of MSC compatible with the Tourist Test, such that merchants are indifferent between being paid with cash or cards. We find that cash is less costly than cards at the average retail-sales transaction-value, hence there is no positive optimal MSC at this ticket value. For the average card transaction ticket, the optimal MSC would be positive but far below the rates charge by the industry (0.74% in a short-term scenario). Yet, the additional incentive that sales-tax evasion provides to cash payments reduces the Tourist Test MSC to 0.44%. Our estimates for long-term scenarios yield even lower optimal MSC. A reduction in MSC fees that strikes a middle ground between these figures should discourage merchant strategies that deter consumers from paying with cards. These results should be taken as a guideline as the estimations depend on the underlying assumptions and only consider the merchant´s side of the card industry.

Keywords: cash, debit and credit cards, tourist test, merchant card fees, merchant interchanges fees.
JEL Classification: D23, D40, G20, G21, G28, E41, E58

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1 Introduction

The use of electronic payments is growing rapidly in emerging countries, however for its consolidation to be achieved the levels of acceptance by merchants must increase. Businesses, particularly small ones, recognize the gains in terms of efficiency and competitiveness of accepting electronic payment instruments but their cost-benefit analysis remains unfavorable. This is the case of Colombia where limited merchant size, low average transaction values, low profit margins and financial capacity, high adoption costs and advantages of remining informal are, among others, factors that explain the high percentage of small businesses that are reluctant to accept electronic payments.[1]

As in other emerging countries, Colombia has a large part of retail payments made in cash mainly due to the limited acceptance of electronic payment instruments by merchants. As shown by different surveys applied to both consumers and merchants in Colombia, 88% of adults use cash as their main payment instrument and only 7.2% use alternative payment instruments to make their purchases (Payment Systems Report, 2020). One of the main reasons for the high use of cash is due to the consumers' perception of limited acceptance of electronic payment instruments (Arango et al., 2017). Indeed, the acceptance levels of means of payment different than cash in Colombia is low compared with peer economies such as Argentina, Brazil, Costa Rica and Turkey (Figure 1). As pointed out by Huynh et al. (2014) the limited merchant acceptance of payment cards can explain why consumers hold cash for precautionary reasons.

Given that the payments market is two-sided,[2] the interaction between consumers and merchants determines the use of payment instruments at the point of sale (POS). This is because both buyers and sellers are needed to create demand for the service and because of the increasing positive externalities that one side enjoys with the rise in the adoption of the service by the other side. Consumers' preferences for alternative payment instruments and

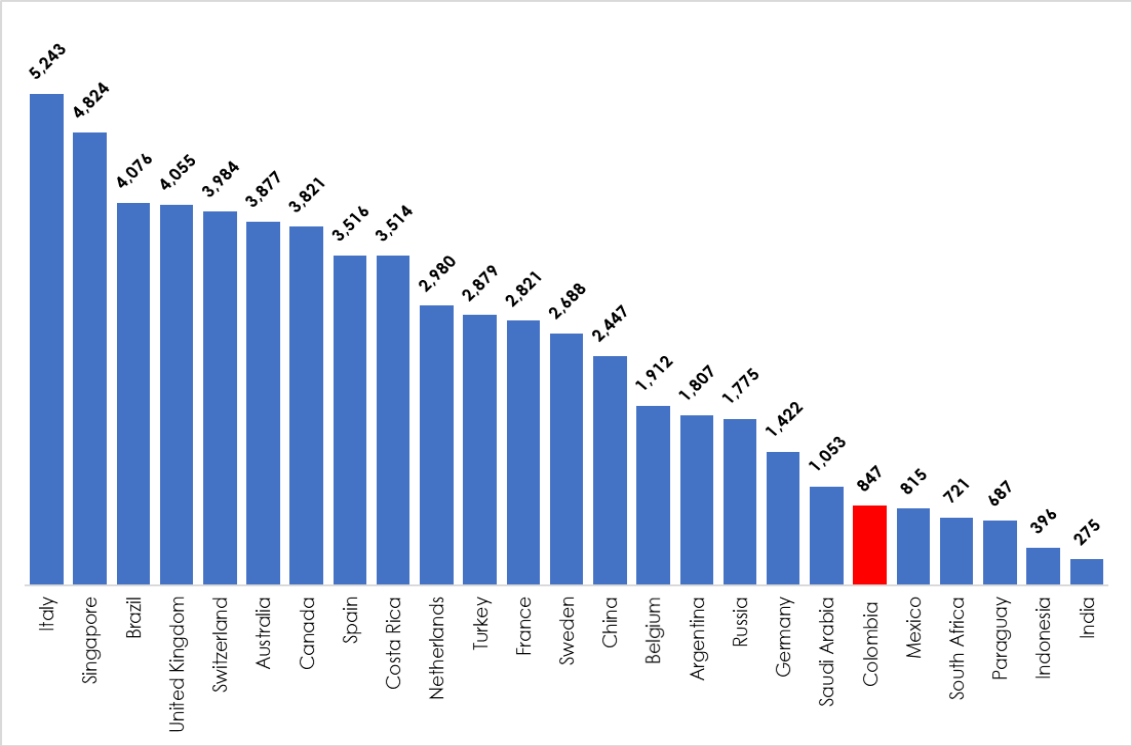
[1] Arango-Arango et al., 2020.

[2] Which means that there are different user groups on each side, on one hand the consumers who choose a payment method among those merchants that will accept it, and on the other hand, merchants who would likely accept payment instruments that attract more customers.

merchants' perceptions and strategies to influence their customers to use a particular payment instrument are factors that help explain market outcomes.

Figure 1. Card acceptance - 2018

(POS-terminals per 100,000 inhabitants)



Source: Red Book statistics, BIS (2020) and Yellow Book statistics, CEMLA (2020).

In Colombia these two-sided forces do not seem to materialize in the electronic payments' realm as 83.6% of the adult population has access to transactional accounts (BDO-DNP, 2020), and therefore could have access to electronic payment methods (electronic transfers, debit or credit cards and mobile payments). But due to their limited acceptance by merchants their use is low. Even among merchants that accept cash and electronic payment instruments, cash accounts for 83.9% of the volume and 60.2% of the value of retail sales while cards only for 12.9% and 29.7% respectively (Arango-Arango and Betancourt-Garcia, 2020).

These imbalances show that the pricing of cards may not be optimal or, alternatively, that cash marginal costs are lower than those of processing cards at the POS. A sign of these

imbalances is the fact that more than half of the merchants that accept cards in Colombia use strategies such as cash discounts, minimum transaction values or card surcharges to induce customers to use cash (Arango-Arango et al., 2021).

According to some studies (e.g. Kosse et al., 2017; Carbó-Valverde, 2019), debit and credit cards are the costliest means of payment for merchants, mainly because merchant service charges (MSC) account for more than 80 per cent of the costs. To measure the degree of mismatch between market and optimal MSC that acquirers charge to merchants, Rochet and Tirole (2011) introduced the notion of the "Tourist Test" or the "Merchant Indifference Test" (MIT). The MIT is based on the idea that card networks should charge merchant a MSC that makes them indifferent between being paid in cash or cards, in the context of a sporadic consumer with no loyalty or attachments to the merchant (a tourist). They show that such pricing would be socially optimal.

To calculate the MSC that is compatible with the MIT (the MIT MSC) the empirical literature estimates the difference between the marginal cost of cash and the marginal cost of cards (net of the MSC charged by acquirers) as a percentage of a representative retail transaction value. Few countries have estimates of the MIT MSC but all of them coincide in finding that the MIT MSC is significantly lower than the MSC charged by their card industry.[3] Furthermore, estimates for Canada and Europe show that the marginal cost of cash would be lower than that for cards at low transaction values and the MIT MSC would be negative (see Appendix C, Table 2C).

Following other studies, we apply the MIT to the Colombian case, based on a merchant cost survey performed by the Colombian central bank in the last quarter of 2018 (Arango-Arango and Betancourt-García, 2020). We apply two alternative methodologies: (i) an accounting or arithmetic estimation of the MIT MSC based on the variable costs as stated by participants and (ii) an econometric approximation based on the estimation of cost functions for each

[3] Bolt, Jonker and Plooij (2013) in the Netherlands, ECDGC (2015) in Europe, Fung et al. (2018) in Canada, Górka (2014) in Poland, Aurazo and Vasquez (2019) in Perú and Layne-Farrar (2013) in the United States.

payment instrument. Yet, cost estimates proved to be prone to measurement error with distributions that showed strong skewedness and kurtosis away from normality and therefore we resorted to robust statistical methods.

We find that at the average retail transaction (USD $12.27), the marginal cost of cash is lower than those of debit or credit cards, implying a negative MIT MSC. Hence, merchants would prefer to be paid in cash rather than cards at any positive MSC. For higher transaction values (at the average card ticket of USD $42.49) we find that, in a short-term perspective of a sporadic consumer, the MIT MSC would be up to 0.74% (0.44% adjusted for sales-tax evasion). In a long-term perspective, where a merchant defines their cash discount and minimum transaction policies for their regular customers, the MIT MSC would be up to 0.17% (but -0.13% if adjusted by sales-tax evasion). In a scenario with a 30%-less cash dependent retail sector the MIT MSC would be up to 0.53% (0.23% adjusted for sales-tax evasion). These figures are considerably below the average MSC charged by the industry in Colombia.

We also show that the MIT MSC varies substantially depending on the payment cost structure of merchants. In particular, the MIT MSC depends on the scale of payment volumes and values processed by merchants, the relative participation of cash and card payments in their sales and the average transaction value at which they operate. Given such dispersion, a regulation based on an average price cap, as has been implemented in various countries, would allow the card industry to accommodate different MSC depending on merchants´ cost structures.

The paper is organized as follows. Section 2 provides background information about interchange fees and the tourist test and gives a brief literature review. Section 3 describes the Colombian retail payments market. Section 4 describes the merchant cost survey performed by the Colombian central bank in 2018. Section 5 presents the results of applying the MIT to the Colombian data. Section 6 presents a discussion of the results and some policy implications and Section 7 concludes.

2 Interchange fees and the merchant indifference test

Various studies in recent years, frequently carried out by central banks, have estimated the costs of payment instruments to measure retail payments efficiency. Some studies estimate the social cost of different retail payment methods (e.g. Australia, Belgium, Netherlands, Portugal and Norway) and others, such as Poland, focus on private costs incurred by merchants (see Schmiedel et al.,2012 and the references therein). Although these estimates are not strictly comparable, they provide valuable information about the efficiency of the retail payments systems on which public policies are based to foster competitive market conditions and innovation in these markets (BIS, 2003).

To promote the use of efficient payment instruments and prevent abuses in the market, policymakers carried out empirical research following the theoretical literature on Merchant Interchanges Fees (MIF) (Baxter, 1983; Rochet and Tirole, 2002, 2003). The MIF are fees charged by issuing banks to acquiring banks for each card payment transaction. Many discussions have focused on the MIF because it is identified as one of the main factors that explains the low level of use of payment cards.

Some authors such as Chakravorti et al. (2009) demonstrate with econometric models a positive impact of MIF reductions on the growth of the card acceptance network in Spain. Ardizzi (2013) empirically found that decreasing the MIF in Italy led to a shift towards payment card transactions instead of cash at the point-of-sale (POS). Carbó et al. (2019) found that merchant discount fees represent most of the cost of debit cards, despite of the generalized reduction in merchant fees in many of the 52 countries analyzed, making debit cards about 2.8 times more costly than cash.[4] Ardizzi et al. (2021) also show that there is a negative and significant relationship between the number and the growth rate of card-based transactions per capita and the level of interchange fees in the period 2010-2019 for the European countries where the Interchange Fee Regulation was applied in 2015.

[4] They find that the merchant discount fee represents more than 81% of the total cost of debit cards for retailers

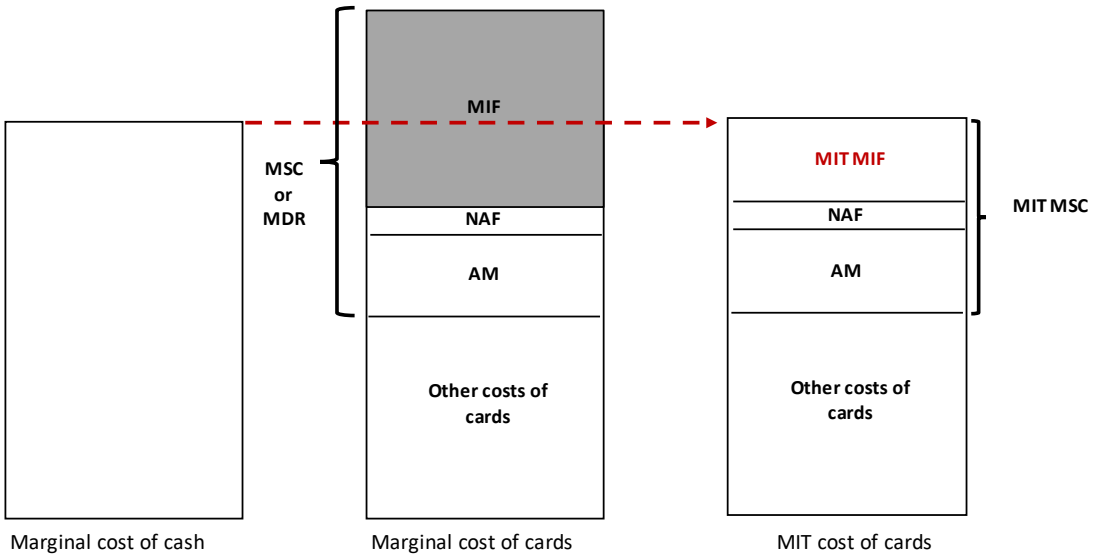
To compare the MIF with an optimal level, Rochet and Tirole (2007, 2011) developed a benchmark called the "Tourist Test" or the "Merchant Indifference Test" (MIT), which assess merchants' costs of cash and cards based on an occasional customer, such as a tourist, who carries enough cash for a transaction and has no long-term ties with the merchant. The MIT explores the question whether a merchant would refuse a card payment in such context. If accepting a card does not increase the merchant's operating costs and if its impact on the merchant's profit and loss account is neutral, then a merchant will be indifferent between card or cash payments (Rochet and Tirole 2007). When the MIF is capped at the MIT level it may promote socially efficient outcomes,[5] given that merchants do not incur on excessive costs for accepting card payments (a "Must-Take cards" situation; Vickers, 2005). In addition, capping the MIF could enlarge the payment card acceptance network and may benefit consumers with lower prices. However, the MIT calculations only consider the costs incurred by merchants and do not consider the cardholders, acquirers and issuers, network externalities for merchants and cardholders or entry in the market (Rochet and Tirole, 2011).[6,7]

