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Card acceptance by small merchants: An application of the tourist test to Peru

Jose Aurazo* y Milton Vega*

* Banco Central de Reserva del Perú.

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Card acceptance by small merchants: An application of the tourist test to Peru[1]

Jose Aurazo
Central Reserve Bank of Peru

Milton Vega
Central Reserve Bank of Peru

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Abstract

In this paper, we present the results obtained using data from small merchants in Peru to estimate the level of the interchange fee that makes them indifferent between accepting cash and debit card payments. We apply an extended version of the tourist test (initially proposed by Rochet and Tirole) that includes tax evasion as a factor in the merchants' decision between cash and card payments. Also, we propose a new empirical approach coined as the cash-flow approach that assumes that small merchants estimate the overall cost in terms of the average ticket related to cash and card payments. The data from small merchants suggest that tax evasion is higher in cash payments, reducing considerably the tourist test threshold. Also, the cash-flow approach allows avoiding the "indetermination" issues reported in other empirical studies, associated with the dependence of the interchange fee on the level of the transaction value and how costs are distributed. However, the results obtained depend on the mark-up that small merchants charge above cost price, because it is an input to calculate the benefit from tax evasion.

Keywords: card payments, interchange fee, tax evasion, tourist test, payment systems, Peru.

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Jose Aurazo: jose.aurazo@bcrp.gob.pe; Milton Vega: milton.vega@bcrp.gob.pe.

I. Introduction

Credit and debit cards are an important part of the retail payment systems in many economies, as they are the main substitute for cash at the point of sale. However, in developing economies, the access and usage of payment cards are low compared to developed countries. Therefore, cash is still the most important payment instrument at the point of sale in emerging economies, which imposes costs and risks that can be avoided by using digital payments, such as debit cards or credit cards. The situation in Peru is more complicated due to its low access and usage of digital payments in comparison with other countries in Latin America and the Caribbean (LATAM). According to the 2017 Global Findex, only 28% of adults have a debit card and 12% have a credit card in Peru, compared with 41% and 22% on average, respectively, in LATAM. Moreover, only 34% of adults in Peru made or received digital payments compared with 46% in LATAM.

Payment cards, either debit or credit card, facilitate the transfer of funds from consumers to merchants related to the purchase of goods and services, and constitute a typical example for two-sided markets. These markets are characterized by indirect network externalities; i.e. the utility of cardholders (merchants) increases when more merchants accept (cardholders have) card as payment instrument (Rochet and Tirole, 2002, 2003), the chicken-egg problem (Caillaud and Jullien, 2003) and the winner-takes-all (Sun and Tse, 2007). In a more formal way, Rochet and Tirole (2003) define a two-sided market in which the price structure can alter the volume of transactions, keeping the price level constant.

The price structure in the market for payment cards implies that cardholders are incentivized through reward programs or other benefits to promote their usage of cards, while merchants are charged with fees for the payment service they receive, being the interchange fee (paid to the card issuer by the acquirer)[2] a "price floor" for the merchant discount. (Rochet and Tirole, 2002; Wright, 2012). As a consequence, the interchange fee is crucial for merchants' decision to accept card payments instead of cash in a transaction, and also for the development of the card market, because it provides resources to card issuers to incentivize cardholders to use their cards.

However, in many jurisdictions authorities have taken actions in the market for payment cards as a response of high merchant fees. Authorities have usually focused on setting caps on interchange fees based on a costs' approach or the tourist test approach[3]. The first one considers the costs incurred by the card issuer to provide the card payment service, but it does not take into account the impact of the level of the interchange fee on the merchant's decision to accept a cash or card payment. The second one, known as the tourist test, was developed by Rochet and Tirole (2011) and seeks to estimate an interchange fee that makes merchants indifferent between accepting cash and card payments, which is achieved when the costs of accepting card payments are equal to the costs of accepting cash payments. The latter approach shows that the merchants' decision to accept card payments is crucial for the card scheme development, putting a cap on the interchange fee and therefore on the issuers income and their capacity to give rewards to cardholders. This approach has been applied by the European Union.

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[2] Issuers are typically banks that issue cards to cardholders, while acquirers enroll merchants to accept card payments. Section 2.1 provides a description with more detail.

[3] Some other regulatory actions are capping the merchant discount (e.g. Argentina) or prohibiting some card rules such as the No-Surcharge Rule (e.g. Australia).

In November 2018, Peru’s Competition Authority (*Indecopi* for its acronym in Spanish) launched a Market Study to assess competition conditions in the market for payment cards[4]. As a premise, Indecopi stated that the low level of access and usage of payment cards were a consequence of a market structure characterized by exclusive relations between card networks and acquirers and vertical relations between issuers, card networks, and acquirers; e.g., issuers are shareholders of acquirers[5]; this market structure may be a barrier to lower merchant fees.

At the beginning of 2020, the main two acquirers in Peru became multi-brand, which means that they process transactions from the main two card brands. In this context, card networks announced that the interchange fee will be set by them. In the past, this fee was in general set by card issuers through acquirers, but it was open to negotiation with merchants with market power (i.e., large retailers).

In the context of Indecopi’s Market Study and recent developments in Peru’s card market, it is relevant to explore the tourist test approach to estimate the level of the interchange fee for small merchants, who are considered as crucial actors in promoting access to digital payments in communities that mainly operate in cash ecosystems.

On the other hand, the Central Reserve Bank of Peru (BCRP) conducted a “Survey on Costs of Accepting Payments with Cards and Cash for Small Merchants” (hereinafter “the Survey”) in 2019, aimed at obtaining information on small merchants’ costs linked to accepting cash or card payments. In addition, the Survey asked merchants about the barriers for accepting card payments and they indicated that the level of the merchant fee is the most relevant barrier[6], which implicitly is associated with the level of the interchange fee that makes worth exploring how to estimate it. We use information from this Survey to assess the level of interchange fee for small merchants that meets the tourist test.

This paper presents a first attempt on estimating the interchange fee, in the case of debit card payments, for small merchants in Peru using the tourist test framework extended by Aurazo and Vasquez (2020) that includes tax evasion (broadly interpreted as informality), when merchants do not provide receipts.

In addition, we develop an empirical approach, coined as the cash-flow approach, which avoids the “indetermination” of the interchange fee, reported in other empirical studies, caused by the dependence on the level of the transaction value and how costs are linked to the value or number of transactions. The cash-flow approach implies that small merchants estimate the overall costs in terms of the average ticket, including those related to cash and card payments, and use these fixed ratios as a benchmark for all transactions.

Our results suggest that the benefit from tax evasion reduces the net convenience cost of cash and thus the estimated interchange fee resulting from the tourist test is lower than when tax evasion is not an issue in the decision between cash and card payments.

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[4] The Market Study is available at https://www.indecopi.gob.pe/documents/51771/2610439/Sistemas+de+tarjetas+de+pago/ (last access: 05/31/2020)

[5] In addition, VISA is shareholder of Visanet (now, Niubiz).

[6] Other barriers mentioned by small merchants were lack of trust, non-access to bank accounts and tax duties.

This paper is structured as follows. Section 2 describes the concepts related to the card industry and the regulatory caps imposed on interchange fees in some jurisdictions. Section 3 discusses the base model of the tourist test (Rochet and Tirole, 2011) and the extension that includes tax evasion (Aurazo and Vasquez, 2020); also presents the empirical standard methodologies used to estimate the tourist test threshold and it discusses a new methodology to estimate the tourist test threshold, the cash-flow approach, considering tax evasion. Section 4 describes Peru's payment cards market, the results from the Survey for small merchants in Peru, and discusses the interchange fee estimations obtained from the cash-flow approach and the standard approach applied in other papers. Finally, Section 5 summarizes the key insights of the paper.

