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Who Gains and Who Loses from the 2011 Debit Card Interchange Fee Reform?

Oz Shy

Abstract:

In October 2011, new rules governing debit card interchange fees became effective in the United States. These rules limit the maximum permissible interchange fee that an issuer can charge merchants for a debit card transaction. This paper provides simple calculations that identify the transaction values for which merchants pay higher and lower interchange fees under the new rules. The paper then uses new data from the Boston Fed's 2010 and 2011 Diary of Consumer Payment Choice to identify the types of merchants who are likely to pay higher and lower interchange fees under the new rules.

Keywords: Debit card interchange fee

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Oz Shy is a senior economist at the Federal Reserve Bank of Boston and a member of the Consumer Payments Research Center in the research department. His mail address is oz.shy@bos.frb.org.

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1. Introduction

The Federal Reserve Board recently issued a final rule establishing standards for debit card interchange fees.[1] This rule, called Regulation II (Debit Card Interchange Fees and Routing), became effective October 1, 2011 and was required by the Dodd-Frank Wall Street Reform and Consumer Protection Act.[2]

Debit card interchange fees are established by payment card networks and ultimately paid by merchants to debit card issuers (mostly banks) for each electronic debit card transaction. Under the final rule, the maximum permissible interchange fee that a card issuer may receive for an electronic debit transaction is the sum of 21 cents per transaction plus 5 basis points multiplied by the value of the transaction. The new interchange fee replaces the proportional fees that a cost study conducted by the Federal Reserve Board found on average to be 1.17 percent, or approximately 44 cents per transaction based on a $38 average value of all purchase transactions.[3]

Whereas the change from an average proportional fee of 1.17 percent to an almost flat fee of 21 cents reduced the fee on the average transaction, some merchants and even the media quickly realized that the new rules allow card issuers to raise the interchange fees on lower-value transactions.[4] The purpose of this paper is to identify the type and value of transactions on which merchants of particular types are likely to pay higher and lower interchange fees after the reform.

The approach taken in this paper demonstrates that although the interchange fees charged to merchants by card issuers are determined by a complex set of schedules that depend on a number of factors, including merchant type and volume of transactions, the apparent underlying logic can be understood via a simple conceptual model. I use average fees in the model and then show that the actual fee burdens, which vary by merchant type, are very similar to those in the model. The

[1] See `http://www.federalreserve.gov/newsevents/press/bcreg/20110629a.htm` and 12 CFR Part 235, Debit Card Interchange Fees and Routing; Final Rule, Federal Register Volume 76, Number 139 (Wednesday, July 20, 2011), available at `http://www.gpo.gov/fdsys/pkg/FR-2011-07-20/html/2011-16861.htm`.

[2] This act was signed into law by President Barack Obama on July 21, 2010. See the Durbin Amendment, available at `http://thomas.loc.gov/cgi-bin/bdquery/z?d111:SP03989`.

[3] BOG (2011) reports a 1.15 percent average interchange fee rather than a 1.17 percent fee, because it includes prepaid card transactions that are not analyzed in this paper. This average was computed by dividing total interchange fees by total transaction value and is therefore a combination of signature and PIN transactions, see Section 2 for more details.

[4] See a *Wall Street Journal* article by Robin Sidel "Debit-Fee Cap Has Nasty Side Effect," December 8, 2011, available at `http://online.wsj.com/article/SB10001424052970204319004577084613307585768.html`.

results should be viewed cautiously because they rely on a number of assumptions, as follows:

(a) Average transaction values for each merchant type did not change very much between the time when the pre-reform diary data were collected and October 2011 when the reform became effective.

(b) The fractions of signature debit and PIN debit transactions out of total debit card transactions did not change very much during the same period.

Assumption (a) is crucial for the computations because whether a merchant pays higher or lower interchange fees following the reform depends mainly on the value of the transaction. If this value is lower now than in 2010, then our results underestimate an increase in interchange fees. If the average transaction value has increased since 2010, then the results overestimate the true value.

Similarly, violations of assumption (b) can also either enhance or diminish the validity of the results. More precisely, if the proportion of signature debit transactions has increased (equivalently, if the proportion of PIN debit has declined) since 2010, merchants will pay less under the reform rules than shown in the results reported in the paper, because signature debit interchange rates were significantly higher before reform. However, if the proportion of signature debit has declined since 2010, then merchants will pay higher interchange fees than the amounts calculated in this paper.