Calculations of the MIT MIF focus on the comparison of variable (and marginal) costs of card and cash payments and treat fixed costs as irrelevant. The marginal costs of cash are mainly driven by front and back-office costs and by some external costs, while the marginal costs of cards are driven by front office costs and the Merchant Service Charges (MSC). The MSC contains the acquirer margin (AM), set by the acquirer, the MIF and the network access fee (NAF) set by the networks. Figure 2 shows that the MSC is strictly larger than the MIF because it contains the AM and the NAF. Hence, this means that additional information on the AM and the NAF is needed to calculate the MIT MIF, for example, through acquirer surveys (Bolt, Jonker and Plooij, 2013) or by making assumptions about AM (ECDGC, 2015; Layne-Farrar, 2013). Due to lack of information about NAF and AM, some studies calculate

[5] In terms of short-term consumer surplus, although it might lead to false positives if the criterium is social welfare, depending on the underlying assumptions (Rochet and Tirole, 2011; Wright, 2012; Zenger, 2011).
[6] It means that cards become more useful to cardholders when there are more merchants that accept them, and acceptance of cards is more beneficial to merchants when there are more customers holding cards.
[7] Hayashi (2006) find that despite the high fees, credit cards are widely accepted and used in countries like Australia, UK and USA.

the MIT MSC which is the difference between the marginal cost of cash and the marginal cost of cards net of the MSC.

Figure 2. Definitions of the Merchant Indifference Test



Note: MIF: merchant interchange fee; NAF: network access fee; AM: acquirer margin; MSC: merchant service charge; MIT: merchant indifference test.

Source: Fung et al. (2018) and ECDGC (2015).

To implement the MIT MSC, the literature assumes that part of the total costs of processing a payment instrument j are associated to transaction volumes and part to sales values (Q_j multiply by the transaction value ATV_j), with a linear total cost function of the form:

$$C_j = \alpha_{0j} + \alpha_j Q_j + \beta_j Q_j ATV_j. \qquad (1)$$

Then, the MIT MSC is calculated as the difference between the marginal costs of cash and the marginal costs of cards (net of the MSC), where the marginal cost of the payment instrument j is $mgc_j = \alpha_j + \beta_j ATV_j$. Hence:

$$MIT\ MSC\ = \frac{\alpha_{cash} - \alpha_{card}}{ATV} + \beta_{cash} - \beta_{card} \quad (2)$$

where:

α_{cash} and α_{card} are the average variable costs per one additional cash/ card transaction
β_{cash} and β_{card} are the average variable cost per one additional dollar of cash/card sales
ATV is the average transaction value at the POS.

This method has been used in different studies. For example, the ECDGC (2015) used it in cases against Visa and Mastercard. They found that cash was less costly than cards at the average retail sale but positive at the average card sale. Layne-Farrar (2013) compared the MIF suggested by MIT with that set by the Durbin Amendment (DA) which capped the debit card MIF in USA. According to this study cash was still a cost competitive instrument compared to debit cards and what mattered most in calculations was the average transaction size. Jonker and Plooij (2013) showed that the tourist test methodology may lead to growing costs for merchants in countries like the Netherlands, characterized by decreasing costs of debit cards and increasing costs of cash. They found MIT MIF would increase from 0.2% to 0.5% of the average debit card transaction value. According to the authors the MIT is heavily dependent on market characteristics. Górka (2014) determined the level of MIF on the basis of primary data from a merchants´ survey for the Polish case and found that the results of the MIT application are sensitive to changes of parameters as well as to changes in the average card and cash transaction values. Fung, et al. (2018) compute the MIT MSC using Canadian merchant data and found that the results are sensitive to the underlying assumptions about the distribution of variable costs.[8]

Recently, Aurazo and Vasquez (2019) extended the theoretical framework of the tourist test to emerging economies by introducing sales-tax evasion as an additional potential benefit merchants have when considering being paid with cash rather than cards. Being paid with cash allows merchants to avoid registering the transaction through formal receipts and paying sales taxes. In the case of payments with cards this is much harder as such transactions are

[8] Table 2C in appendix C shows the main results of various country studies in the calculation of the MIT-MIF.

traceable. Aurazo and Vega (2020), in the case of Perú, find that such benefits may reduce the MIT MSC and the MIT MIF calculations, at 0.63% and 0.56% before adjustments for value-added-tax evasion (VAT), by 0.28%, resulting in 0.35% and 0.28% respectively.

Because estimations are sensitive to the underlying assumptions and changes in the parameters α and β, as well as to changes in the average transaction values, the results of the MIT MSC and the MIT MIF should be taken as guidance in the possible regulation of card fees. In this sense, Hayashi (2012) and Layne-Farrar (2013) found that the introduction in the United States of a uniform MIF cap for debit cards increased fees for merchants with small average transaction values and decreased them for those with large average transaction values.

Another caveat of regulating cards fees based on the MIT is related with the network externalities given that this is a multi-sided market because the MIT focuses on the merchants only and does not consider the cardholders, acquirers, and issuers. In this sense, Rochet and Tirole (2011) argue that network externalities for merchants and cardholders depend on the level of MIF. Moreover, Hayashi (20) finds that credit cards are widely accepted and used in Australia, UK and USA despite high fees.

Finally, because the MIT is based on a non-repeat customer who carries enough cash for the transaction, it does not consider strategic considerations related to attracting and retaining customers, an important driver of card acceptance. Tirole (2011) argues that the benefits to the merchants generated by card acceptance would likely generate a MSC higher than the MIT MSC. Also, medium-term strategic considerations may change the differences in marginal costs as some of the fixed costs may become variable and entry may affect merchants' payment technologies.

3 Colombian market structure of retail payments and institutional arrangements

The Colombian economy has high levels of informality, modest results in terms of use of financial services, and a high dependence on cash (more than 90% of the volume of payments from individuals and close to half of the payments from companies are still made in cash).

However, advances in the digitalization of payments in Colombia have allowed for 69% of payments of the economy in terms of values (mainly from companies, individuals, and the government) to be made digitally (BTC, 2015).

As Arango et al. (2017) show, the relative costs of operating with electronic payments versus cash are still a significant barrier for most small businesses to accept debit and credit cards, due to higher operating costs and expectations of higher tax burdens. This has led to low levels of acceptance and use of these instruments in this segment of commerce, which contrasts with a relatively high card holdings by consumers. This imbalance between the two sides of the market shows that in Colombia the positive network externalities have not been materialized in the world of cards.

In addition, there is a high degree of vertical and horizontal integration in the payments ecosystem because the main banks own the infrastructures where they clear and settle electronic transfers and payments made with debit and credit cards: the ACH Colombia S.A. which provides interbank transfer services, and Redeban and Credibanco, the two switches in charge of clearing debit and credit card payments of the two franchises Visa and Mastercard. Furthermore, the banks have control of the acquisition side through Redeban and Credibanco, which carry out this activity on behalf of the banks. Likewise, banks, which are the main providers of transactional accounts, also control the card issuance.

In Colombia, in accordance with the law, the national government through the Ministry of Finance (MHCP-URF) regulates the low-value payment systems and the Central Bank regulates the high-value payment systems, according to a threshold of operations defined by the Decree 2555 of 2010. The supervision of the entities that administer payment, clearing and settlement services (including debit and credit card systems) corresponds to the Financial Superintendency of Colombia (SFC) and the Superintendency of Industry and Commerce (SIC) is the competition authority in control of anticompetitive practices in the provision of payment services.

Regulation and supervision of the payments ecosystem in Colombia have focused on its prudential role of ensuring the security of clearing and settlement systems, but marginally on

the efficiency and pertinence for the end users. The regulation concentrates the acquiring activity in the credit establishments, giving them high bargaining power, since only through them can payment service providers offer card payment services.

In Colombia, the MIF have been subject to various interventions by the SIC. As detailed in Bardey et al. (2012), the SIC opened an investigation in 2004 under the presumption of price fixing by the card networks. Such investigation led to agreements where the MSC would be negotiated bilaterally between acquirer banks and merchants and the MIF was introduced together with a cost-based methodology to determine its level.

In 2006 the SIC stated that the cost model was not well managed by banks and card networks and introduced an average price cap as a transitory measure, while it contracted a study that would recommend and alternative way of setting the MIF. In 2007 the banks told the SIC that the MIF would be set by the banks and not the card networks. By doing so, the SFC, and not the SIC, was then in charge of looking at the MIF set by banks and the SIC advised de SFC about possible price fixing by banks in the determination of the MIF.

In 2009 the SIC became the competition authority for all sectors in the economy (Act 1340, July 2009), including the banking sector, and in 2011 opened a new MIF investigation, which led in 2012 to the implementation of the REMI. It was a MIF-setting model based on an auction mechanism where the banks posted the MIF and the tariff was set under the median voter´s rule by choosing the median value of the proposed MIF bids.[9]

During this first period of the SIC´s interventions, the MIF for Visa debit fell from 1.4% to 1.1% (the MIF for Mastercard debit remained at 1.1%), while the MIF for Visa credit fell from 2.8% to 1.5%. As for the MSC, the one for Visa debit fell from 1.86% to 1.45% (The MSC for Mastercard remained at 1.56%) and the one for Visa credit fell from 3.32% to 2.06.[10] The REMI was used to set the MIF since its inception until the warranty agreements expired, and now it is up to the card industry to set their MIF.

[9] Resolution 40478, June 2012, issued by the SIC.
[10] See Bardey and Meléndez (2012) for a detail account of pricing in the cards´ market during this period.

Currently, in Colombia the MIF for debit cards range between 0.34% and 2.46%, with an average of 1.28%, and, for credit cards, between 0.35% and 2.25%, with an average of 1.44%. These fees are greater than those in the European countries, where the MIF for Visa and Mastercard are capped at 0.20% for debit cards and 0.30% for credit cards (EY-EC,2020). In the United States the MIF for debit cards (regulated) are 0.8%+15 cents for Visa and 1.05%+15 cents for Mastercard and for credit cards the MIF are 1.51%+10 cents for Visa cards and 1.58%+10 cents for Mastercard (unregulated).[11] As for the MSC, [12,13] they average 1.54% for debit cards (ranging from 0.15% to 6.85%) and 1.69% for credit cards (ranging from 0.09% to 6.43%), higher than the average MSC charge in Europe of 0.32% for debit cards and 0.72% for credit cards (EY-EC,2020).[14]

There is evidence that the current fee structure in Colombia may not be optimal in the sense of the MIT as 60% of merchants that accept cash and cards use cash discounts, minimum transaction limits or card surcharges to dissuade customers from using cards at the POS (Arango-Arango et al., 2021).

4 Survey of merchant costs of different payment instruments

To compare the cost efficiency of alternative payment instruments, central banks have implemented surveys to obtain information about the costs that merchants incur when they accept them. The Survey on Merchant Costs of Processing Payments carried out by the Central Bank of Colombia in 2018 (SMC18) collected information about the costs of accepting different payment methods at the point of sale (POS), focused on cash, debit cards and credit cards. The sample is made up of 867 merchants, located in the urban area of 15 municipalities in Colombia and was divided by size into micro merchants, small businesses

[11] https://usa.visa.com/dam/VCOM/download/merchants/visa-usa-interchange-reimbursement-fees.pdf and https://www.mastercard.us/content/dam/public/mastercardcom/na/us/en/documents/merchant-rates-2021-2022-apr-2021.pdf (last seen 27/06/2021).
[12] These values are calculated from public reports issued by Redeban and Credibanco, as they are required by law. In the calculation of both the MIF and the MSC we discharge fees reported as zero although it is possible that MIF are set to zero for some niches of the cards´ payment market.
[13] See Table 1C in Appendix C for a detail account of the MIF and the MSC fees.
[14] In Colombia the highest average MIF for debit cards is set at restaurants, automotive and household appliances and electronics whereas the lowest average MIF are set at gas stations, fast food restaurants, travel agencies and large retail chains (the distribution is similar for credit cards).

and medium and large businesses and by economic activity.[15] Fifty percent of the merchants in the sample are located in the four main cities of the country (Table 1), and about half of the sample corresponds to micro merchants. In terms of the economic sectors 64.5% is concentrated in four activities (clothing and footwear, bars, restaurants and hotels, vehicles and auto-parts, and household appliances) (Table 2).