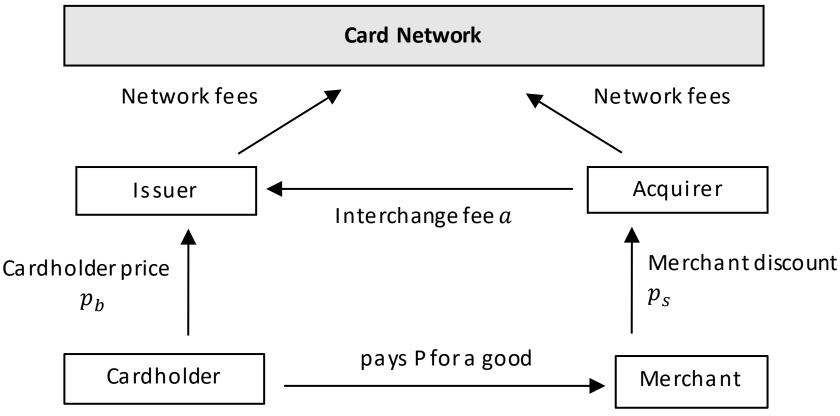
II. Card payments and interchange fee regulation

2.1. The industry of card payments

Payments cards are a two-sided market where consumers (cardholders) interact with merchants through a card network (Visa, Mastercard, etc.) to make payments for the purchase of goods and services. According to Rochet and Tirole (2003), in a two-sided market the volume of transactions is determined by the price structure (i.e., how much each side pays) rather than the price level (i.e., the sum of prices charged on each side).

As illustrated in Figure 1, the market for payment cards is usually composed by five types of agents: consumers, merchants, acquirers, issuers, and the card network (or card brand). This arrangement is known as a four-part scheme, where financial entities perform the issuance function and the acquirers, who affiliate merchants to accept card payments, perform the acquisition function[7].

Figure 1. Fees in Payment Cards



Source: Authors' own elaboration

In each card transaction, issuers charge a fee to cardholders denoted by p_b, which may be negative (cardholders receive rewards or other benefits)[8]; and acquirers charge a

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[7] When the issuance and the acquisition functions are performed by the same entity, this arrangement is known as three-part scheme o closed scheme.

[8] Reward programs are commonly used in credit cards, for example, air-miles, cash-back or interest-free periods. For debit cards, this practice is rarely to occur. Usually, banks give some rewards to debit cardholders as a whole rather than per transaction (i.e. cardholders who have salary accounts). That said, it is difficult to observe negative cardholder prices for debit cards.

fee to merchants, known as the merchant discount, denoted by p_s. The acquirer pays the issuer a fee known as the interchange fee, denoted by a, typically, this fee is determined by the card networks. Finally, card networks charge fees on issuers and acquirers, known as network fees.

In this context, where P is the retail price, cardholders pay $P + p_b$ for the purchase of goods and services, merchants receive $P - p_s$, acquirers obtain $p_s - a$ and issuers receive $p_b + a$.

Note that issuers' income received from the interchange fee covers the issuer's costs (reward programs and processing). The net income received by acquirers covers their processing costs, which include the network fees.

The interchange fee plays a crucial role in four-part schemes. A higher interchange fee allows promoting the usage of cards, because cardholders may receive more benefits or pay a reduced fee, while a lower level allows fostering merchant acceptance, so this fee helps to balance the market. In developing countries, it is important to acknowledge that high interchange fees may be a barrier in order to promote card acceptance by small merchants. A higher interchange fee will increase the merchant discount, and thus merchants could be resistant to accept card payments.

Merchant card acceptance can be analyzed from two different perspectives. From an ex-ante point of view, given that cardholders want to avoid the costs and risks of going to the bank to withdraw cash and hold it in a physical manner (i.e., evade the costs and risks of handling cash)[9], they will prefer to purchase goods and services from merchants that accept card payments. Hence, merchants will accept card payments in order to: i) gain market share from rivals who only accept cash; and ii) be able to increase their retail prices, extracting (part of) the benefit obtained by cardholders[10]. This ex-ante analysis (i.e., before the cardholder is at the cash register) is known as the "must-take card" phenomenon or merchant internalization, and states that merchants are less reluctant to accepting high merchant discounts even if they are higher than their cost savings. Merchant internalization is one factor that may explain why card networks set high merchant fees. (Rochet and Tirole, 2002, 2011; Wright, 2004)

However, from an ex-post perspective, i.e. once the cardholder is at the cash register, merchants can "turn off" POS terminals and induce cardholders to pay in cash if the merchant discount is higher than cost savings. The tourist test, as we will see later, explains ex-post decisions by the merchant. (Rochet and Tirole, 2011)

2.2. Interchange fee regulation

Card payments market is subject to competition issues because of economies of scale and network effects, which may induce high fees. As a consequence, in some countries the antitrust authority or the central bank have decided to set caps on interchange fees to promote a more efficient market and, in developing economies, also to foster financial inclusion and reduce the usage of cash.

[9] In a context of COVID-19, cardholders also want to avoid sources of contagion and prefer paying by card instead of cash, moreover if contactless devices are available.
[10] The increase in retail price is for cash and card users due to the No Surcharge Rule imposed by card networks. Under the No Surcharge Rule merchants are prohibited of giving discounts in the retail price if the consumer pays with cash instead of card.

There are two approaches for determining regulatory caps on interchange fees. The first approach is based on the costs incurred by the issuer to provide the card payment service. These costs include: security mechanisms, anti-fraud procedures, rewards, etc. Some countries where this approach has been applied are Australia, South Africa and the United States of America. The major criticism of this approach is that it does not take into account merchants' cost structure, which ultimately determines if they accept a card or cash payment once the consumer is at the store.

The second approach, known as the tourist test, was proposed by Rochet and Tirole (2011) and seeks to establish an interchange fee that makes merchants indifferent between accepting cash and card payments, which is achieved when the costs of accepting cards are equal to the costs of accepting cash. This approach has been applied by the European Union.

Table 1 provides a summary of some regulatory interventions to set caps on interchange fees.

Table 1. Interchange Fees: International experience*

Country	Debit Card	Credit Card	Approach
Australia**	Weighted Average: 8c*** Individual caps: 15c o 0,20%	Weighted Average: 0,50% Individual caps: 0,80%	Costs
United States****	21c + 0,05%	-	Costs
Brazil	0,80%	-	-
Mexico	1,15%	1,80%	-
European Union	0,20%	0,30%	Tourist test
South Africa	0,36%-0,53%	1,41%-1,89%	Costs

*% of the transaction value.
** Weighted average refers to average interchange fee considering market share of each type of trade.
*** c: indicates local currency cents per transaction.
**** For regulated financial institutions only, which account for 60-70% of US debit volume.
Source: Own elaboration

III. The tourist test: Theory and empirical methodologies

3.1. The base model: Rochet and Tirole

The tourist test, also called the merchant indifference test, is related to the ex-post perspective; i.e., once the cardholder is at the cash register; the general idea is that the interchange fee, set by the card network, should make merchants indifferent between accepting cash or card payments. The rationale of the tourist test is how much the card network should charge to merchants who are attending customers who will not come back to their stores and who have enough cash in their pockets. Under certain assumptions, the tourist test is compatible with the results from the maximization of the total user surplus (cardholders' utility plus merchants' profits)[11].