The new maximum interchange fees on debit card transactions that became effective in October 2010 were set by the Federal Reserve Board following a rule-making required by the Durbin Amendment, which was part of the Dodd-Frank Wall Street Reform and Consumer Protection Act. Section 1075, "Reasonable Fees and Rules for Payment Card Transactions," states:

> (a) IN GENERAL.—The Board shall prescribe regulations in final form not later than nine months after the date of enactment of the Consumer Financial Protection Act of 2010, to establish standards for assessing whether the amount of any interchange transaction fee described in paragraph (2) is reasonable and proportional to the cost incurred by the issuer with respect to the transaction.

In order to pursue this goal, the Board was required to maintain cost studies as follows:

> (b) INFORMATION COLLECTION.—The Board may require any issuer (or agent of an issuer) or payment card network to provide the Board with such information as

> may be necessary to carry out the provisions of this subsection and the Board, in issuing rules under subparagraph (a) and on at least a bi-annual basis thereafter, shall disclose such aggregate or summary information concerning the costs incurred, and interchange transaction fees charged or received, by issuers or payment card networks in connection with the authorization, clearance, or settlement of electronic debit transactions as the Board considers appropriate and in the public interest.

The Board's initial cost study has been made public in BOG (2011). This study serves as a basis for the calculations performed in this paper with respect to the actual interchange fees that prevailed before October 2011, when the new interchange fees rule became effective.

Debit card transactions are divided into two types: signature and PIN. PIN transactions are those in which buyers key in their 4-digit personal identification number (PIN) at the point of sale. All other transactions are classified as signature regardless of whether customers actually sign the receipt at the point of sale. As shown in Section 2 below, signature interchange fees were much higher than PIN interchange fees before the new rule took effect. This is because signature debit transactions were cleared via the credit card networks whereas PIN transactions were cleared via the debit card networks, and merchants are charged higher interchange fees for transactions cleared via credit card networks than for transaction cleared via the debit card networks. It should be mentioned that some small merchants do not offer a PIN option to buyers, as the availability of this option depends on the type of processors merchants use to transmit the information to their acquiring bank.

Section 2 of this paper identifies the dollar value of transactions under which merchants paid higher or lower interchange fees on signature debit and PIN debit card transactions. Section 3 uses the Federal Reserve of Boston Diary of Consumer Payment Choice (DCPC) in 2010 to predict which type of merchants pay higher or lower interchange fees under the new rules. Whereas Sections 2 and 3 use average interchange fees to develop the basic intuition behind the results, Section 4 recomputes the changes using interchange fees that vary by merchant type. Section 5 introduces results from the 2011 DCPC data and compares them to the results obtained from the 2010 DCPC data. Section 6 discusses the quality of the data and the need for more observations. Section 7 concludes.

2. Analysis by Transaction Value

This section computes the range of transaction values under which merchants paid higher or lower interchange fees under the new rule. The method involves finding transaction value cutoff levels for three types of debit card transactions: signature, PIN, and a weighted average of the two.

2.1 Average interchange fee before the reform

Table 1 displays the number of transactions, average transaction values, and average interchange fees in 2009 for signature debit, PIN debit, and the weighted average of the signature and PIN cards.

Transaction type	#Trans. (bil)	%	Avg. Trans. Val ($)	Avg. Int. Fee ($)	Avg. Int. Fee (%)
Signature Debit	32.5	61.8	37.15	0.56	1.53
PIN Debit	13.9	38.2	40.03	0.23	0.58
Weighted Average	n/a	n/a	38.25	0.43	1.17

Source: BOG (2011).

Table 1: Signature debit and PIN debit: Transactions and interchange fees in 2009.

The data in Table 1 are from BOG (2011), which was obtained from a Federal Reserve Board survey of 131 financial institutions (most of them card issuers), 16 networks that process debit card transactions, and 9 large merchants. The weighted averages have been adjusted slightly to accommodate the removal of prepaid card transactions, which are not investigated here.

2.2 Average interchange fee after the reform

The computations in this section are based on a new interchange fee of 21 cents plus 5 basis points of the transaction value as prescribed in the final rule referenced in Footnote 1. Because this fee schedule constitutes the maximum permissible fee, a question that immediately arises is whether the use of 21 cents plus 5 basis points generates an overestimation of the actual interchange fees paid by merchants to card issuers after the reform. In other words, what evidence do we have that card issuers actually levy the maximum permissible interchange fees rather than imposing lower interchange fees?