Table 1. Sample distribution by municipalities and merchant size

City	Merchant size			
	Large-medium	Small	Micro-commerce	All merchants
Bogotá	10.6%	5.0%	3.6%	19.2%
Medellin	5.9%	1.3%	3.9%	11.1%
Cali	4.6%	1.9%	4.0%	10.5%
Barranquilla	2.4%	3.8%	2.7%	8.9%
Bucaramanga	2.1%	2.2%	4.4%	8.7%
Cartagena	0.2%	2.1%	3.9%	6.2%
Villavicencio	1.2%	2.4%	2.2%	5.8%
Pasto	1.3%	1.6%	2.4%	5.3%
Manizales	0.2%	1.2%	3.0%	4.4%
Pitalito	0.1%	0.2%	3.8%	4.2%
Florencia	0.0%	0.4%	3.7%	4.0%
Ocaña	0.0%	0.2%	3.8%	4.0%
Santa Marta	0.0%	1.4%	2.3%	3.7%
Candelaria	0.0%	0.2%	1.9%	2.1%
La ceja	0.0%	0.1%	2.0%	2.1%
Total	28.6%	23.9%	47.5%	867

Source: Survey on Merchant Costs of Processing Payments. Authors' calculations.

[15] For more details about the sampling framework, questionnaire, and the survey´s responses see Arango-Arango and Betancourt-Garcia (2020).

Table 2. Sample distribution by retail sectors

Industry sector	Merchant size			
	Large-medium	Small	Micro-commerce	All merchants
Vehicles, auto parts and technical service	7.2%	4.8%	3.6%	15.6%
Bars, restaurants and hotels	5.3%	4.5%	6.0%	15.8%
Food, drinks and groceries	3.0%	1.5%	5.0%	9.5%
Health, Sports and Beauty	2.1%	1.0%	5.1%	8.2%
Clothing and footwear	3.2%	2.2%	13.0%	18.5%
Home appliances	3.7%	5.1%	5.9%	14.6%
Technology	0.8%	1.2%	3.3%	5.3%
Services	0.7%	1.7%	4.3%	6.7%
Lubricants and fuels	2.7%	1.8%	1.4%	5.9%
Total	28.6%	23.9%	47.5%	867

Source: Survey on Merchant Costs of Processing Payments. Authors' calculations.

The survey sought to collect information about costs for merchants that accept cash and cards based on a questionnaire which was divided in two parts. The first part focused on the costs that merchants incurred when they receive payments, considering the volume and value of payments and different types of costs. This part asked for:

- Back- and front-office labor costs associated with payment processing and the costs of third-party services by payment instrument (e.g. cash handling services, EFTPOS and card processing fees),
- costs associated with fraud, sales' surcharges and discounts and cash balances.
- and merchants' perceptions about the nature of costs between fixed and variable in a 3-to-4-years horizon, with a reduction in cash sales of 20%.

The second part asks about the costs incurred when merchants make payments to third parties due to operating expenses. Questions included the volume and value of the payments done by merchants to third parties for labor, services and merchandise, costs associated with different payment instruments and their profit margins.

The total private costs that merchants incur for accepting each payment method include pecuniary (fees they pay to other parties) and non-pecuniary costs such as front- and back-office costs. Front-office costs include the cost of the time it takes to process and finalized a transaction at the cash register. For this reason, a subsample of 245 merchants were directly monitored for 750 hours to obtain information about the time taken for each payment at the POS. Back-office costs come from numerous activities that facilitate cash and card transactions and they are more diverse in nature than front-office costs.

According to the survey´s results the distribution between fixed and variable costs shows that fixed costs are about half of the total costs for all merchants in the sample and for all instruments. In the case of micro merchants, fixed costs are a larger part of the total costs of accepting debit and credit cards. A large proportion of variable costs for cash are associated with processing costs, which comprise front- and back-office activities (counting, reconciliation, bundling and depositing at a financial institution). For cards acquiring fees are the most important variable costs followed by processing costs (Table 3).

Table 3. Distribution between fixed and variables costs per payment instrument

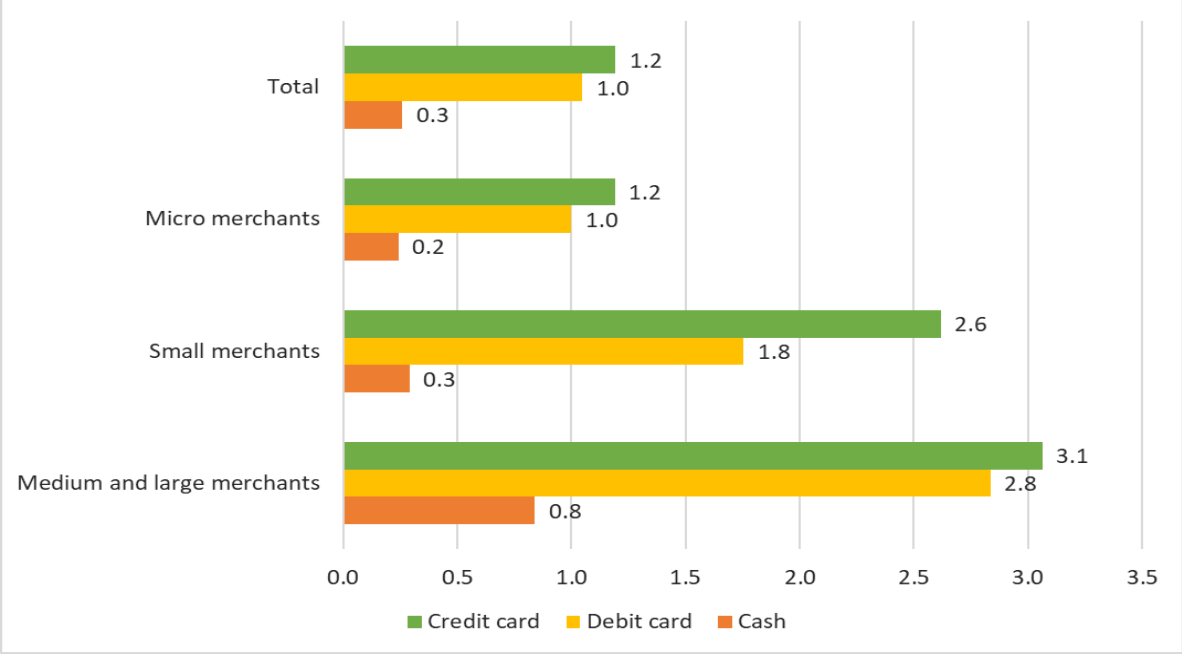
	Fixed costs	Acquiring fees	Processing costs	Opportunity costs	Froud/counter feiting/robbery losses
			All merchants		
Cash	43.60%	0.00%	55.67%	0.08%	0.65%
Debit card	50.43%	30.70%	18.87%	0.00%	0.00%
Credit card	49.55%	34.92%	15.53%	0.00%	0.00%
			Micro merchants		
Cash	43.49%	0.00%	55.71%	0.09%	0.71%
Debit card	51.57%	28.48%	19.95%	0.00%	0.00%
Credit card	53.73%	29.54%	16.73%	0.00%	0.00%
			Small merchants		
Cash	44.63%	0.00%	54.99%	0.05%	0.34%
Debit card	46.83%	39.74%	13.43%	0.00%	0.00%
Credit card	34.96%	54.18%	10.86%	0.00%	0.00%
			Medium and large merchants		
Cash	42.56%	0.00%	57.14%	0.14%	0.17%
Debit card	35.93%	50.06%	14.01%	0.00%	0.00%
Credit card	31.31%	55.89%	12.80%	0.00%	0.00%

Source: Survey on Merchant Costs of Processing Payments. Authors' calculations.

Most of the cost studies used two approaches to analyze the cost-efficiency of payment instruments, either dividing costs by the total number of transactions made with a payment instrument (per-transaction costs) or dividing costs by the total dollar value of sales with the instrument (per-dollar costs).

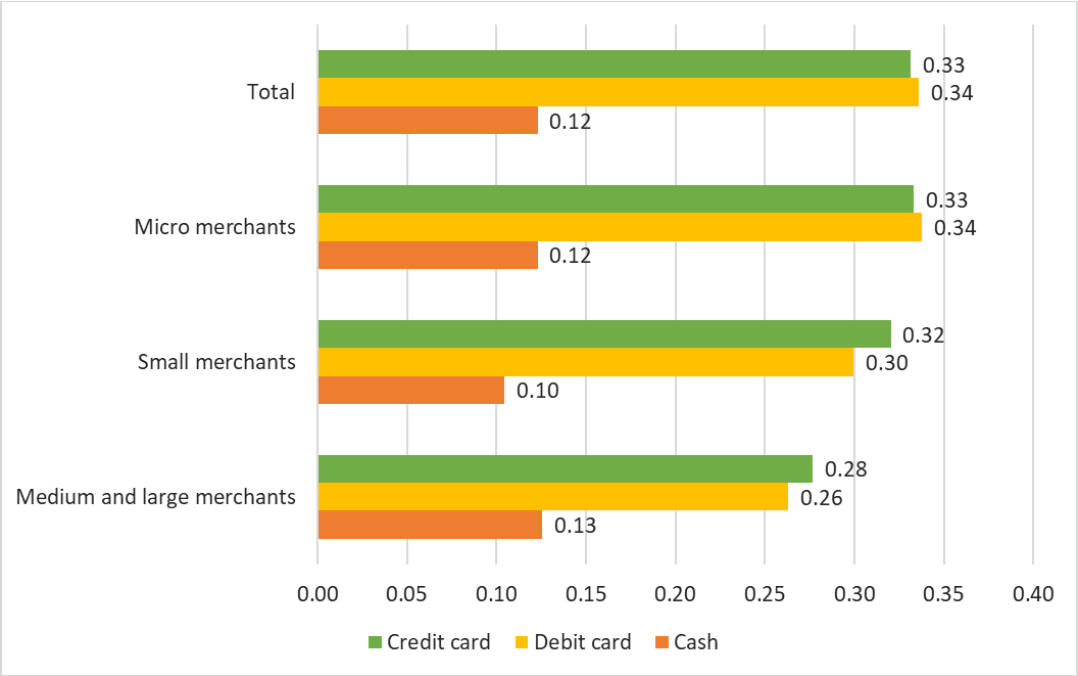
In the Colombian case, the survey result indicates that, in terms of variable costs, cash is the least expensive payment instrument. The per-transaction cost of cash is four times lower than that of cards (USD $0.24 for cash versus USD $ 0.98 for debit card USD $ 1.1 per payment) (Figure 3). Variable per-dollar costs show similar results, where cash is three times cheaper than cards (Figure 4). The costs of cards are slightly lower for larger merchants, probably because they can negotiate lower acquiring rates (MSC) with the card networks. The result that cash is less costly than cards has been found in many countries due mainly to the high MSC faced by merchants (Carbó-Valverde and Rodríguez Fernández, 2019).

Figure 3. Variable costs per payment received (USD median)



Source: Arango and Betancourt (2020).

Figure 4. Variable costs per USD 10 (USD)



Source: Arango and Betancourt (2020).

It can be noticed that the survey results for all companies are similar to those of micro merchants and that costs may differ depending on the economic activity and on merchants' size. The cost of cash and cards increases with the merchant size, this may be related with the fact that medium and large merchants tend to have lower transaction volumes and larger ticket size than the micro and small counterparts. As Table 4 shows transaction values for medium and large merchants are higher than for the other merchants regardless of the payment method.

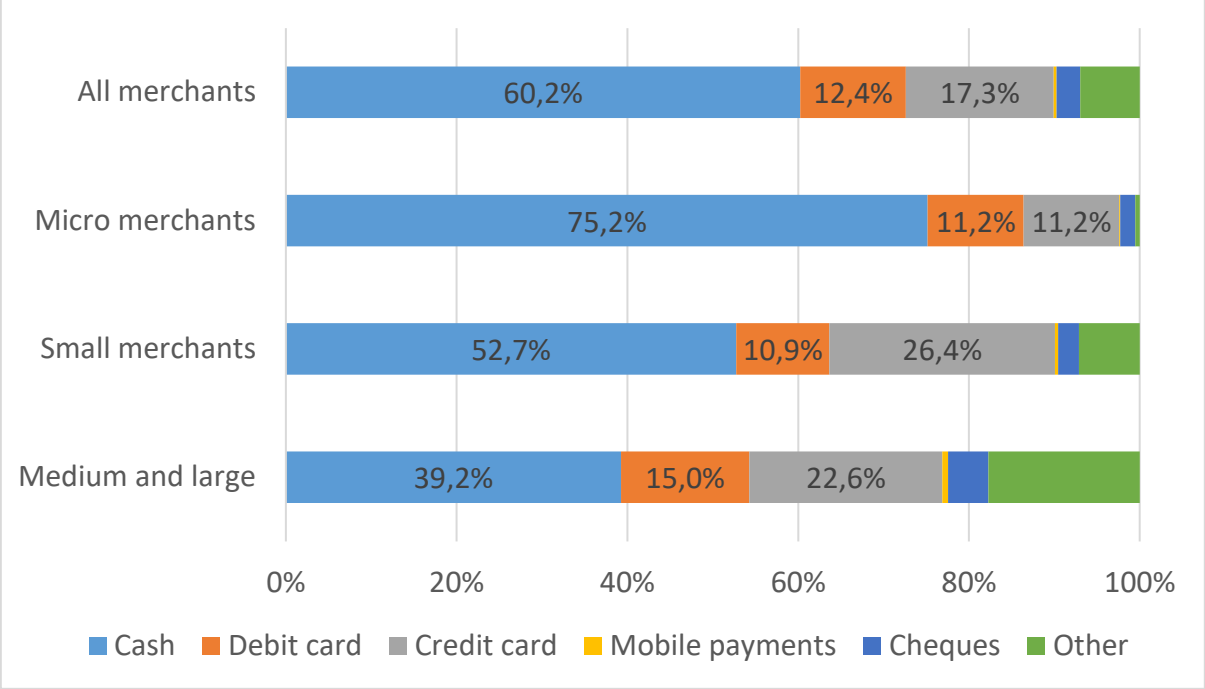
Table 4. Average transaction values (USD 2020)

Cash				
Merchant size	**Media**	**p25**	**p50**	**p75**
Micro merchants	$ 67	$ 9	$ 23	$ 57
Small merchants	$ 71	$ 8	$ 31	$ 80
Medium and large merchants	$ 213	$ 17	$ 84	$ 212
All merchants	**$ 73**	**$ 8**	**$ 23**	**$ 64**
Debit card				
Merchant size	**Media**	**p25**	**p50**	**p75**
Micro merchants	$ 51	$ 9	$ 24	$ 57
Small merchants	$ 95	$ 19	$ 53	$ 126
Medium and large merchants	$ 221	$ 27	$ 71	$ 231
All merchants	**$ 65**	**$ 11**	**$ 26**	**$ 61**
Credit card				
Merchant size	**Media**	**p25**	**p50**	**p75**
Micro merchants	$ 53	$ 12	$ 26	$ 57
Small merchants	$ 112	$ 17	$ 60	$ 183
Medium and large merchants	$ 180	$ 19	$ 85	$ 174
All merchants	**$ 70**	**$ 13**	**$ 28**	**$ 71**

Source: Survey on Merchant Costs of Processing Payments. Authors' calculations.