Following the model setup of Rochet and Tirole (2011), suppose consumers hold cards and decide whether to use card at the point of sale or another alternative means of payment as cash. They obtain a net convenience benefit b_b derived from paying by

[11] Rochet and Tirole (2011) show that the tourist test interchange fee is compatible with the interchange fee that maximizes total user surplus under three assumptions: homogeneous merchants, constant card issuers' mark-up and free entry of issuers in the long-run.

card instead of cash and pay a per transaction fee p_b to their card issuer (which can be negative if receive some rewards). Consumers are heterogeneous in b_b which is a random variable $\widetilde{b_b}$ according to cumulative distribution function $H(b_b) = \Pr(\widetilde{b_b} \leq b_b)$ and the density function $h(b_b) = H'(b_b)$.

The retail price p is the same regardless of the payment instrument used by the consumer; i.e., the No Surcharge Rule is imposed by card networks. Therefore, a card payment is optimal if and only if $\widetilde{b_b} \geq p_b$. As the net convenience benefit is known once the consumer purchases the good, the average net cardholder benefit per card payment is defined by $v_b(p_b) = E[b_b - p_b | b_b \geq p_b]$.

In addition, suppose that merchants are already affiliated to a card network, and are homogenous in the net benefit obtained from accepting card payments instead of cash payments, denoted by b_s, which can be interpreted as the net convenience cost of cash[12] and pays a per-transaction price p_s to the acquirer known as the merchant discount. As a result ot the No Surcharge Rule, the merchant will accept a card payment at the cash register if and only if $p_s \leq b_s$. That is, the additional cost of accepting card payments (the merchant discount paid to the acquirer) is not higher than the net convenience benefit from accepting them; i.e. cost savings from accepting cards instead of cash.

Issuers have a constant mark-up[13] m and a per-transaction cost c_b, and acquirers are perfectly competitive and face a per-transaction cost c_s. The cardholder price is equal to issuers' per transaction cost plus mark-up minus the interchange fee they receive from acquirers; i.e. $p_b = c_b + m - a$. The merchant discount is equal to the acquirer's per-transaction cost plus the interchange fee $p_s = c_s + a$. The card network sets the interchange fee a to maximize the volume of transactions.

The tourist test implies that the interchange fee determined by the card network should guarantee that merchants accept (ex-post) card payments. Hence, the interchange fee that meets the tourist test a^T is

$$a \leq a^T = b_s - c_s \tag{1}$$

Eq. (1) implies that the interchange fee should not be higher than the net convenience cost of cash minus the acquirer's cost. As Rochet and Tirole (2011) pointed out, this level prevents from over-incentivizing cardholders or generating excess benefits to issuers.

The tourist test can be instrumental for debit cards, as it only considers operating costs (customer service and operational management, among others). However, it can also be applied to credit cards when considering the store credit, other financing costs, and associated risks (Rochet and Wright, 2010).

3.2. Tourist test with tax evasion

The tourist test is designed for developed countries, where the operating costs are the main ones involved in accepting payment cards, specifically debit cards (cash handling,

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[12] This cost is the difference between the costs of cash and the costs of cards (different from the merchant discount) that the merchant has to incur per payment.

[13] The idea of a constant mark-up is that any change in costs or income is perfectly passed to the cardholder price, i.e. the issuer does not increase nor reduce the mark-up. Rochet and Tirole (2011) show that when the mark-up is variable, the equality between the tourist test threshold and interchange fee that maximizes total user surplus does not hold.

front-office costs, etc.) However, the situation may considerably differ in developing countries like Peru, where the proportion of cash payments is high, and merchants generally evade sales taxes through cash transactions.

In this context, we take the extended version of the tourist test that considers tax evasion when accepting cash payments. This extension was developed by Aurazo and Vasquez (2020), who introduce evasion of the Value Added Tax (VAT) in cash payments. Small merchants do not usually provide a receipt when consumers make cash payments and, since the retail price includes VAT[14], merchants pocket a fraction of VAT and thus obtain an additional benefit per cash transaction[15].

Suppose θ is the share of cash payments the merchant reports to the government, so $(1-\theta)$ is the share of cash payments that evade VAT. Let us denote as $\phi = (1-\theta)t$ the benefit from tax evasion or the tax benefit of accepting cash, where t is the tax rate. Therefore, the merchant will accept a card payment at the cash register if and only if $p_s \leq b_s - \phi$. Notice that the benefit from tax evasion reduces the net convenience cost of cash.

As noticed in subsection 3.1, the tourist test implies that the interchange fee determined by the card network should guarantee (ex post) card acceptance by merchants. Hence, the interchange fee that meets the tourist test a^T is defined as:

$$a \leq a^T = b_s - c_s - \phi \quad (2)$$

Eq. (2) implies that the interchange fee should not be higher than the net convenience cost of cash minus the acquirer's cost and the benefit from tax evasion. In this context, issuers receive a lower income, that constraints their ability to give rewards to cardholders.

Aurazo and Vasquez (2020) show that the interchange fee in Eq (2) is compatible with the level of the interchange fee that maximizes total user surplus (cardholders utility and merchants profit), as in Rochet and Tirole (2011). See Appendix A.

3.3. Empirical methodologies

3.3.1 The standard approach

The application of the tourist test consists of estimating Eq.(1) using detailed data on merchants' private costs to compare the costs associated with cash vis-à-vis card payments.

The costs involved in the merchant's comparison between cash and card payments can be classified in different ways. One is distinguishing between fixed and variable costs, where the latter can be divided into volume-related and value-related. Another one is distinguishing between pecuniary and non-pecuniary costs, where the former is related to costs expressed in money and the latter is expressed in time (which should be converted into money); and finally, costs can be associated with front-office (customer service), back-office (management and handling), and fraud and losses (fake banknotes and coins and robbery). The most relevant issue in the empirical studies is how to allocate costs between fixed and variable; and the latter into volume-related and value-related. There is no a unique approach to do this, and as we will see

[14] This assumption is consistent with the No Surcharge Rule.
[15] In practice, this extra benefit equals the VAT adjusted by the merchant's margin (retail price minus cost of inputs), since merchants can deduce the VAT from input purchases.

later, this is a problem that introduces “indetermination” in the calculation of the interchange fee.

Bolt et al. (2013) calculate the interchange fee for the Netherlands. Their calculations are based on the assumption that the cost function of each payment instrument is linear (e.g., the marginal cost is equal to the variable cost of a payment). In other words, fixed costs (e.g., POS rental and purchase of the POS terminal, building rental) do not play any role in the decision of the merchant to choose between cash or card payment.

The authors distinguish between variable costs associated with the number or volume and those associated with the value of the transaction; and assume that cash involves both types of costs, while debit card costs are only associated with the number of transactions[16]. The authors find that economies of scale in the use of cards have an important role in the interchange fee; that is, the greater the number of card payments, the lower their average cost, which increases the interchange fee, and thus make it different for each level of card payments.

Using information of merchants’ private costs in Poland, Gorka (2014) calculates the maximum interchange fee that merchants should accept for a card payment[17]. Unlike Bolt et al. (2013), he proposes different scenarios according to the distribution of variable costs regarding the number and value of the transaction. The author shows that the calculation of the interchange fee is sensitive to how costs are distributed between value and volume. Again, the interchange fee varies with the cost structure.

Fung et al. (2018) calculate the maximum merchant discount (acquirer's cost plus interchange fee) for small and medium Canadian merchants to accept a credit card payment instead of cash. The authors consider different scenarios to test the robustness of calculations, changing the merchant planning horizon and distributing costs between fixed and variable with respect to value and number of payments. The result shows that the merchant discount compatible with the tourist test is sensitive to the level of the value of the transaction, the merchant planning horizon (asset depreciation), and the cost distribution.