The answer to this question is given in Table 2, which displays recent data released by the Federal Reserve Board of Governors.[5]

Transaction type	Avg. Trans. Val ($)	Avg. Int. Fee ($)	Avg. Int. Fee (%)
Signature Debit	38.03	0.24	0.63
PIN Debit	42.13	0.23	0.55

Source: Federal Reserve Board of Governors, see Footnote 5.

Table 2: Signature debit and PIN debit: Transactions and average interchange fees from October to December 2011.

Table 2 shows that, on average, debit card issuers charged the maximum interchange fee allowed under the Board's new rules. In fact, Table 2 shows that the actual average interchange fee exceeded 21 cents plus 5 basis points; this is permissible under the new rule because the Board's rule also allows for an upward adjustment of no more than 1 cent per transaction to an issuer's debit card interchange fee if the issuer develops and implements policies and procedures reasonably designed to achieve the fraud-prevention standards set out in the interim final rule.

The analysis in this section is based on an average per-transaction interchange fee of 21 cents plus 5 basis points and not on 23–24 cents as displayed in Table 2, for the following three reasons. First, although this research investigates the fees paid by a wide variety of merchant types, special attention is given to merchants who sell low-value products and services. For merchants with low transaction values, the 5 basis points do not add much to the total fee burden. Second, the 1-percent allowable fraud prevention surcharge may not last forever. Third, the use of 21 cents plus 5 basis points ensures that we do not overestimate the increase in the fee burden of those merchant types that this paper finds to be losing from the reform. Thus, the reader should bear in mind that the increase in the actual fee burden for these merchants may be 1 cent higher than the one calculated in this section.

2.3 Covered card issuers only

For the sake of illustration, I start the analysis with an extreme assumption that the new debit card interchange fees cover all card issuers. Section 2.4 adjusts the computations to take into

[5]See `http://www.federalreserve.gov/paymentsystems/regii-average-interchange-fee.htm`.

consideration the fact that about 40 percent of debit card transactions are not covered by the new regulation because they involve cards issued by "small" banks (banks with less than $10 billion of assets).

Let p denote a transaction value. That is, p is the price a consumer is charged on a debit card (in dollars). Then, under the new rule, the maximum interchange fee (in dollars) is

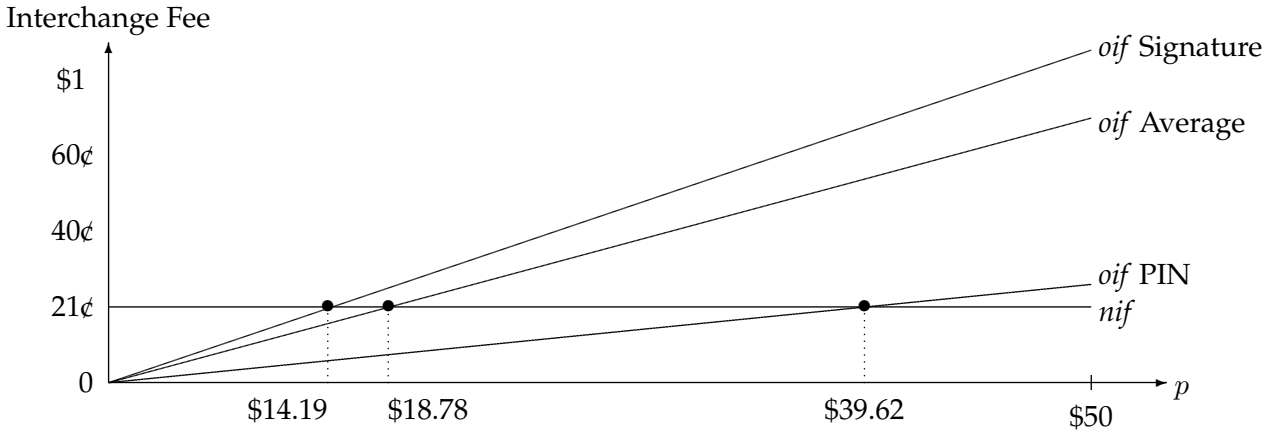
$$nif = 0.21 + 0.0005p. \tag{1}$$

Next, Table 1 implies that the "old" interchange fees were

$$oif = \begin{cases} 0.0153p & \text{Signature debit transaction} \\ 0.0058p & \text{PIN debit transaction} \\ 0.0117p & \text{Average debit transaction.} \end{cases} \tag{2}$$

The fee structure exhibited in (1) is commonly referred to as a "two-part tariff" because it has a fixed component that does not vary with the transaction value and a proportional component expressed as a fraction of the transaction value. See Chapter 5 in Shy (2008) for general definitions of multipart tariffs.