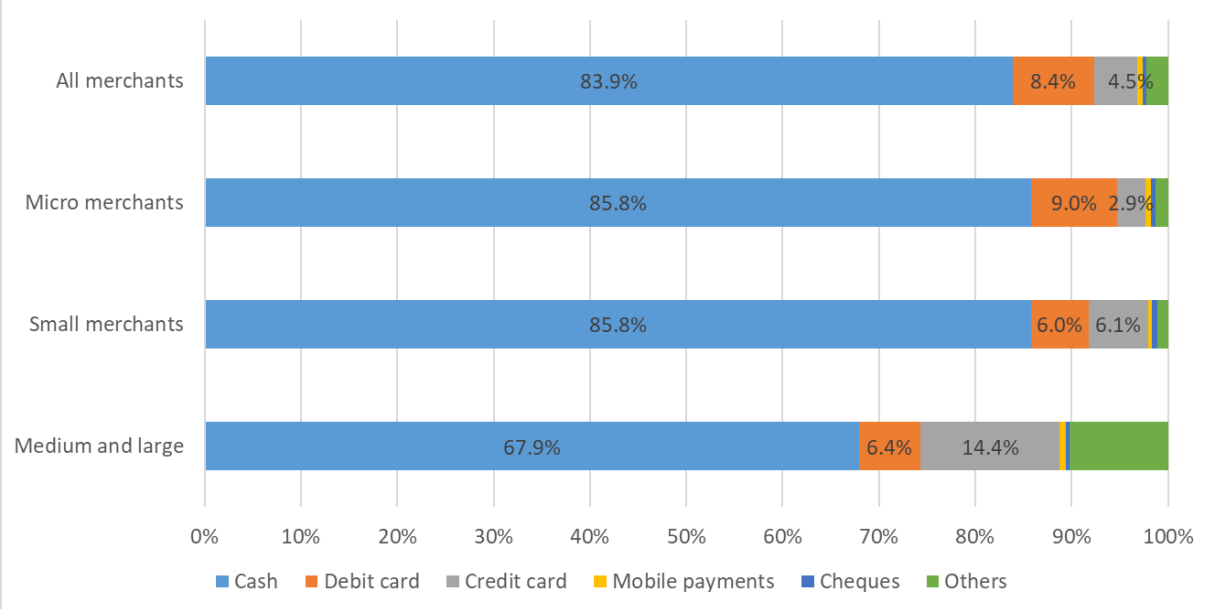
According to the survey's results, cash is the most widely used payment instrument in Colombia, both in terms of value and number of transactions, 60% of the value of transactions are made in cash and 84% of the number of transactions are made with this means of payment (Figure 5 and 6).

Figure 5. Payment shares by value



Source: Arango and Betancourt (2020).

Figure 6. Payment shares by volume



Source: Arango and Betancourt (2020).

5 Application of the tourist test to Colombian merchants

In this section we calculate the MIT MSC using two methodologies presented in the literature (Fung et al., 2018; EC, 2015). The first is an arithmetic estimation of the variable costs of accepting cash and card payments and assumes a linear cost structure with marginal costs as defined in equation (1). Based on these assumptions we can estimate the parameters α and β for each merchant and weighted averages of this parameters for the whole sample. The second methodology is based on the econometric estimation of the cost functions for each payment instrument (see appendix A for further details).

These methodologies allow us to estimate the MIT MSC under three scenarios: the first two scenarios are estimated using the arithmetic method and the third one using econometric models. The first is a short-term scenario which looks only at the direct variable costs of processing cash and card payments. The second is a medium-term scenario that allows for some of the fixed costs to be variable as stated by survey participants. The third looks at a long-term perspective and is based on econometric estimations of the cost functions for cash, debit, and credit cards.

We calculate the MIT MSC for each merchant in the survey as well as location and scale statistics of their distribution. We estimate the MIT MSC for three different transaction values: the first two values come from a survey performed by the Colombian central bank in 2016, which collected transactional information on the value and frequency of use of different instruments by urban consumers (Arango et al, 2017). The first is the median retail transaction value (MdRetail), which (at 2020 prices in US dollars) is USD $ 3.7. The second is the average retail transaction (MaRetail) at USD $12.3. The third is the average card transaction value (MaCard20), calculated from the annual statistics of card sales for the year 2020 at USD $42.5.

5.1 Short-term arithmetic MIT MSC

The arithmetic methodology relies on two accounting assumptions. The first is about which costs are fixed and which costs are variable. We use the classification that survey participants make of labor and capital inputs of processing payment instruments between fixed and variable costs.[16] The second assumption is about the assignment of variable costs between those associated with the volume of payments and those associated with the sales value for each payment instrument. Broadly speaking, we assume that cash costs are associated with sales value, except for the time involved in clearing a cash transaction at the POS. For cards, we assume that all variable costs are associated with the volume of transactions, except for the cost of time dedicated to the reconciliation process.

Under the short-term scenario, we assume that all the costs of the equipment involved in the processing of cash and cards are fixed as well as the proportion of the labor costs of back- and front-office activities that each survey participant declares to be fixed.

As Table 5 shows, the median short-term MIT MSC are negative for debit and credit cards at the MdRetail and at the MaRetail but positive at the MaCard20 transaction values (0.10% for debit and 0.02% for credit). Similarly, the interquartile mean (the midmean) is positive for both debit and credit cards at the MaCard20 with slightly higher values for debit cards than the median, showing that the distributions are skewed to the right. This is confirmed by the asymmetry shown by the 25th and 75th percentiles of the distribution around the median.[17]

Table 6 shows the estimates of the median and the midmean MIT MSC for different transaction values by merchant size.[18] Both estimates for debit cards are slightly higher for micro merchants at MaCard20, compared with medium and large merchants but it is the

[16] Survey participants are asked to classify both labor and capital inputs between fixed and variable costs in a hypothetical scenario where in a two-to-three years horizon the use of cash decreases in 20% and cards increase by the same token.
[17] We present the median and midmean statistics as well as the 25th and the 75th percentiles as robust measures of centrality and scale as the data has strong skewness and kurtosis away from normality.
[18] Merchant size is defined by number of employees.

opposite for credit cards. At lower transaction values (MaRetail) cash has lower marginal costs than debit and credit cards (negative MIT MSC) and the difference is proportionally smaller for the micro merchants.

Table 5. Arithmetic short-term MIT MSC for all merchants

(Percentage of average transaction value)

		Midmean	p25	Median	p75
At USD 3.67	Debit card	-2.28	-7.24	-0.95	0.29
	Credit card	-2.81	-7.97	-1.02	0.34
At USD 12.27	Debit card	-0.32	-1.79	-0.10	0.90
	Credit card	-0.60	-2.76	-0.07	0.87
At USD 42.49	Debit card	0.16	-0.50	0.10	1.61
	Credit card	0.00	-1.10	0.02	1.26

Note: The median retail transaction value is MdRetail = USD 3.67; the average retail transaction value is MaRetail = USD 12.27 and the average card transaction value in 2020 is MaCard20 = USD 42.49.

Table 6. Arithmetic short-term MIT MSC by merchant size

(Percentage of average transaction value)

		At USD 3.67		At USD 12.27		At USD 42.49	
		Median	Midmean	Median	Midmean	Median	Midmean
Micro merchants	Debit card	-0.88	-2.11	-0.10	-0.27	0.10	0.18
	Credit card	-1.00	-2.67	-0.07	-0.56	0.01	0.01
Small merchants	Debit card	-3.18	-4.45	-0.36	-1.02	0.00	-0.03
	Credit card	-3.05	-4.60	-0.68	-1.17	0.04	-0.13
Medium and large merchants	Debit card	-2.47	-3.69	-0.44	-0.79	0.08	0.15
	Credit card	-2.47	-3.93	-0.42	-0.90	0.04	0.09
Total	Debit card	-0.95	-2.28	-0.10	-0.32	0.10	0.16
	Credit card	-1.02	-2.81	-0.07	-0.60	0.02	0.00

Note: The median retail transaction value is MdRetail = USD 3.67; the average retail transaction value is MaRetail = USD 12.27 and the average card transaction value in 2020 is MaCard20 = USD 42.49.

From the estimates of α and β stated in equation (1) for each merchant, we can estimate a weighted average for these parameters as well as for the marginal cost of each payment instrument (see Appendix A). Figure 7 shows the results of these estimates. The marginal

cost of cash crosses the marginal costs of debit and credit cards from below being lower than the cost of cards for low transaction values and higher for high transaction values.

Figure 7. Arithmetic short-term marginal costs by average transaction value

(USD 2020)

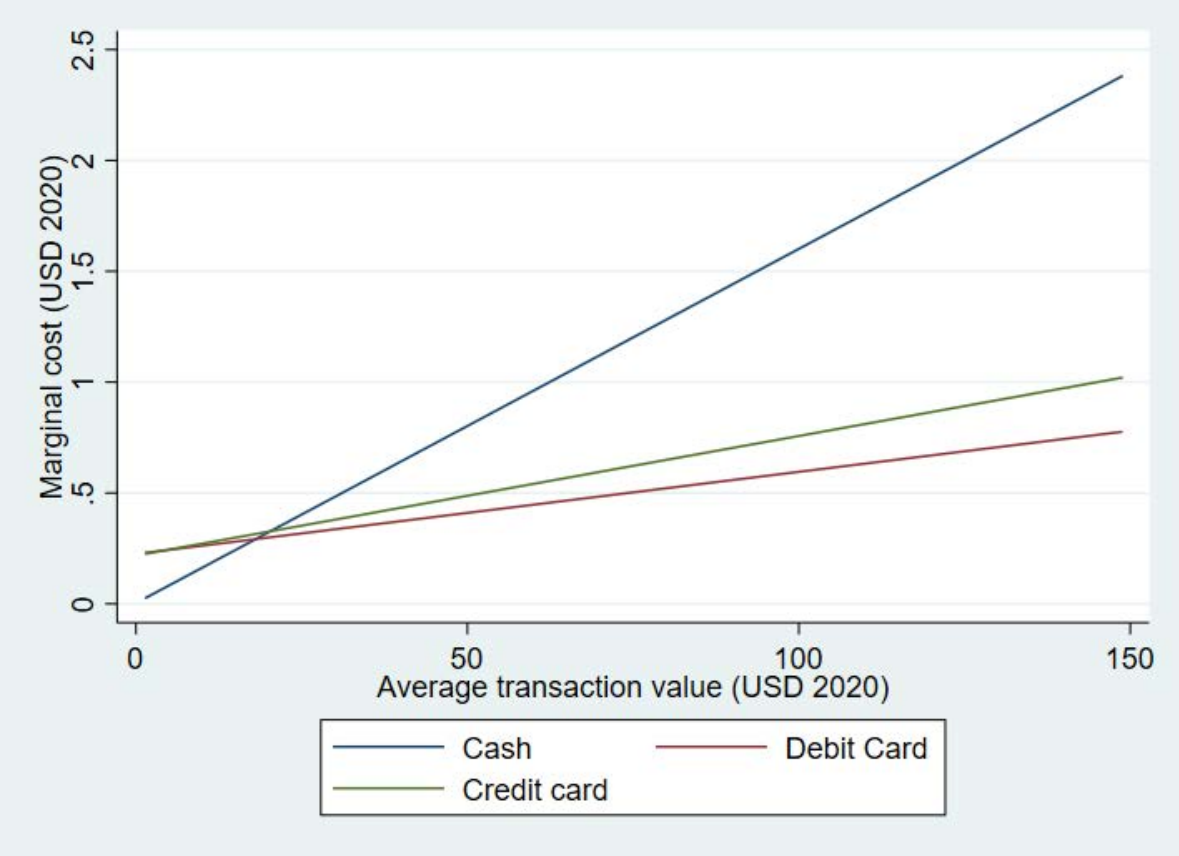
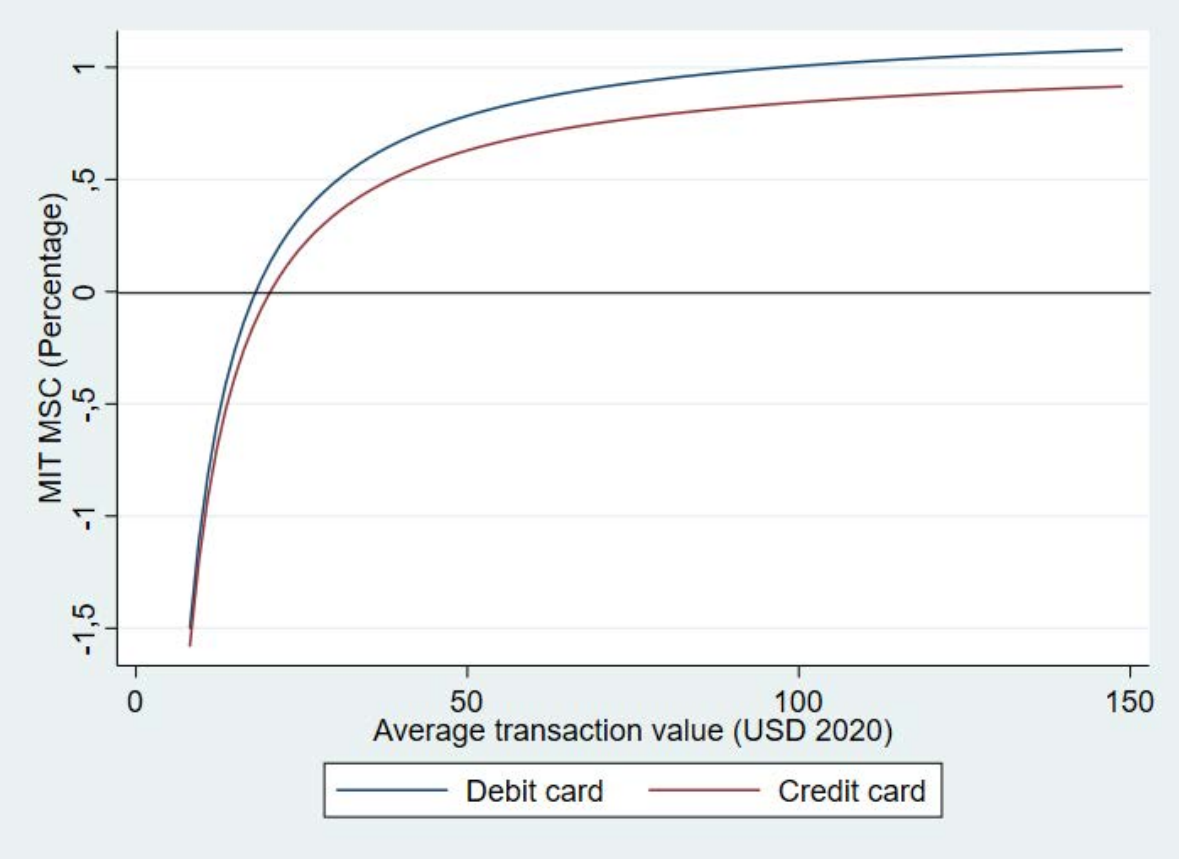