In sum, the aforementioned studies conclude that the level of the interchange fee depends on the economies of scale, the transaction value, and the cost distribution between the value and volume of transactions; therefore, the interchange fee turns out to be “indeterminate”. In order to define a cap it is necessary to use an average ticket and assume a particular cost distribution. Our analysis incorporates a cash flow approach in order to avoid the indetermination issue.

3.3.2. Standard approach with tax evasion

In order to calculate the tourist test threshold, we need to estimate Eq. (2). However, as the interchange fee is set as 80% of the merchant discount in Peru (until the end of 2019), we can work with the merchant discount and then apply this percentage to estimate the interchange fee. Hence, we estimate Eq. (3), which indicates that the merchant discount should not be higher than the net convenience benefit of card

[16] This is because in the Netherlands the acquirer’s commission is fixed and not a transaction percentage. In order to make the analysis comparable, the authors assume that interchange fee charged is also fixed.

[17] The author uses the sum of debit and credit cards.

payments (or equivalently, the net convenience cost of cash) minus the benefit from tax evasion in cash payments:

$$p_s \leq b_s - \phi \quad (3)$$

Following Bolt et al. (2013), Gorka (2014), Fung et al. (2018) and Aurazo and Vasquez (2020), the marginal cost functions per cash payment and per card payment are:

$$MC_k = \alpha_k + \beta_k V + \theta_k tV, \text{ for a cash payment}$$

$$MC_c = \alpha_c + \beta_c V + \theta_c tV, \text{ for a card payment}$$

Where the subscripts k and c refer to cash and card, respectively, and:

MC: is the marginal cost,
α: is the cost attributable to an additional transaction,
β: is the cost related to the value of an additional transaction,
θ: is the frequency of providing a receipt in each type of payment,
t: is the VAT multiplied by the mark-up[18], and
V: is the value of the transaction.

Assuming that β_c is the merchant discount, the maximum fee (in terms of the transaction value) that the merchant accepts per card payment is:

$$\beta_c = \frac{(\alpha_k - \alpha_c)}{V} + \beta_k - (\theta_c - \theta_k)t \quad (4)$$

Later, we multiply Eq. (4) by 80% to estimate the interchange fee compatible with the tourist test in a context of merchant tax evasion.

Note that in Eq. (4) the merchant discount, and therefore the interchange fee, depends on the transaction value (V). The idea is that when the cardholder is at the cash register, the merchant should recalculate costs related to the specific transaction value of the purchase.

3.4 Alternative methodology: The cash-flow approach

Small merchants live day-to-day and need to control, in a simple manner, their net cash-flow in order to “subsist”. In that context, they estimate their costs in terms of the average ticket, including those related to cash and card payments, and use these fixed ratios to make decisions in all their transactions. This way of thinking is consistent with the way the merchant discount is applied; i.e., a percentage of the sale.

In practice, the cash-flow approach implies that the small merchant calculates fixed ratios comparing the costs of each payment instrument with their average transaction value, so small merchants internalize in their decisions that cards are associated with a higher transaction value than cash. In this way, the interchange fee is no longer dependent of the value of the transaction or the cost distribution between value and volume of transactions, like in other studies discussed above.

Following Bolt et al. (2013), Gorka (2014), Fung et al. (2018) and Aurazo and Vasquez (2020), the marginal cost functions per cash payment and per card payment are

[18] We multiply the VAT by the mark-up since the effect of not paying the VAT implies that merchants cannot reduce VAT from purchases.

defined as functions with two components: one for the volume and another for the transaction value.

$$MC_k = \alpha_k + \beta_k V_k + \theta_k t V_k, \text{ for cash payments}$$

$$MC_c = \alpha_c + \beta_c V_c + \theta_c t V_c, \text{ for card payments}$$

Where the subscripts k and c refer to cash and card, respectively, and:

MC: is the marginal cost,
α: is the cost attributable to an additional transaction,
β: is the cost related to the value of an additional transaction,
θ: is the frequency of providing a receipt in each type of payment,
t: is the VAT multiplied by the mark-up[19], and
V: is the value of the transaction in each type of payment.

Notice that the cash-flow approach implies that small merchants compare such costs based on the transaction value of each payment instrument; that is, all costs are expressed as a percentage of the value of the additional transaction.

$$mc_k = \frac{MC_k}{V_k} = \frac{\alpha_k}{V_k} + \beta_k + \theta_k t, \text{ for cash payments}$$

$$mc_c = \frac{MC_c}{V_c} = \frac{\alpha_c}{V_c} + \beta_c + \theta_c t, \text{ for card payments}$$

In the case of card payments, β_c is the merchant discount, so the maximum fee (in terms of value transaction) that the merchant will accept for card payments is:

$$\beta_c = \left(\frac{\alpha_k}{V_k} - \frac{\alpha_c}{V_c}\right) + \beta_k - (\theta_c - \theta_k)t \tag{5}$$

Eq. (5) summarizes the concept of the cash-flow approach, where the merchant compares the costs per cash transaction and per card transaction in terms of the value of the ticket related to each payment instrument. Therefore, the merchant discount, under this approach, does not depend on either the transaction value or a distribution between value-related and volume-related costs, since merchants assume fixed cost coefficients over the transaction value for each instrument to simplify their decision. The cash-flow approach is consistent with the idea of the tourist test, which seeks to make merchants indifferent between cash and card in an additional purchase.

4. Application of the tourist test to small merchants in Peru

4.1 The Peruvian card industry

Credit and debit cards are an important part of Peru's retail digital payments. In terms of volume, payment cards nearly accounted for 60% of digital payments in 2019. Four international card networks operate in Peru: VISA, Mastercard, AMEX, and Diners, the first one being the most important in the market. VISA and Mastercard issue debit and credit cards, while AMEX and Diners only issue credit cards. In addition, there are four acquirers: *Visanet, PMP, Expressnet* and *Dinersclub*, and some sub-acquirers such as *Vendemás* and *Izipay* which are focused on fostering the card acceptance by small merchants.

[19] Idem.

Until the end of 2019, the Peruvian market was characterized by: i) exclusive relations between card networks and acquirers (Visa with Visanet, now called *Niubiz*; and Mastercard with *Procesos de Medios de Pagos*); and ii) vertical relations (issuers are shareholders of acquirers). In addition, the interchange fee was collectively determined by the issuers as 80% of the merchant discount.

According to Peru's Competition Authority, these characteristics pose limitations to competition; and as a consequence, merchant discount were higher than the ones in other LATAM countries. On average, the merchant discount was around 3%-4% of the transaction value; thus, the interchange fee was around 2.1%-2.4%[20].

After the launch of the Market Study by *Indecopi* in 2018, acquirers became multi-brand by the beginning of 2020; i.e., both Niubiz and Izipay are able to work with any card brand. In this new context, card networks (VISA and Mastercard) announced that the interchange fee will now be set by them. However, issuers may be reluctant to reduce their income[21].

Additionally, it is important to consider that Peru has a large shadow economy, where many market participants evade taxes in their cash payment transactions. According to Immordino and Russo (2019), tax evasion is positively correlated with a high usage of cash and negatively correlated with electronic payments, such as credit and debit cards. According to Peru's Tax Authority, evasion of the Value Added Tax (VAT) reaches 36% of potential tax revenue[22].