Figure 1 illustrates the merchants' interchange fees as a function of the transaction value (price paid by the customer) according to the fee schedules defined by (1) and (2).



Source: Author's calculations. *Note*: *nif* new interchange fee; *oif* old interchange fees. The 0.0005 slope of the *nif* is too shallow to be noticeable.

Figure 1: Interchange fees paid by merchants as a function of the transaction value.

Figure 1 implies the following results:

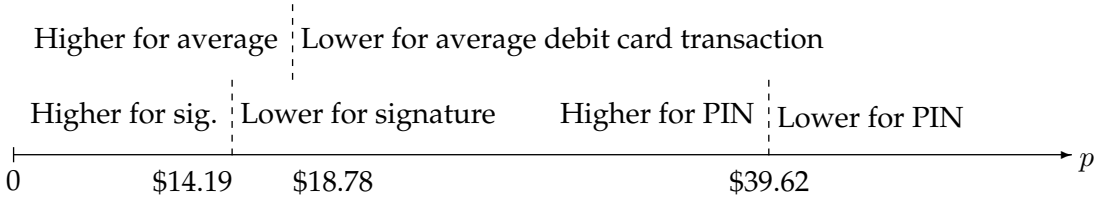
Result 1. *Suppose that all card issuers (regardless of their size) adhere to the new rules characterized by equation (1). Then, under the new rules, merchants pay higher interchange fees*

(a) on average debit card transactions below $18.78, and, more precisely,

(b) on signature debit transactions below $14.19, and

(c) on PIN debit transactions below $39.62.

Figure 2 illustrates Result 1.



Source: Author's calculations.

Figure 2: Cutoff transaction values for which merchants pay the same interchange fee under the old and new fee schedules.

Transaction values lower than the cutoff levels generate higher interchange cost to merchants under the new rule compared with the fees that prevailed before the new rule became effective.[6] Transaction values higher than the cutoff levels generate lower interchange fees under the new rule. This is because, for small transaction values, the fixed component of the new interchange fee dominates the proportional component.

Figures 1 and 2 show that merchants that are paid mainly with PIN debit cards are more likely to lose from the new rule than merchants whose transactions are mostly signature debit. This is because the new rule sets the same interchange fee for signature and PIN transactions, and as Table 1 shows, signature interchange fees were much higher than PIN interchange fees before the new rule took effect.

[6] Wang (2012) constructs an analytical model to explain why card networks do not offer fee discounts to small ticket merchants in response to the interchange fee cap regulation.

2.4 Adjustments for non-covered (exempt) card issuers

The new regulations on interchange fees do not apply to card issuers with assets worth less than $10 billion. These smaller card issuers are exempt from this regulation and can therefore continue to charge the old fees if they find it profitable to do so. This section modifies the computations performed in Section 2.3, assuming that card issuers that are exempt from the new regulation continue to charge the old interchange fees. Formally, the computations and calibrations in the paper assume that merchants are charged according to the new fee described in (1) for only 60 percent of their debit card transactions and that they continue to pay the old fees, described in (2), for the remaining 40 percent of their debit card transactions.[7] Using the 60–40 ratio of covered versus non-covered transaction volume, the new average interchange fee schedule for a transaction valued at $\$p$ defined in (1) is now modified to

$$nif = 0.6(0.21 + 0.0005p) + 0.4 \cdot \begin{cases} 0.0153p & \text{signature debit transaction} \\ 0.0058p & \text{PIN debit transaction} \\ 0.0117p & \text{average debit transaction,} \end{cases} \tag{3}$$

which constitutes a 60–40 linear combination of the new (1) and old (2) interchange fees.

Comparing (2) and (3) yields the following general result.