Figure 8 presents the MIT MSC for different transaction values. Notice that with this calculation the MIT MSC for debit cards is positive from USD $ 18.1 onwards (USD $ 20.3 for credit cards). Also, it is -0.46% at MaRetail (-0.57% for credit cards) and 0.74% at MaCard20 (0.59% for credit cards) transaction values.

The results from the short-term estimations show wide dispersion in the MIT MSC estimates. They also show that merchants would prefer cash when facing transactions close to the average retail ticket value and cards at higher transaction values. Finally, the optimal MIT MSC are slightly higher for debit cards than for credit cards.

Figure 8. Arithmetic Short-term MIT MSC by average transaction value



5.2 Medium-term arithmetic MIT MSC

Under the medium-term scenario, we consider as variable costs those labor and capital inputs that are declared as so by survey participants, to estimate the parameters α and β for each merchant.

In this case, the distribution of the MIT MSC for both debit and credit cards at different transaction values is centered around negative figures as measured by the median and the midmean in most cases (Table 7). As the marginal cost of cash is significantly lower than that for cards, the difference between them could be up to a median value of -0.41% at MaRetail (-1.35% in terms of the midmean) for debit cards (-0.99% and -2.05% for credit

cards, respectively). Again, dispersion is significant. For example, at MaCard20, the MIT MSC fluctuates between -1.99% and 1.26% for debit cards and between -2.67% and 1.01% for credit cards. Indeed, merchants at the top 25% of the distribution face positive values for the MIT MSC as cash is more costly than cards at all transaction values considered.

Table 7. Arithmetic medium-term MIT MSC for all merchants

(Percentage of average transaction value)

		Midmean	p25	Median	p75
At USD 3,67	Debit card	-5.34	-23.29	-2.54	0.01
	Credit card	-6.27	-24.83	-3.46	0.11
At USD 12,27	Debit card	-1.35	-6.55	-0.41	0.82
	Credit card	-2.05	-8.14	-0.99	0.54
At USD 42,49	Debit card	-0.20	-1.99	-0.02	1.26
	Credit card	-0.57	-2.67	-0.14	1.01

Note: The median retail transaction value is MdRetail = USD 3.67; the average retail transaction value is MaRetail = USD 12.27 and the average card transaction value in 2020 is MaCard20 = USD 42.49.

The results are similar when looking at the medium-term estimations by merchant size. Most of the estimates are negative, except for the medium and large merchants with MIT MSC slightly higher than zero at high transaction levels (MaCard18 and MaCard20) for both debit and credit cards (Table 8).

Table 8. Arithmetic medium-term debit card MIT MSC by merchant size

(Percentage of average transaction value)

		At USD 3.67		At USD 12.27		At USD 42.49	
		Median	Midmean	Median	Midmean	Median	Midmean
Micro merchants	Debit card	-2.41	-5.27	-0.39	-1.34	-0.02	-0.21
	Credit card	-3.44	-6.24	-0.99	-2.09	-0.18	-0.60
Small merchants	Debit card	-4.24	-6.32	-1.13	-1.50	-0.06	-0.14
	Credit card	-4.62	-7.09	-1.23	-1.82	0.00	-0.35
Medium and large merchants	Debit card	-2.40	-4.04	-0.46	-0.96	0.03	0.09
	Credit card	-2.28	-4.40	-0.46	-1.13	0.03	0.06
Total	Debit card	-2.54	-5.34	-0.41	-1.35	-0.02	-0.20
	Credit card	-3.46	-6.27	-0.99	-2.05	-0.14	-0.57

Note: The median retail transaction value is MdRetail = USD 3.67; the average retail transaction value is MaRetail = USD 12.27 and the average card transaction value in 2020 is MaCard20 = USD 42.49.

Using the medium-term α and β estimates for each merchant, we calculate their weighted mean for each payment instrument (Figure 9). For the medium-term scenario the MIT MSC for debit cards is positive from USD $42.4 onwards (USD $ 47.6 for credit cards). Also, it is -2.0% at MaRetail and 0.06% at MaCard20 for debit cards (-2.0% and -0.03 for credit cards). We find that the MIT MSC has a lower graph than the one estimated for the short-term scenario (Figure 10).

The medium-term scenario shows that when merchants face a horizon where some of the fixed costs are seen as variable, cash is less costly than both debit and credit cards by different measures of distribution centrality, in particular at the MaRetail transaction levels.

Figure 9. Medium-term marginal costs by average transaction value

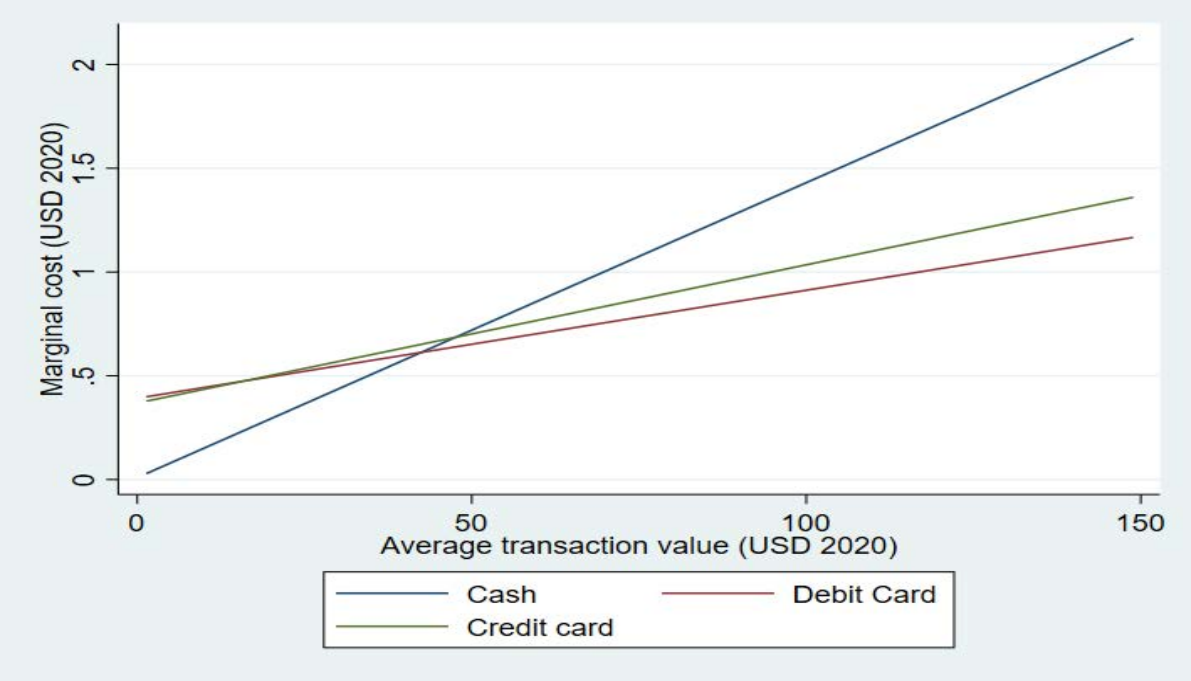
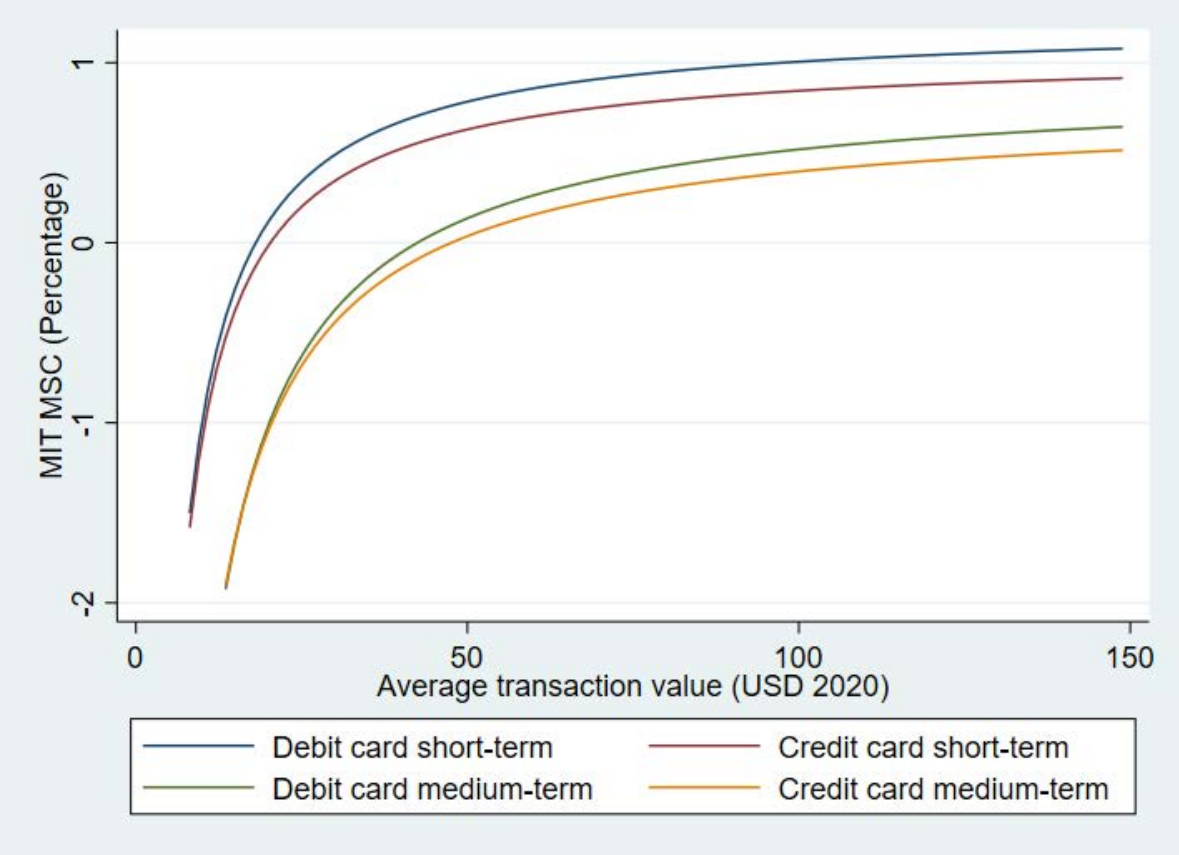


Figure 10. Short-term and medium-term arithmetic MIT MSC by average transaction value



5.3 Long term MIT MSC based on econometric cost models

The econometric specifications have the advantage that no assumptions are made regarding which costs are fixed, variable or associated with transaction volumes or sales values. They represent a long-term view of the cost structure as they allocate costs by exploiting the cross differences among merchants in the survey, in terms of payment instrument scales, payment shares and average transaction values.

We explore two econometric specifications: a linear model and a more general specification that accounts for economies of scale and the relative combination of payment instruments

used at each merchants' locations. We call the latter the mixed specification. We use robust regression to account for extreme values and non-normal disturbances in the models (Hamilton, 1991).[19]

5.3.1 The linear model

In the linear specification, we follow the literature and estimate equation (1) for the total cost of processing each instrument. This specification gives us overall estimates of α and β.

The estimates for cash, debit, and credit cards show that all payment instruments have significant transaction volume and sales value effects (Table 1B in appendix B). The parameter α is lower for cash than for both debit and credit cards but the parameter β is higher for cash than for cards. This means that for low transaction values cash is less costly than cards and becomes more costly as transaction values increase. Indeed, the MIT MSC for debit cards is -1.31% and -0.18% at the MdRetail and the MaRetail (-0.40% and 0.002% for credit cards) and 0.17% at MaCard20 (0.13% for credit cards) (Table 9).