4.2 The Survey on costs of accepting payments with cards and cash for small merchants

As mentioned above, the BCRP Survey was conducted between May and June 2019, aimed at obtaining cost information on cash and cards (debit and credit) payments. The sample size was 1,063 small merchants[23], defined as those merchants which own and operate a business independently (chains such as supermarkets or pharmacies are excluded), with at least one POS terminal. The Survey was applied in 7 important cities in Peru (Lima Metropolitan Area, Arequipa, Trujillo, Iquitos, Huancayo, Piura, and Cusco).

According to the results of the Survey, cash was the main payment instrument accepted by small merchants, representing 67% of the value of their sales, while cards represented 33% (16% for credit cards and 17% for debit cards). Likewise, the average ticket per card payment is 47% higher than the average ticket per cash payment (PEN 58 versus PEN 39)[24]. Moreover, almost half of small merchants consider that the main barrier to accepting card payments is high merchant discounts. Small merchants responded that the main reasons for accepting card payments are the attraction of new consumers (87%) and the greater security offered by accepting card payments (86%), which is consistent with the theoretical framework.

[20] In 2019, we estimate that the card issuers' income from interchange fees accounted for PEN 1 500 million (around US$ 438 millions).
[21] The new levels for interchange fees were scheduled in April 2020; however, as a consequence of the pandemic crisis the new interchange fee were applied recently in July 2020.
[22] In Peru the current VAT is 18%. See for more detail https://gestion.pe/economia/sunat-suma-evasion-tributaria-peru-144009 (last access: 05/31/2020).
[23] This definition may differ from those based on the value of sales and/or the number of workers.
[24] For reference, the exchange rate between PEN/USD was 3.5.

On the other hand, the Survey found, through an indirect question, that the frequency of providing receipts in cash payments was 71.8%, compared to 87.4% in card payments, which shows that tax evasion is less likely in card payments than in cash payments[25].

The Survey allowed collecting information on four types of costs to merchants associated with cash and cards:

- **a. Customer service (front-office)**. The amount of time it takes for a merchant to complete a sale.
- **b. Operational management (back-office)**. The amount of time dedicated to perform activities involving cash and card payments; e.g., in the case of cash, the amount of time associated with depositing and withdrawing money from a financial institution.
- **c. Taxes**. Information on the frequency with which a receipt is provided when payment is made by card or cash. The VAT rate in Peru is 18%.
- **d. Others.** Information about fraud (counterfeit bills) associated with cash[26].

Table 2 summarizes the data obtained on sales, costs and its components from the Survey.

Table 2. Sales information and payment cost components

Variable	Cash			Cards*		
	Obs	Mean	Confidence Interval (95%)	Obs	Mean	Confidence Interval (95%)
General information						
Percentage of sales, %	1063	66.9	65.45 - 68.38	1063	33.0	31.49 - 34.42
Monthly sales, PEN	986	10 651	9 771 - 11 531	986	6 095	5 222 - 6 968
Average ticket per transaction, PEN	1055	39.33	37.00 - 41.64	925	57.81	54.82 – 60.80
Number of monthly transactions , units	980	430.2	381.1 – 479.3	925	129.1	108.1 – 150.2
Worker hourly wage, PEN	818	4.02	3.92 - 4.11	818	4.02	3.92 - 4.11
Customer Service (Front- Office)						
Time to complete a sale, minutes	1063	5.73	5.41 - 6.04	1041	4.09	3.88-4.29
Operation Management (Back-Office)						
Management daily time, minutes	1063	18.0	16.9 - 19.1	1052	10.4	9.6 - 11.3
Number of deposits in one month, units	995	5.16	4.72 - 5.59	-	-	-
Number of withdrawals in one month, units	990	3.91	3.61 - 4.22	-	-	-
Time it takes per deposit, minutes	825	18.57	17.60-19.55	-	-	-
Time it takes per	866	15.86	14.86 - 16.86	-	-	-

[25] Merchants were asked about the frequency that merchants in general provide receipts in cash and card payments. Answers were in scale of 1 to 5 where 1 refers to “always” and 5 refers to “never”. For calculating the average frequency of evading taxes, the average data for each scale was multiplied by 100%, 75%, 50%, 25% and 0%, and then they were added up. The results obtained should be taken as an approximation to the levels of tax evasion for cash and card payments.

[26] The Survey also asked for other types of fraud such as robbery and store credit, however, the number of respondents was quite small and not representative of the sample.

withdrawal, minutes						
Other costs						
Counterfeit bills in one year, PEN	449	167.5	133.5 – 201.5	-	-	-
Counterfeit bills in one month, PEN	449	14.0	11.13 – 16.79	-	-	-
Taxes						
Frequency of providing receipt, %	1063	71.8	-	1063	87.4	-

Note: Means and confidence intervals are calculated using the expansion factor of the population size. (*) It considers the debit and credit cards as a whole group.
Source: Costs of accepting card and cash payments in small merchants Survey – BCRP

We calculate several variables for average costs that will be used in the estimation of the merchant discount and interchange fee compatible with the tourist test. The cost associated with the front-office and back-office per cash payment is PEN 0.49 while the cost per card payment is PEN 0.43, or equivalently to 1.38% and 0.75% of the transactional value, respectively. Table 3 shows the data for the main variables associated with cash and card payments, including information about VAT paid and losses.

Table 3. Calculation of payment costs using average data

	Cash	**Cards**
Front-Office		
Cost per transaction, PEN	0.38	0.27
Cost per sale of PEN, %	0.98	0.47
Back-Office		
Cost per transaction, PEN	0.11	0.16
Cost per sale of PEN, %	0.28	0.28
Other costs		
Cost per sale of PEN, %	0.13	
Total costs (without taxes)		
Cost per transaction, PEN	0.49	0.43
Cost per sale, %	1.38	0.75
Taxes (effective VAT)*		
Cost per sale, %	1.29	1.57
Total costs (with taxes)		
Cost per sale of PEN, %	2.68	2.33

* Calculated as the product of the VAT, frequency of providing a receipt and the mark-up of small merchants (e.g. for cash, 18% x71.8% x10%).

4.2 Interchange fee calculations

This section compares the level of the tourist test interchange fee for debit cards estimated using the cash-flow approach for the case of Peru with the one obtained with the standard approach used in other studies, considering tax evasion[27].

4.2.1 Standard approach

As it was discussed, in this framework it is necessary to make some assumptions about the distribution between volume-related and value-related costs. In our baseline, the front-office and back-office costs of cards depend entirely on the number of transactions, while the front-office cost of cash completely depends on the transaction value (100%) and the back-office cost depends equally on the volume and value of the transaction (50%-50%). Using the average ticket of a card sale (PEN 58) and data on private costs obtained from the BCRP Survey, and replacing in Eq. (4), we obtain:

$$\beta_c = \frac{(0.05 - 0.44)}{58} + 1.25\% - (1.29\% - 1.57\%) = 0.30\%$$

Applying the above mentioned interchange fee rule, the interchange fee compatible with the tourist test is 0.24% of the transaction value.

In order to check the robustness of the interchange fee calculated, we consider two additional scenarios. In Scenario 1, the front-office cost of cash is divided 50%-50% between volume and value. In Scenario 2, the front-office cost of cash depends equally on the volume and value of the transaction and the back-office cost depends entirely on the transaction value (100%). The merchant discounts and interchange fees resulting from these two scenarios are lower than the baseline results. See Table 4.

Table 4. Standard approach: Calculation of tourist test interchange fee*

	Baseline		**Scenario 1**		**Scenario 2**	
Components	Cash	Cards	Cash	Cards	Cash	Cards
Volume-related	PEN 0.05	PEN 0.44	PEN 0.25	PEN 0.44	PEN 0.30	PEN 0.44
Front-Office	-	PEN 0.27	PEN 0.19	PEN 0.27	PEN 0.19	PEN 0.27
Back-Office	PEN 0.05	PEN 0.16	PEN 0.05	PEN 0.16	PEN 0.11	PEN 0.16
Value-related	1.25%	-	0.76%	-	0.62%	-
Front-Office	0.98%	-	0.49%	-	0.49%	-
Back-Office	0.14%	-	0.14%	-	-	-
Losses	0.13%	-	0.13%	-	0.13%	-
Merchant discount without tax benefit**	0.59%		0.44%		0.39%	
Taxes (effective VAT)	1.29%	1.57%	1.29%	1.57%	1.29%	1.57%
Merchant discount with tax benefit***	**0.30%**		**0.15%**		**0.10%**	
Interchange fee****	**0.24%**		**0.12%**		**0.08%**	

*Calculations using a transaction value of PEN 58.
(*) Considers the standard components of the convenience costs for cash and cards.
(**) Considers the standard components of the convenience costs for cash and cards net of the benefit from evading taxes.

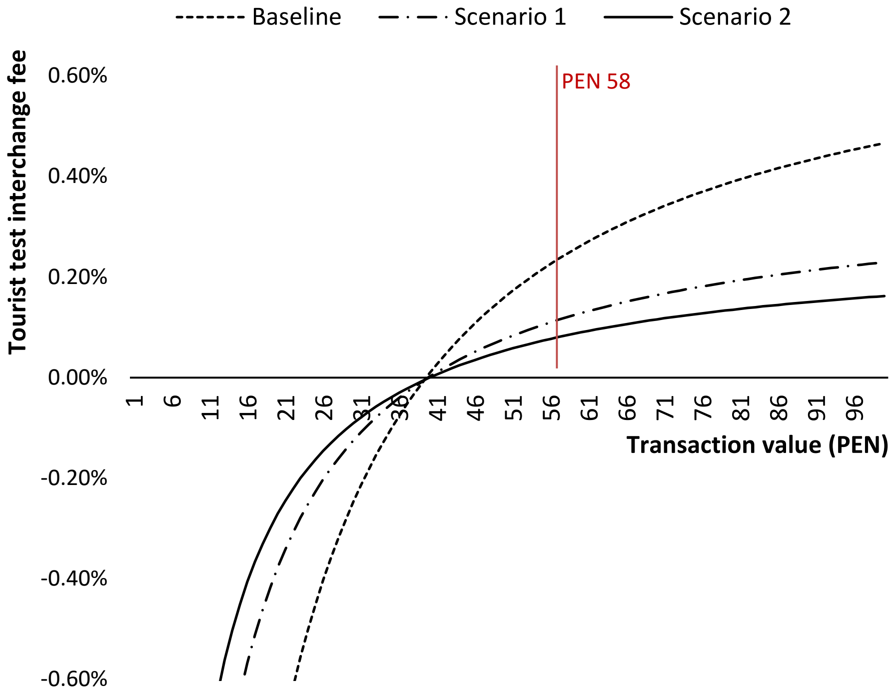
[27] In the case of credit cards, other costs have to be taken into account, such as the store credit. Merchants can give some credit lines to consumers; and thus merchant can avoid this cost if cardholders pay by credit card instead of cash.

(***) Calculated as the 80% of the merchant discount with the benefit from tax evasion.

This exercise shows that in the standard approach the level of the interchange fee depends on the transaction value and the cost distribution, which makes the level of the fee undetermined. In Figure 2 we show how the interchange fee increases with the transaction value considering the different assumptions for cost distribution.

It is important to notice that the merchant recalculates its decision of accepting cards considering the value of each transaction. For example, if the interchange fee is set at the average value of PEN 58, but the value of a new transaction is higher than PEN 58, the merchant would prefer accepting card payments instead of cash, and vice versa. This situation does not arise in the cash-flow approach.

Figure 2. Standard approach: Interchange fee (%) and transaction value



4.2.2 Cash-flow approach

Notice that the cash-flow approach defines costs in terms of transaction values. There are no costs related to the volume of transactions, but rather the costs are entirely related to the value of the transaction; i.e., how much it costs per PEN of sales. The total value-related cost is obtained as the sum of front-office costs, back-office costs, VAT paid, and losses and thefts in terms of the transaction of value of each payment instrument[28]. See Table 5.

Following the cash-flow approach developed in section 3.4, using the cost data obtained from the BCRP's Survey, and replacing in Eq. (5), we obtain:

$$\beta_c = (1.38\% - 0.75\%) - (1.29\% - 1.57\%) = 0.35\%$$

Applying the fixed rule of the interchange fee to Peru's market until 2019, which establishes it as a 80% of the merchant discount, the interchange fee compatible with

[28] Some costs such as the POS rental are not taken into account in the estimation of the interchange fee due to that the current business practice of acquirers and sub-acquirers is to not charge monthly fees.

the tourist test is 0.28%. This level, as well as the ones obtained from the standard approach, is lower than the interchange fee applied until 2019 for debit card payments, so this fee should be redefined to promote card acceptance by small merchants in the Peruvian card market.

Table 5. Cash-flow approach: Calculation of the tourist test interchange fee

Components	Cash	Cards
Volume-related	-	-
Value-related	1,38%	0,75%
Front-Office Back-Office Losses	0.98% 0.28% 0.13%	0.47% 0.28% -
Merchant discount without tax benefit*	0,63%	
Taxes (effective VAT)	1,29%	1,57%
Merchant discount with tax benefit**	**0,35%**	
Interchange fee***	**0,28%**	

(*) Considers the standard components of the convenience costs for cash and cards.
(**) Considers the standard components of the convenience costs for cash and cards net of the benefit from evading taxes.
(***) Calculated as the 80% of the merchant discount with the benefit from tax evasion.

The result of our calculation shows that the interchange fee level is affected by the tax evasion related to cash payments, falling from 0,5% to 0,28% of the sale value.

An alternative way to calculate the interchange fee is to estimate the results for each merchant respondent in the Survey and then obtain their average level. Our estimations suggest that the merchant discount without considering the benefit from evading taxes in cash payments is around 0.42% of the transaction value and thus the interchange fee would be around 0.33% of the transaction value. Once we include the net benefit from evading taxes in cash payments, the merchant discount lowers to 0.14% of the transaction value and the interchange fee for debit cards compatible with the tourist test is around 0.11% of the transaction value. See Appendix B.

4.3 Comparing both methodologies

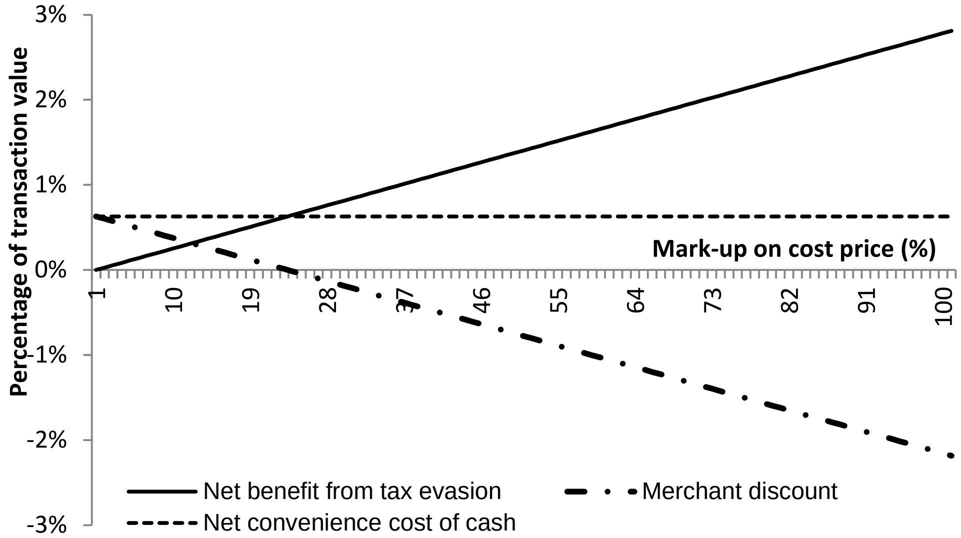
We have presented different ways to calculate the level of interchange fees for small merchants in Peru, all of them show that this fee has a low level, compared with the one applied to them.