Table 9. Linear model MIT MSC by transaction value

(Percentage of average transaction value)

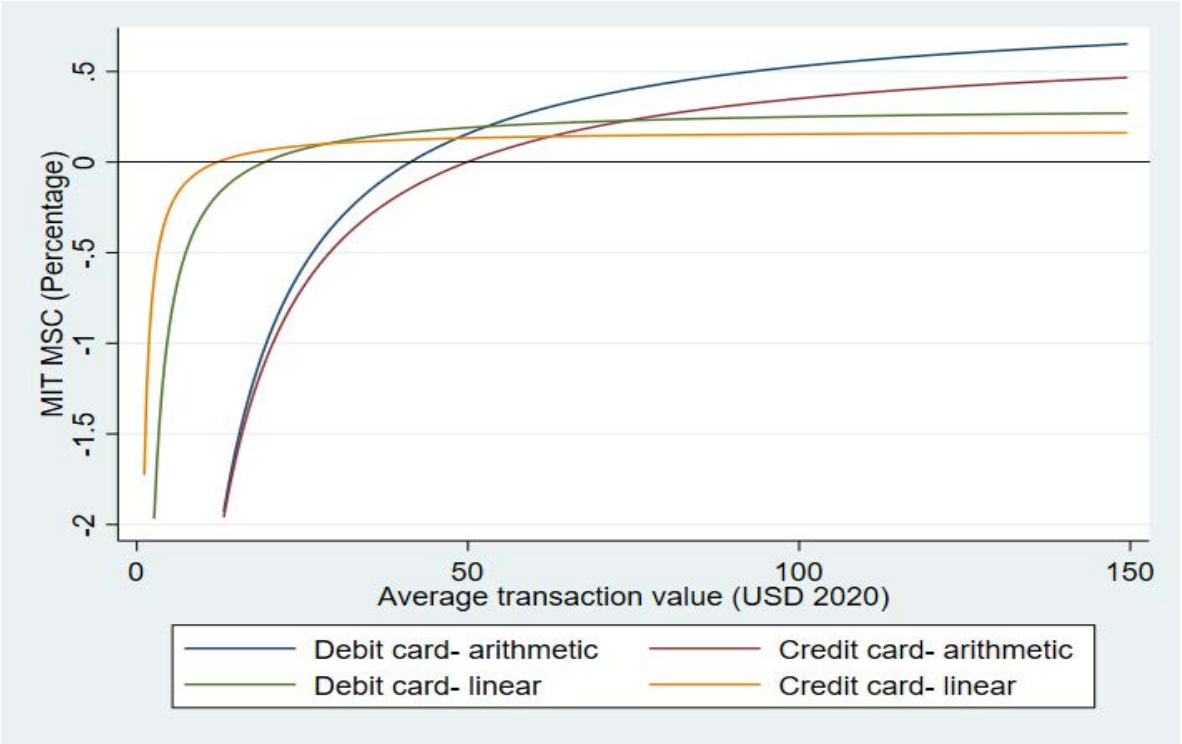
	At USD 3.67	At USD 12.27	At USD 42.49
Debit Card	-1.306	-0.176	0.169
Credit Card	-0.403	0.002	0.125

Note: The median retail transaction value is MdRetail = USD 3.67; the average retail transaction value is MaRetail = USD 12.27 and the average card transaction value in 2020 is MaCard20 = USD 42.49.

[19] Several other specifications were considered before selecting the one used in our calculations based on its statistical performance. Specifications with higher fitness statistics such as R^2 were discharged as they were affected by strong influential observations.

Compared with the arithmetic medium-term estimations, the graph of the MIT MSC for the linear model becomes positive at lower transaction values (USD $19.3 for debit cards and USD $12.2 for credit cards) (Figure 11).

Figure 11. MIT MSC from medium-term arithmetic and linear models by average transaction value



5.3.2 The mixed model

Linearity may be a strong assumption in modeling the cost of handling different payment instruments by merchants and little is known about nonlinearities in merchants' cost structure of processing cash or card transactions. It is quite possible that marginal costs decrease with higher volumes and sales values as efficiencies may be gained with a larger payments scale. Another possible critic of the empirical treatment of cost functions for payment instruments

is that their estimation does not account for effects of joint processing of payments (ECDGC, 2015).

We illustrate scale economies in payments by using our estimates of marginal costs based on the medium-term arithmetic calculations and group merchants by transaction volume categories for cash, debit, and credit cards. We find evidence that the marginal costs of all three instruments fall as payment volumes increase. For cash, the difference between the marginal costs at the upper quartile of transaction volumes (0.32% of the MaCard20) is six times lower than that for the lower quartile (1.85%). For debit and credit cards it could be up to 7 times lower (Table 10).

Table 10. Marginal costs by transaction volumes (medium-term arithmetic estimation)

(Percentage of average transaction value)

	At USD 12,27			At USD 42,49		
	Cash	Debit card	Credit card	Cash	Debit card	Credit card
Tiny transaction volumes	2.07	3.45	3.37	1.85	1.74	2.24
Low transaction volumes	1.86	2.20	3.23	1.64	0.87	1.70
Medium transaction volumes	0.92	1.59	1.71	0.84	0.66	0.77
High Transaction volumes	0.41	0.57	0.65	0.32	0.27	0.31

Note: The transaction-volume categories are chosen based on the quartile statistics of the volume distributions for each payment instrument (e.g., "Tiny transaction volumes" correspond to those merchants between the minimum and first quartile range). The average retail transaction value is MaRetail = USD 12.27 and the average card transaction value in 2020 is MaCard20 = USD 42.49.

In the mixed model we explore how economies of scale may impact the estimation of the MIT MSC compared with the linear specifications (both the arithmetic and the linear econometric model) by introducing quadratic specifications for sales volumes, (Q_j) and values ($SALES_j$). We also allow the relative combination of payment instruments to affect the marginal costs of each instrument. This is done by interacting the proportion of transactions made in cash, P_e, with transaction volumes, and the sales values in the cost function for each payment instrument j:

$$C_j = \alpha_{0j} + \alpha_{1j}Q_j + \alpha_{2j}Q_j^2 + \alpha_{3j}SALES_j + \alpha_{4j}SALES_j^2 + \alpha_{5j}Q_jP_e + \alpha_{6j}SALES_jP_e. \quad (3)$$

In this case the marginal cost for each payment instrument j is (assuming $SALES_j = Q_jATV_j$):

$$Cmg_j = \alpha_{1j} + 2Q_j(\alpha_{2j} + \alpha_{4j}ATV_j^2) + \partial_jP_eQ_j(\alpha_{5j} + \alpha_{6j}ATV_j) + P_e(\alpha_{5j} + \alpha_{6j}ATV_j) + \alpha_{3j}ATV_j. \quad (4)$$

Where the proportion of cash P_e changes with cash and card volumes as follows:

$$\partial_eP_e = (T_q - Q_e)/T_q^2 \quad (5)$$

$$\partial_cP_e = (-Q_e)/T_q^2 \quad (6)$$

We find that this specification results in a higher explanatory power of the cost models (Table 2B in appendix B). Interaction variables are significant as well as the non-linear effects in transaction volumes and sales values for all payment instruments. However, some differences are worth mentioning. For cash, higher levels of P_e reduce the slope associated with transaction volumes, whereas for debit and credit cards it increases the slope associated with transaction volumes and sales values. These is clear evidence that the joint processing of payments matters for the marginal costs associated with each instrument and therefore for the calculation of the MIT MSC. Furthermore, the marginal cost of processing an additional dollar of cash sales decreases as the merchant becomes more cash intensive in its total sales and the marginal cost of cards increases accordingly because of the lower card payments shares. As for the transaction volume effects, a higher P_e makes the marginal cost of cards, per-payment, higher but does not affect the marginal cost of cash.

Using our estimates to calculate the MIT MSC for each merchant in the survey we find that they are lower than the linear model estimates at the midmean and the median. For credit cards the MIT MSC is centered around negative values for low and high transaction values

(median of -0.35% at MaRetail, and -0.02% at MaCard20 respectively), whereas for debit cards they are negative at the MaRetail (median of -0.17%) and positive at MaCard20 (median of 0.11%). The mixed model accommodates a wide range of the MIT MSC as it reflects merchants´ heterogeneity (Table 11).

When we break the estimations by merchant size, we find that the MIT MSC for debit and credit cards are positive at the MaCard20 (0.20% and 0.09%, respectively) for medium and large merchants and they are also higher than those for the small and micro merchants (Table 12). Compared with the linear model, the mixed model has lower MIT MSC graphs for both debit and credit cards (Figure 12).

Table 11. MIT MSC statistics from the mixed model by average transaction value

(Percentage of average transaction value)

		Midmean	p25	Median	p75
At USD 3.67	Debit Card	-0.86	-2.20	-1.11	1.45
	Credit Card	-1.29	-2.18	-1.48	0.41
At USD 12.27	Debit Card	-0.09	-0.50	-0.17	0.57
	Credit Card	-0.29	-0.60	-0.35	0.26
At USD 42.49	Debit Card	0.12	0.02	0.11	0.30
	Credit Card	-0.01	-0.13	-0.02	0.20

Note: The median retail transaction value is MdRetail = USD 3.67; the average retail transaction value is MaRetail= USD 12.27 and the average card transaction value in 2020 is MaCard20 = USD 42.49.

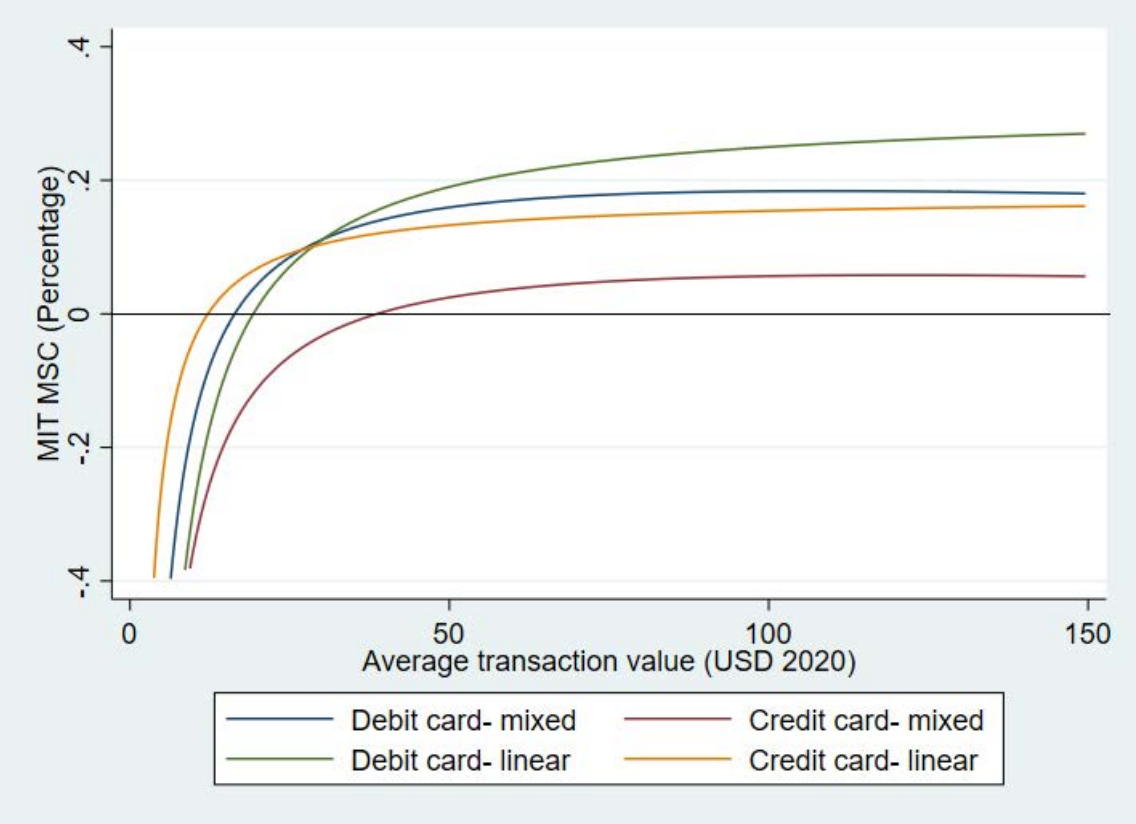
Table 12. MIT MSC from the mixed model by merchant size

(Percentage of average transaction value)

		At USD 3.67		At USD 12.27		At USD 42.49	
		Median	Midmean	Median	Midmean	Median	Midmean
Micro merchants	Debit Card	-1.12	-0.89	-0.17	-0.10	0.11	0.12
	Credit Card	-1.48	-1.31	-0.36	-0.30	-0.02	-0.01
Small merchants	Debit Card	-1.24	2.40	-0.20	0.79	0.07	0.32
	Credit Card	-1.47	1.34	-0.36	0.47	-0.06	0.24
Medium and large merchants	Debit Card	0.34	0.76	0.22	0.35	0.20	0.21
	Credit Card	-0.24	0.26	0.02	0.10	0.09	0.12
Total	Debit Card	-1.11	-0.86	-0.17	-0.09	0.11	0.12
	Credit Card	-1.48	-1.29	-0.35	-0.29	-0.02	-0.01

Note: The median retail transaction value is MdRetail = USD 3.67; the average retail transaction value is MaRetail= USD 12.27 and the average card transaction value in 2020 is MaCard20 = USD 42.49.