The interchange fee resulting from the cash-flow approach is slightly higher than the interchange fee based on the standard approach. The reason is that the cost of cash under the former approach is higher because it is divided by its average transaction value (PEN 39), which is lower than the card transaction value applied in the traditional approach (PEN 58).

The cash-flow approach exhibits certain advantages over the standard approach. First, the interchange fee is the same regardless of the value of the transaction. This is consistent with theoretical models, where there is no dynamics between the interchange fee and the transaction value. Second, the effect of the economies of scale is not relevant, since costs are related to the average sales ticket and not to the volume of card transactions. This avoids the dynamics of an increase in the volume of card payments (i.e., a decrease in the average cost, which in turn increases the interchange fee).

However, introducing tax evasion implies that both the merchant discount and interchange fee depend on the net benefit from evading taxes in cash payments, which in turn is a function of the mark-up on the cost price; i.e. the higher the mark-up, the higher the net benefit from evading taxes and thus lower both the merchant discount and interchange fee. When the mark-up is zero or tax evasion is similar for cash and cards payments, the benefit from tax evasion is null and thus the merchant discount and interchange fee would be 0.63% and 0.50%, respectively. Figure 3 shows this idea in detail, notice that when the mark-up is around 22% and keep the same assumptions, the merchant discount that makes the merchant indifferent between cash and cards is zero.

Figure 3. Cash-flow: Relevance of the mark-up on estimations



4.4 Discussion about private and public actions

In this subsection we discuss some private and public actions that could affect the level of the interchange fee by changing costs associated with cash and card payments (Table 6).

Table 6: Expected Effects in the Interchange Fee

Cost increase in	Cash	Card
Customer Service (Front-Office)	+	-
Operation Management (Back-Office)	+	-
Loss (theft and fraud)	+	-
Tax Compliance	+	-

(+) meaning a direct relation.
(-) meaning an inverse relation.

Technological improvements may reduce the time to complete a card sale (i.e., NFC technology) which in turn reduces the front-office cost of cards. Additionally, the introduction of QR codes facilitates the interaction between merchants and customers. Reisinger and Zenger (2019) studies theoretically the interchange fee regulation and service investments, in which the card network invest to improve quality on both sides. The increase in the merchant benefit due to the increase in the quality is reflected in the tourist test interchange fee.

Regarding government policies, actions oriented to reduce losses and fraud in cash payments decrease the cost of cash. Policies geared to promote tax compliance in cash payments will reduce the benefit from tax evasion. As the interchange fee that makes merchants indifferent is measured as the difference between the cost of a cash payment and a card payment, actions aimed at increasing this gap (by increasing the cost of cash or by lowering the cost of cards, different from the merchant discount) will imply a higher interchange fee. In contrast, actions aimed at reducing this gap will imply a lower interchange fee.

Finally, we recognize that our estimations are based on the convenience costs and taxes; however, in the context of COVID-19, customers and merchants may see cash as a threat to their health and prefer using cards, even more if they are contactless. However, if the transaction requires to go to the store that factor may be negligible[29].

5 Concluding comments

This paper is a first attempt on estimating the level of the interchange fee for debit cards in Peru that makes small merchants indifferent between card and cash payments, known as the tourist test threshold, using cost data from small merchants obtained from a BCRP Survey in 2019.

We follow an extended version of the tourist test, developed by Aurazo and Vasquez (2020) that takes tax evasion into account, as Peru is characterized by a high level of shadow economy. In their model, merchants evade taxes through cash payments, and thus obtain an extra benefit per cash payment, which reduces the net convenience benefit from accepting card payments.

Additionally, we propose a new empirical methodology, coined as the cash-flow approach, to estimate the tourist test threshold. Small merchants live day-to-day and need to control, in a simple manner, their net cash-flow in order to “subsist”. In that context, they estimate their costs in terms of the average ticket, including those related to cash and card payments, and use these fixed ratios to make decisions for all their transactions. This way of thinking is consistent with the way the merchant discount is applied; i.e., as a percentage of the transaction value.

Using this approach, we avoid the problems highlighted in existing empirical literature that estimates the level of the interchange fee according to the tourist test. The cash-flow approach leads to an interchange fee that does not depend either on the transaction value or the distribution of merchant costs. However, the results depend on the mark-up small merchant charge above price cost. The higher the mark-up, the higher the benefit from tax evasion and thus lower net convenience cost of cash, which in turn implies a lower interchange fee.

[29] In Peru’s case, the usage of payment cards (debit and credit) has considerably declined at the point of sale due to the lockdown during March and June. During this period, e-commerce has increased its share in total volume.

According to our estimation, the interchange fee that makes small merchants indifferent between card and cash payments is around 0,5%, but taking into account the difference of tax evasion related to these payment instruments, this threshold lowers to around 0,3% on average. This level could be lower if we estimate the average fee for merchants that answered the Survey. All calculations presented indicate that the level of interchange fee should be lower in order to promote merchant acceptance at the point of sale.

Finally, we consider that estimating an interchange fee compatible with the tourist test is particularly relevant in less-developed markets like in Peru, in order to guide public policy to promote digital payments; in particular, for small merchants who are more sensitive to cost levels. In addition, promoting card acceptance among small merchants is critical to increasing digital payments among the low income population, so establishing an interchange fee that favors card payments acceptance could be a potential strategy.

6 Appendices

6.1 Appendix A: Total User Surplus with tax evasion

The Total User Surplus is defined as the sum of the consumer's surplus and retailer's profit. With an inelastic final demand, these two functions are:

<u>Consumer's surplus</u>

$$CS = u - p - p_b D_b(p_b) - \int_{-\infty}^{p_b} b_b dH(b_b)$$

Where u is the utility of a good for consumers, p is the retail price, p_b is the issuer's price (reward program), and $\int_{-\infty}^{p_b} b_b dH(b_b)$ represents the expected convenience cost of cash payments.

<u>Retailer's profit</u>

$$RP = p - \gamma - (p_s + t)D_b(p_b) - (b_s + \theta t)\big(1 - D_b(p_b)\big)$$

Where γ is the marginal cost of production, p_s is the merchant discount, b_s is the net convenience benefit of accepting cards (or equivalently, the net convenience cost of cash), t is the tax rate and θ is the share of cash payments that merchants report.

Adding these two functions, we see that the total user surplus is equal (up to a constant) to the following function:

$$\omega \equiv [b_s - p_s - (1-\theta)t]D_b(p_b) + \int_{p_b}^{\infty} (b_b - p_b) dH(b_b)$$

$$\omega \equiv \int_{p_b}^{\infty} (b_b + b_s - p_b - p_s - \phi) dH(b_b)$$

Using the definitions of p_b and p_s, we have:

$$\omega \equiv \int_{p_b}^{\infty} (b_b + b_s - c - m - \phi) dH(b_b)$$

Then,

$$\frac{\partial \omega}{\partial p_b} = 0 \;\rightarrow p_b^{TUS} = c - b_s + m + \phi$$

Replacing p_b^{TUS} in $a = p_b^{TUS} - m - c_b$, the interchange fee that corresponds to this maximization internalizes the tax evasion in cash payments:

$$a^{TUS} = b_s - c_s - \phi$$

Notice that the interchange fee that maximizes the total user surplus is identical to the tourist test interchange fee in Eq. (2).

6.2 Appendix B: Estimating the interchange fee for each merchant

Following the Cash-Flow approach developed in section 3.4, we use Eq. (5) as follows:

$$\beta_{c,i} = \left(\frac{\alpha_{k,i}}{V_{k,i}} - \frac{\alpha_{c,i}}{V_{c,i}}\right) + \beta_{k,i} - (\theta_c - \theta_k)t$$

Where sub index i refers to the merchant interviewed and the rest of variables are the same as in Eq. (5).

The merchant discount that meets the tourist test, without taking into consideration tax evasion, is 0.42% of the transaction value; once we include the net benefit from evading taxes in cash payments versus debit card payments, this level lowers to 0.14% and applying the rule that the interchange fee is 80% of the merchant discount, the tourist test threshold is set at 0.11% of the transaction value.

Table A1. Cash-Flow approach: costs, merchant discount and interchange fee

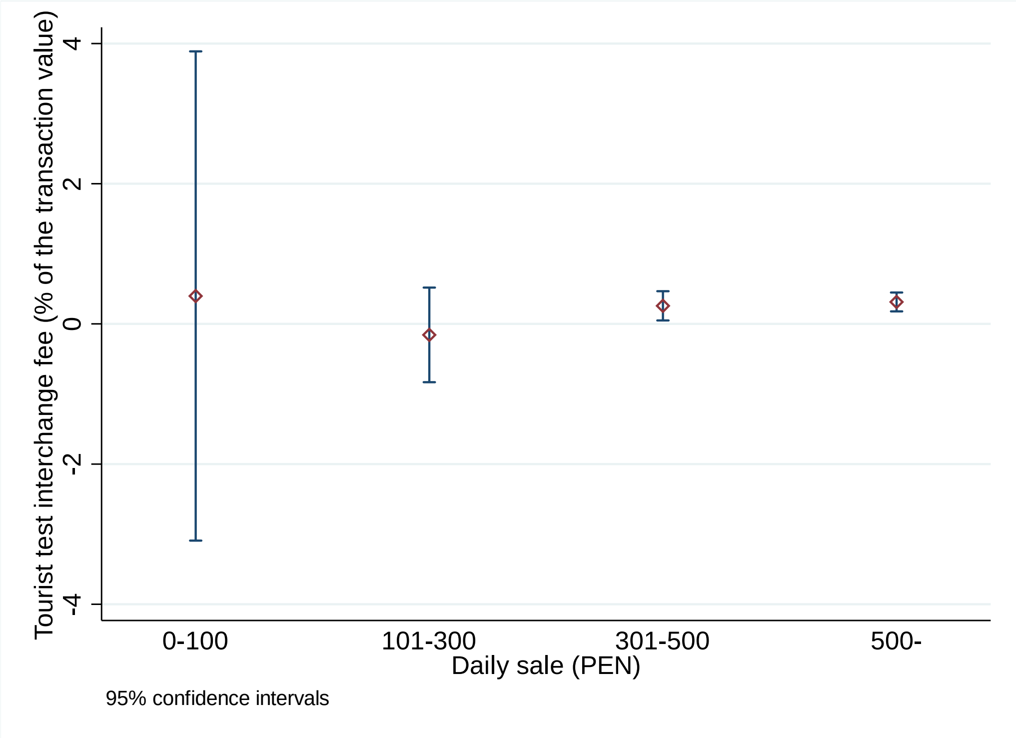
Components	Cash			Cards		
	Obs	Mean	Conf. Inter. (95%)	Obs	Mean	Conf. Inter. (95%)
Volume-related	-	-	-	-	-	-
Value-related, %	**896**	**2.46**	**2.15 - 2.77**	**700**	**2.37**	**1.89 - 2.85**
Front-Office	810	1.58	1.40 - 1.77	689	0.65	0.60 - 0.70
Back-Office	742	1.03	0.79 – 1.27	692	1.74	1.26 – 2.21
Other costs	417	0.28	0.19 - 0.38	-	-	-
Taxes (Effective VAT), %	1063	1.29	-	1063	1.57	-
	Obs		Mean		Conf. Inter. (95%)	
Merchant discount 1*, %	**700**		**0.42**		**-0.09 - 0.94**	
Merchant discount 2, %**	**700**		**0.14**		**-0.37 - 0.66**	
Interchange fee*, %**	**700**		**0.11**		**-0.30 - 0.53**	

Note: Means and confidence intervals are calculated using the expansion factor of the population size. Effective VAT calculated with a mark-up of 10%.
(*) Considers the standard components of the convenience costs for cash and cards.
(**) Considers the standard components of the convenience costs for cash and cards and the benefit from evading taxes.
(***) Calculated as the 80% of the MDR with the benefit from tax evasion.

In addition, Figure A.1. shows the tourist test interchange fee estimated by ranges of the daily sale per merchant (0-100 PEN, 5% of the sample, 101-300 PEN, 34%, 301-

500 PEN, 18%, and 501- more PEN, 42%). We perform a means test to verify whether the interchange fees are statistically different among the ranges of daily sale; the results show that the interchange fees compatible with the tourist test are not statistically different, i.e. the amount of daily sale does not affect the estimation of the interchange fee.

Figure A.1: Tourist test interchange fee and daily sale



References

Aurazo, J. and Vasquez, J. (2020). Merchant card acceptance: An extension of the Tourist Test for developing countries. *Review of Network Economics*, 18(2):109-139.

Bolt, W., Jonker, N., and Plooij, M. (2013). Tourist test or tourist trap? Unintended consequences of debit card interchange fee regulation. DNB Working Paper.

Caillaud, B. and Jullien, B. (2003). Chicken & egg: Competition among intermediation service providers.The RAND Journal of Economics, 32(2):309–328

Fung, B., Huynh, K. P., Nield, K., and Welte, A. (2018). Merchant acceptance of cash and credit cards at the point of sale. *Journal of Payments Strategy Systems*, 12(2):150-165.

Gorka, J. (2014). Merchant indifference test application: A case for revising interchange fee level in Poland. Bundesbank Working Paper.

Immordino, G. and F. Russo (2018). Cashless Payments and Tax Evasion. *European Journal of Political Economy*, 55:36-43.

Reisinger, M. and Zenger, H. (2019). Interchange fees and service investments. *International Journal of Industrial Organization*, 66(3): 40-77.

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

Rochet, J.-C. and Tirole, J. (2003). Platform Competition in Two-Sided Markets. *Journal of the European Economic Association*, MIT Press, 1(4), 990-1029.

Rochet, J.-C. and Tirole, J. (2011). Must-take cards: Merchant discounts and avoided costs. *Journal of the European Economic Association*, 9(3):462–495.

Rochet, J.-C. and Wright, J. (2010). Credit card interchange fees. *Journal of Banking & Finance*, 34(8):1788-1797.

Sun, M. and Tse, E. (2007). When does the winner take all in two-sided markets? Review of Network Economics, 6(1):16–40.

Wright, J (2004). Determinants of optimal interchange fees. *Journal of Industrial Economics,* 52:1-26.

Wright, J (2012). Why payment card fees are biased against retailers. *RAND Journal of Economics,* 43(4):761-780.