Figure 12. Linear and mixed models MIT MSC by average transaction value



6 Discussion

The empirical attempt at measuring the MIT MSC shows that it depends on the assumptions made about the cost structure of processing payments by merchants. It also shows that the linear assumption used in the literature may yield biased estimates of the MIT MSC. The Colombian case also reflects significant differences in the way payments are processed between small and large merchants and, hence, arithmetic MIT MSC estimates have high dispersion. One of the reasons for such dispersion is the large differences in marginal costs that arise from the scale at which a merchant is operating, in terms of transaction values and sales volumes for each payment instrument. Econometric models show that this is indeed the case, and that, besides the transaction value at which MIT MSC are calculated, scale

effects as well as the relative payment share of cash in the overall operation impact the value of the MIT MSC.

Table 13 summarizes the empirical results. Most estimates for the MIT MSC are centered around negative values at MaRetail, independently of the horizon or methodology used, showing that cash is a more efficient payment method than cards in these transaction environments. Furthermore, cash would be more efficient than cards for more than 50% of transactions in the economy (in urban commerce) given that the median MIT MSC at the MdRetail is also negative.

Table 13. Summary of MIT MSC results for short-term, medium-term and long-term estimations

(Percentage of average transaction value)

		At USD 12.27		At USD 42.49	
		Debit Card	Credit Card	Debit Card	Credit Card
Short- term arithmetic (median)		-0.10	-0.07	0.10	0.02
Short- term arithmetic (weighted average)		-0.46	-0.57	0.74	0.59
Medium-term aritmetic (median)		-0.41	-0.99	-0.02	-0.14
Medium-term aritmetic (weighted average)		-2.00	-2.00	0.06	-0.03
Long-term econometric	Linear	-0.18	0.00	0.17	0.13
	Mixed	-0.17	-0.35	0.11	-0.02

Note: The average retail transaction value is MaRetail= USD 12.27 and the average card transaction value in 2020 is MaCard20=USD 42.49.

It is only at higher transaction values, those typically handled by cards in the Colombian context, that the MIT MSC becomes positive, and, hence, cash becomes less efficient than cards. The short-term estimates are perhaps the closest to the notion of the tourist test in the sense that a sporadic client represents a very short-term decision problem for the merchant, where most costs are fixed and driving the customer towards one payment instrument or another does not anticipate medium-term changes in scale or payment shares. The estimates show that the highest MIT MSC compatible with this scenario is 0.74% for debit cards and 0.59% for credit cards. Nonetheless, there is room for MIT MSC that could reach up to 1.6% for the top 25% merchants most efficient in handling card payments relative to cash.

However, the optimal level of the MIT MSC should reflect more the medium- or long-term perspective, as most merchants´ clientele are not tourists and dissuasive strategies used on cards are applied to all customers. Hence, the implications of driving a customer towards one payment instrument or another have medium- or long-term repercussions on the scale and relative participation of different payment instruments in their business. In this case, the medium- and long-term MIT MSC estimates are more relevant.

The medium-term arithmetic estimates show that the optimal MIT MSC level is centered around 0.06% for debit cards and -0.03% for credit cards at the MaCard20 (0.11% and -0.02% in the mixed model), far below the rates currently charged in the Colombian market of 1.54% for debit cards and 1.69% for credit cards. And it is negative for the MaRetail, showing limited room for cards to expand into the broader retail person-to-business space. These estimates are consistent with the fact that 60% of merchants in Colombia provide cash discounts or impose minimum transaction values and surcharges to cards to drive their clients to pay in cash (Arango-Arango and Betancourt-Garcia, 2020). A clear evidence that the MDR rates are not optimal in the sense of the tourist test.

The reasons why all merchants in the survey accept cards despite of such high MDR is beyond the scope of this paper. Yet, one can consider competition effects among merchants. High ticket retail sectors are usually provided by a mix of large scales merchants for which cards are much more efficient than cash (as our results demonstrate) and small merchants which may decide to accept cards to retain their clientele: the "Must-Take Cards" argument (Vickers, 2005; Rochet and Tirole, 2011; Jonker, 2011). Also, the two-sided market forces may play a role as consumers tend to prefer cards to cash at higher transaction values (Arango-Arango et al., 2015; Arango-Arango et al, 2018).

The results imply that, under the current cost structure, merchants would only find the cost proposition for paying a MSC acceptable in environments with high transaction values. They also state that the rates currently charged are much higher than those implied by the MIT. Yet, the MSC rates charge currently show that there is room for accommodating the levels suggested by the MIT MSC estimates although they will imply that the industry should move towards the lower bounds of their current fees.

6.1 Interchanges fees compatible with the Tourist Test (MIT MIF)

So far, the calculations have focused on the MIT MSC. Although in some countries like Costa Rica the regulator is entitled to rule over the MSC, in other jurisdictions, the regulation on card fees has focused on the MIF. To calculate the MIT MIF, we need estimates of the acquiring margins (AM) and the processing fees charged by the card networks (NAF) as shown in Figure 2. Note that the sum of the AM and the NAF can be calculated from the difference between the MSC and the MIF charged by the industry.

We use the information on MSC and MIF published by the two switches, Redeban y Credibanco, for the third quarter 2020. The average MSC across sectors is 1.54% for debit cards and 1.69% for credit cards. The average MIF, on the other hand, is 1.28% for debit cards and 1.44% for credit cards (Table 1C, Appendix C). The difference between the MSC and the MIF represents 16.9% of the MSC for debit cards and 14.8% for credit cards.

Applying these percentages to the MIT MSC estimated previously we can have estimates of the MIT MIF for the different methodologies summarized in Table 15. In particular, the short-term weighted MIT MIF would be centered around 0.62% for debit cards and 0.48% for credit cards at the MaCard20. The medium-term MIT MIF would be 0.05% for debit cards and -0.035% for credit cards (0.09% and -0.023% respectively, in the case of the mixed model).

6.2 Sales-tax evasion and the Merchant Indifference Test

We have presented the MIT MSC and the MIT MIF based purely on the relative efficiency in marginal costs between cash and cards. Yet, as shown by Aurazo and Vasquez (2019), in economies with high sales-tax evasion there is a major incentive for merchants to drive their clients to pay with cash and avoid the issuance of any formal receipt. In the Colombian case, the VAT is set at 19% and businesses can deduct the VAT that has been paid for inputs of goods and services used in their economic activities. There are VAT exceptions on certain

goods and services and small businesses (those with annual sales below USD 32,000) are exempt from the VAT.

In Colombia the level of sales-tax evasion is estimated in 23.2% for the year 2019 (DIAN-OCDE, 2021). We estimate the tax evasion benefits of cash sales as follows. First, we calculate what would be the level of sale-tax evasion that would apply to merchants that accept payment cards, which presumably would be lower than the evasion rate for merchants that operate only with cash. Using the results of a survey on merchants performed by the central bank in 2020[20] we find that the degree of fiscal compliance[21] among those merchants that accept cards is 2.2 times the compliance among merchants that do not accept cards. Therefore, we estimate that the evasion rate in card accepting stores that would be consistent with a weighted average of 23.2% would be 15.8%.[22]

Second, assuming that card-accepting merchants would only evade taxes on their cash sales, the net benefit of VAT evasion from cash payments relative to card payments would be 15.8% times the merchants' annual mark-up,[23] times the VAT rate of 19%. We estimate the median mark up at 10.1% base on the survey described in section 4.[24] Hence, all MIT MIF and MIT MSC estimated should be reduced by 0.30% to accommodate the evasion incentives associated with cash.

Accounting for sales-tax evasion would bring most of the MIT MSC presented in Table 15 to negative figures. That would be also the case for the interchange fees compatible with the MIT (MIT MIF) discussed in the previous section. Only the weighted short-term estimates

[20] Arango-Arango et al. (2021).
[21] Based on whether the merchant has a fiscal identification number.
[22] Given that we do not have access to desegregated levels of VAT evasion, we assume that the overall evasion rate θ (23.2%) is a weighted average of the evasion rate in the no-cards sectors θ_{nc} and the evasion rate in the card-accepting sectors θ_c: $\theta = w_{nc}\theta_{nc} + w_c\theta_c$. We estimate the weights w_{nc} and w_c as the sales shares of each sector in total sales using the central bank merchant survey 2020 (Arango-Arango et al., 2021). Assuming that θ_c / θ_{nc} is proportional to the relative levels of fiscal compliance in cards and no-cards sectors we estimate this ratio in 2.1 and solve for θ_c (15.8%).
[23] The mark-up rate proxies for the fiscal base upon which the VAT is applied and corresponds roughly to the value added in the merchants' operation.
[24] We take the median mark-up rate before taxes (12%) and divide it by 1.19 to subtract the effect of sales taxes.

would be positive for debit cards (credit cards), at 0.44% (0.29%) for the MIT MSC and 0.32% (0.18%) for the MIT MIF.

6.3 A scenario with less dependence on cash

Base on the mixed models' results we can run simulation where merchants´ sales shift towards a higher share of card payments. We decrease cash payment volumes and cash shares by 30% and increase debit card payment volumes by the same amount. By doing so, the marginal cost of cash would increase and the one for debit cards would decrease.

In this less-cash dependent scenario cash would have higher marginal costs than cards leading to positive MIT MSC (0.53% midmean MIT MSC) for debit cards at the MaRetail (0.21% for credit cards); and at the MaCard20 (0.28% for debit and 0.19% for credit cards) (Table 14 and 15). Note that the MIT MSC for low value transactions would be higher than those for high value transactions. We also underscore the fact that the medium and large merchants would face higher MIT MSC than the small and micro counterparts at the MaRetail and the MaCard20 transaction values (Table 16). The MIT MIF consistent with these MIT MSC would be 0.44% at the MaRetail and 0.23% at the MaCard20 for debit cards and 0.18% and 0.16% for credit cards. The MIT MSC and the MIT MIF en this scenario should be reduced by 0.30% if the sales-tax evasion incentives modeled by Aurazo and Velasquez (2019) ought to be accounted for, which leads the MIT MSC and the MIT MIF to negative numbers, except for debit cards at the MaRetail (0.23% and 0.14% respectively).

Table 14. MIT MSC in a 30%-less cash scenario by average transaction value

(Percentage of average transaction value)

		Midmean	p25	Median	p75
At USD 3.67	Debit Card	1.42	0.17	1.17	3.23
	Credit Card	0.43	-0.63	0.15	2.05
At USD 12.27	Debit Card	0.53	0.15	0.45	1.10
	Credit Card	0.21	-0.11	0.14	0.73
At USD 42.49	Debit Card	0.28	0.16	0.26	0.43
	Credit Card	0.19	0.06	0.16	0.37

Note: The median retail transaction value is MdRetail = USD 3.67; the average retail transaction value is MaRetail = USD 12.27 and the average card transaction value in 2020 is MaCard20 = USD 42.49.

Table 15. Current state and 30%-less cash median MIT MSC by average transaction value

(Percentage of average transaction value)

	At USD 12.27		At USD 42.49	
	Current state	30%-less cash	Current state	30%-less cash
Debit Card	-0.17	0.45	0.11	0.26
Credit Card	-0.35	0.14	-0.02	0.16

Note: The average retail transaction value is MaRetail= USD 12.27 and the average card transaction value in 2020 is MaCard20=USD 42.49.

Table 16. MIT MSC in a 30%-less cash scenario by average transaction value and merchant size

(Percentage of average transaction value)

		At USD 3.67		At USD 12.27		At USD 42.49	
		Median	Midmean	Median	Midmean	Median	Midmean
Micro merchants	Debit Card	1.07	1.31	0.44	0.50	0.26	0.27
	Credit Card	0.11	0.33	0.12	0.19	0.16	0.18
Small merchants	Debit Card	2.39	2.44	0.78	0.81	0.34	0.34
	Credit Card	1.20	1.45	0.46	0.50	0.26	0.26
Medium and large merchants	Debit Card	4.48	4.66	1.43	1.50	0.53	0.54
	Credit Card	3.12	3.28	1.08	1.14	0.47	0.50
Total	Debit Card	1.17	1.42	0.45	0.53	0.26	0.28
	Credit Card	0.15	0.43	0.14	0.21	0.16	0.07

Note: The median retail transaction value is MdRetail = USD 3.67; the average retail transaction value is MaRetail = USD 12.27 and the average card transaction value in 2020 is MaCard20 = USD 42.49.

We also estimate a more radical scenario to see how MIT MSC would change under the current cost structure estimated by the mixed models. In this case, we reduce cash payment volumes and cash shares by 80% and increase debit card payment volumes by the same amount. In such case, the MIT MSC reaches an upper bound at the MaRetail of 1.05% and of 0.50% at the MaCard20. We acknowledge that this scenario has the caveat that such large change in the payment´s environment would most probably change many of the current practices in merchants´ payment processing. Yet, it gives us an idea of how much the MSC can be stretched as cash subsides with the current cost structure.

These simulations beg the question of whether shifting to a less-cash retail sales environment would reduce the overall merchants´ transaction costs. We calculate the aggregated costs of running the current volumes and sales values at the current marginal costs (mixed model) for cash debit and credit cards and did so for processing the new levels under the 30% cash reduction scenario. We find that total variable costs would increase 31.9%. This shows how sensitive cash marginal costs are to scale. It is only when the reduction in cash shares drops substantially (at about 20%) that merchants would experience a reduction in the total variable costs, under the mixed-model cost structure.

Our work shows that this is due to the nature of payment costs with strong economies of scale for cash. Raising MIT MSC as cash declines and cards rise may induce higher MSC as the retail sector digitalizes its payments (Bolt et al, 2013). This is where competition of alternative electronic payment systems should discipline the market. As they become more ubiquitous the tourist test would be not against cash but alternatives such as instant and mobile payment alternatives.

The results are consistent with the average price cap regulation implemented in various countries, where the MSC charged by the industry under regulation can be tuned to the heterogenous scale, average transaction value, and sales composition of different payment instruments that merchants present at a given point. They also provide a long-term view of the card payments market where shifts towards card payments and less dependence on cash would bring the right incentives for merchants to promote them at their point of sale if the MSC is low enough to conform with the MIT MSC. In fact, merchants may find it optimal to promote card payments not only because cash becomes more costly but because a strong shift from cash to cards would provide higher savings at the margin and for the overall operation.

Yet, sales-tax evasion brings an extra burden in the levels of MIF and MSC compatible with the MIT that are based on pure relative marginal costs of cash and cards. Indeed, it could represent 40% to 51% reductions for the short-term weighted MIT MSC and about 28.6% (20% cash) to 56.6% (30% cash) for the long-run scenarios. Such extra burden may imply card fee regulations that are incompatible with the sustainability of the card networks. Therefore, regulation ought to seek a middle ground and be complemented with sales-tax reforms that curtail tax evasion, so that card fees are set closer to the relative efficiencies of cash and cards in terms of marginal costs.

Finally, the arithmetic estimates show that there is a wide dispersion in marginal costs both for cash and cards. This dispersion is only partially accounted for by the econometric models estimated. The fact that robust estimation techniques where needed to estimate them show that either the specifications are short of fully accounting for the heterogeneity in the data or measurement error could be a matter of concern.

In any case the results presented here should be tested with follow-up measurements to confirm their validity. This is particularly true as card networks are currently undertaking measures to reduce merchants´ costs by innovating in card terminals, introducing QR technology and expanding the use of contactless cards and non-signature payments that would certainly help to reduce card processing times at the POS.

7 Conclusion

More than half of the merchants that accept cash and cards in Colombia use strategies such as cash discounts and minimum transaction limits for card payments to discourage customers to use cards at the POS. Furthermore, for these merchants, cash accounts for 83.9% of sales in transaction volumes and 60.2% in sales values. This are signs that merchant service fees (MSC) are not optimal in the sense of the Tourist Test.

The Tourist Test introduced by Rochet and Tirole (2007) establish that, under certain assumptions, it is socially optimal to charge merchants with MSC that make them indifferent between accepting cards or cash when facing a sporadic customer (a tourist).We estimate optimal interchange fees (the fees paid by acquirers to issuers in card networks) and merchant service charges (the final per-transaction charges faced by merchants) that are compatible with the Tourist Test for the Colombian card payments market.

We find that the MSC that are compatible with the Tourist Test are far below those charged currently by the industry. However, there is hardly a merchant service charge that fits all as there is wide heterogeneity in merchants' costs structures of processing cash, debit, and credit cards. In this sense, the results are consistent with the average price cap regulation implemented in various countries, which allow the industry to accommodate this heterogeneity while maintaining the right incentives on the merchants´ side so that they neither discriminate against card payments nor they favor cash. Such approach has been introduced in various developed countries with empirical evidence showing that reductions in merchant interchange fees (and hence merchant service charges) increase card usage.

Yet, in developing countries such as Colombia sales-tax evasion brings an additional incentive for merchants to promote cash usage. Accounting for such incentive would bring and additional burden to the merchant interchange and service fees compatible with the Tourist Test and could make the sustainability of card networks inviable. Therefore, any consideration regarding the regulation on card fees should be complemented with measures on sales-tax evasion, so that fees would be closer to the relative efficiencies of cash and cards faced by merchants.

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Appendix A: Econometric and arithmetic methodologies used in MIT MSC estimations

We apply two methodologies to the estimation of the MIT MSC the arithmetic method most frequently used in the literature and one base on the estimation of cost functions for each payment instrument.

The arithmetic tourist test

The arithmetic MT MSC follows the formulation in EC (2015). However, we use a different set of weights to estimate the weighted average marginal costs for cash, debit, and credit cards.

Assuming marginal costs are linear in the average transaction value (ATV), we estimate the intercept α_{ij} for each merchant i and payment instrument j by dividing total variable costs associated with transaction volumes by the number of transactions of each payment instrument. The slope of the marginal costs, β_{ij}, are estimated by dividing total variable costs associated with sales volumes by the total sales of each payment instrument.

Then the MIT MSC for each merchant is:

$$MIT\ MSC_{ij} = (\alpha_{i,cash} - \alpha_{i,card})/ATV_{ij} + (\beta_{i,cash} - \beta_{i,card})$$

The weighted average MIT MSC for the whole sample or a subsample of merchants would be:

$$MIT\ MSC = \frac{\sum_{i=1}^{n} w_i(\alpha_{i,cash} - \alpha_{i,card})}{ATV} + \sum_{i=1}^{n} w_i(\beta_{i,cash} - \beta_{i,card})$$

Where the w_i is the survey weighting factors.[25]

In practice, we striped out the top 10% of the distribution of alphas and betas to account for outliers in the sample.

[25] ECDGC (2015) uses two types of estimates in the estimation of the average MIT MSC: weights based on the share of transaction volumes of each merchant in the sector´s total transactions for the first difference between alphas and weights based on the share of sales values of each merchant in the sector´s total sales. We prefer the use of the survey weights as they provide representative estimates for any statistics and because we want to study the representative merchant in the sample. By using the ECDGC (2015) we would be studying the representative payment made at retailers that accept both cash and cards.

A. Arithmetic for all, weighted mean based (ECDGC, 2015):

- $MIT\ MSC_{all}$ = weighted mean of $(\propto_{i,cash} - \alpha_{i,card})/Tv$ plus weighted mean of $(\beta_{i,cash} - \beta_{i,card})$

The tourist test based on econometric estimations

We use econometric estimations of total costs as a function of transaction volumes and sale values for cash, debit and credit cards for three alternative specifications: (i) a linear specification, (ii) a quadratic specification and (iii) a quadratic specification with interactions with cash payment shares, called the mixed model.

We trimmed observations with extreme values for total costs (the dependent variable) (total costs) by dropping the top 5% of the distribution of total costs and dropped salient outliers for transaction values and volumes.

Regressions are perform using robust regression due to the strong kurtosis and skewness observed in the que key variables used in estimation compared with a normal distribution. We use the Cook´s distance algorithm to weight the observations depending on their influence and their error size in estimation. The procedure in Stata iterates to convergency by recalculating the Cook´s distance in each iteration until their variation is less than a tolerance level. Once the weights are calculated robust estimation methods are used to get efficient standard errors.

Appendix B: Results of the econometric estimations

Table 1B. Linear model estimation results

Variables	Cash	Debit Card	Credit Card
Total number of cash transactions	0.0106***		
	(0.00395)		
Total value of cash transactions	0.00314***		
	(0.000260)		
Cash related equipment	0.795***		
	(0.174)		
Number of selling points	-1.234***	-0.166	-0.0114
	(0.311)	(0.155)	(0.168)
Total number of debit card transactions		0.0704***	
		(0.00750)	
Total value of debit card transactions		4.28e-05***	
		(8.28e-06)	
Card related equipment		0.0646	-0.0180
		(0.0608)	(0.0673)
Total number of credit card transactions			0.0320***
			(0.00356)
Total value of credit card transactions			0.00138***
			(0.000136)
Constant	72.19***	42.26***	40.62***
	(3.182)	(1.348)	(1.308)
Observations	613	688	672
R-squared	0.322	0.229	0.314

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

Table 2B. Mixed Model estimation results

VARIABLES	(1) Cash	(2) Debit Card	(3) Credit Card
num_tran_Efectivo_total_suc	0.174***		
	(0.0192)		
num_tran_Efectivo_cuad	-2.02e-06		
	(1.85e-06)		
valtra_Efectivo_total_suc	0.00490***		
	(0.000904)		
valtra_Efectivo_cuad	-2.64e-08***		
	(9.21e-09)		
numero_de_sucursales	-0.987***	0.0105	-0.0737
	(0.239)	(0.155)	(0.150)
equipos_efectivo	0.675***		
	(0.138)		
valtra_prom_efectivo	-1.45e-06***		
	(3.94e-07)		
Int3	-0.170***		
	(0.0180)		
Int4	-0.000880		
	(0.000964)		
num_tran_TD_total_suc		-0.0265	
		(0.0171)	
num_tran_TD_cuad		-7.51e-06***	
		(1.21e-06)	
valtra_TD_total_suc		0.00282***	
		(0.000369)	
valtra_TD_cuad		-4.75e-10***	
		(5.48e-11)	
equipos_tarjetas		-0.00684	0.0176
		(0.0595)	(0.0533)
valtra_prom_TD		-5.20e-07	
		(4.95e-07)	
Int3_TD		0.144***	
		(0.0239)	
Int4_TD		-0.00187***	
		(0.000426)	
num_tran_TC_total_suc			0.0356**
			(0.0147)
num_tran_TC_cuad			-9.25e-06***
			(2.40e-06)
valtra_TC_total_suc			0.00210***
			(0.000293)
valtra_TC_cuad			-1.66e-08***
			(2.49e-09)
valtra_prom_TC			-2.10e-07
			(1.55e-07)
Int3_TC			0.0615**
			(0.0280)
Int4_TC			0.000965***
			(0.000343)
Constant	61.80***	37.84***	36.69***
	(3.505)	(1.292)	(1.338)
Observations	609	687	671
R-squared	0.438	0.424	0.376

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

Appendix C: Interchange fees and merchant service charges in Colombia and merchant-indifferent-test studies

Table 1C: Interchange fees and merchant service costs in Colombia 2020

Interchange Fees

	Credit card			Debit card		
	Min	Max	Prom	Min	Max	Prom
Airlines and travel agencies	0.53%	1.48%	1.12%	0.67%	1.54%	1.00%
Automotive	1.29%	1.77%	1.63%	1.25%	1.91%	1.51%
Household applience and electronics	1.12%	1.65%	1.54%	1.01%	1.69%	1.28%
Hotels, social clubs and events	1.11%	1.70%	1.44%	0.93%	1.70%	1.42%
Restaurants	1.17%	2.25%	1.85%	1.16%	2.46%	1.80%
Department and food stores and retail chains	0.91%	1.72%	1.51%	0.56%	1.72%	1.02%
Fast foods ans kiosks	0.79%	1.97%	1.55%	1.11%	1.82%	1.45%
Fuel stations	0.35%	0.99%	0.61%	0.34%	1.35%	0.46%
Drugstores	0.88%	1.61%	1.48%	0.81%	1.56%	1.35%
Large retail chains	0.76%	1.73%	1.41%	0.38%	1.68%	1.18%
General retail sales and miscellaneous	0.98%	2.01%	1.65%	0.64%	1.93%	1.59%
Total	0.35%	2.25%	1.44%	0.34%	2.46%	1.28%

Merchant Service Cost

	Credit card			Debit card		
	Min	Max	Prom	Min	Max	Prom
Airlines and travel agencies	0.20%	4.70%	1.52%	0.23%	3.68%	1.31%
Automotive	0.54%	6.85%	1.85%	0.53%	6.03%	1.70%
Household applience and electronics	0.50%	6.40%	1.68%	0.54%	5.46%	1.43%
Hotels, social clubs and events	0.81%	5.33%	1.72%	0.49%	4.87%	1.68%
Restaurants	0.46%	6.43%	2.13%	0.33%	6.43%	2.04%
Department and food stores and retail chains	0.47%	5.41%	1.65%	0.29%	4.79%	1.30%
Fast foods ans kiosks	0.84%	5.17%	1.95%	0.46%	5.05%	1.89%
Fuel stations	0.15%	6.30%	0.78%	0.09%	5.10%	0.70%
Drugstores	0.95%	5.60%	1.69%	0.66%	5.56%	1.55%
Large retail chains	0.60%	5.87%	1.69%	0.67%	5.45%	1.43%
General retail sales and miscellaneous	0.50%	6.29%	1.92%	0.53%	6.29%	1.85%
Total	0.15%	6.85%	1.69%	0.09%	6.43%	1.54%

Note: minimum, maximum, and average of the fees reported by Redeban and Credibanco from their public reports for the third quarter 2020. These statistics exclude minimum values posted as cero in some sectors.

Table 2C: International measures of the merchant indifference test

Studies	Data	Methodology /Assumptions/Model	Main Results of MIT
Canada (Fung et al., 2018)	2015 merchant cost survey. Consolidated costs questions.	Arithmetic methodology base on aggregate weighted sums. Focuses on small and medium size businesses. Gives different scenarios for fixed and variable costs. Focuses on transaction values of $20, $50 and $100. MIT-MSC	Merchants would preferer cash for transactions bellow $43. MIT for $20 (-0.38%) and for $100 (0.19%)
European Union (ECDGC, 2015)	Cost survey of large Merchants across 10 countries (about 500). Detail questionnaire.	Arithmetic (weighted parameter average) and econometric methodologies. Short and medium term assumptions on fixed costs.	Medium term: Low transaction value: -0.3; High transaction value: 0.13
Netherlands (Bolt and Jonker, 2013)	Merchant cost survey in 2009 and data for 2002 from Brits and Winder (2005), HBD (2002) and the Dutch competition authority NMa (2006).	Comparison on MIT in two time periods. Extrapolations based on linearity of the cost function. Costs on cash varies with transaction value whereas for cards not so.	MIFs may increase from 0.2% to 0.5% of the transaction amount of an average debit card payment because of rising costs for cash relative to cards.
Poland (Górka, 2012)	Merchant survey 2011-2012. 1000 merchants stratified by branch of economic activity, size of employment, territorial distribution. Detail questionnaire, several contacts.	Three scenarios of fixed costs: short, medium, long-term. Assumptions with respect to acquiring margin based on average MSC and MIF.	ATV card (20.24 EUR) => MIT MIF = 0.18% ; ATV cash (6.89 EUR) => MIT MIF = –0.73%
United States (Layne-Farrar, 2013)	Relied on Garcia-Swartz et al., 2006. Part of the data for some venues taken from the Food Marketing Institute (1998), wages from BLS (2009), and the rest from banks and commerce industry reports.	Tourist test for cash and cheque	For cash: At $7=0.8%; at $50=0.46%


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