Result 2. *The threshold transaction values under which merchants pay higher interchange fees under the new regulation are invariant with respect to the fraction of covered and uncovered debit card issuers. Therefore, the threshold values described in Result 1, Figure 1, and Figure 2 hold true also for the 60–40 ratio of covered versus non-covered debit card transactions.*

To prove Result 2, denote by π a merchant's fraction of transactions paid for with cards issued by covered card issuers, where $0 < \pi < 1$. Hence, $1 - \pi$ is the fraction of card transactions paid with cards issued by non-covered card issuers. For example, in our case $\pi = 0.6$. Also, let $nif(p)$ and $oif(p)$ denote the new and old interchange fees, respectively, for a transaction value of $\$p$,

[7] The cost study described in BOG (2011) surveyed only card issuers who are covered by the new interchange fee regulation. All issuers with very large volume responded to the Board's survey, which corresponded to 57 percent of all debit card transaction volume and 60 percent by value. Because a certain amount of volume was not included, 57 percent of the total transaction volume should serve as a lower bound on the fraction of covered transaction volume (and 43 percent serves as an upper bound on debit card volume by non-covered issuers). For this reason all subsequent computations will be based on the 60 percent figure.

see schedules (1) and (2). Then, the transaction value $\hat{p}$ under which the merchant pays the same amount in interchange fees after and before the regulation takes effect is implicitly determined from

$$\pi \cdot (\text{\# trans}) \cdot nif(\hat{p}) + (1-\pi)(\text{\# trans}) \cdot oif(\hat{p}) = (\text{\# trans}) \cdot oif(\hat{p}), \tag{4}$$

or, equivalently, $nif(\hat{p}) = oif(\hat{p})$, which is independent of the value of π.

3. Analysis by Merchant Type, Assuming Equal Pre-Reform Fee

Section 2 identified the range of transaction values under which merchants pay higher and lower interchange fees under the new rule compared with what they paid before the interchange fee reform was implemented. Using actual transaction data, this section extends the investigation of the effects of the interchange fee reform to identify the types of merchants that are likely to pay higher or lower interchange fees under the new rule.

The computations in this section are fairly simple because they rely on the assumption that merchant fees did not vary by merchant type before the new, regulated fees were implemented in October 2011. Unlike the pre-reform fees, the new fees do not vary by merchant type and are the same for signature and PIN transactions. Section 4 extends the analysis by redoing the calculations based on pre-reform fees that varied by merchant and network types and shows that the computations performed in this section can serve as a good approximation of the results of the effect of the reform on total interchange fees paid by each merchant type.

3.1 The Diary Data

The data used in this analysis are taken from the Boston Fed's Diary of Consumer Payment Choice (DCPC) in 2010 and in 2011. The DCPC collects data on the dollar value, payment instrument used, and type of expense (merchant type) for each purchase. This is information that the Survey of Consumer Payment Choice (Foster et al. 2011) does not collect.

Among other things, for each purchase, 353 respondents in 2010 and 387 in 2011 recorded the type of merchant they patronized and the payment method they used over a three-day period.

Table 3 displays the merchant category codes respondents used to record their transaction types.

Goods		*Services*	
M1:	Grocery, pharmacy (144, 148)	M6:	Restaurants, bars (65, 64)
M2:	Gas station, convenience store (100, 96)	M7:	Fast food, beverage (60, 63)
M3:	General merchandise store, websites (75, 100)	M8:	Transportation, tolls, parking (1, 5)
M4:	All other retail (43, 33)	M9:	Recreation, entertainment, travel (12, 16)
		M10:	Health, medical, personal care (12, 11)
Other		M11:	Maintenance, repairs (10, 3)
M5:	Payments to people (87, 98)	M12:	Education, day care (0, 1)
		M13:	Nonprofit, charity, religious (2,2)
		M14:	Other services (19, 18)

Source: Federal Reserve Bank of Boston Diary of Consumer Payment Choice.

Table 3: Merchant categories and number of debit card transactions recorded in (2010, 2011).

Table 4 breaks down the diary data by merchant type and signature versus PIN debit card transactions and provides some statistics on the dollar value of the transaction.

For debit card transactions, respondents recorded whether they had to key in their PIN or whether the transaction did not use a PIN, in which case, the transaction is classified as a signature transaction in this research. Card-not-present transactions (CNP) transactions are classified as online payments and are recorded separately in the diary. Table 4 shows that, excluding "merchant" type 5 (payments to people), for the whole diary period, which spanned from September 29, 2010 to November 2, 2010, there were 234 signature (43.1 percent) and 309 PIN (56.9 percent) debit card payments with a dollar amount recorded.[8]

Table 4 reveals that the respondents transacted mainly with merchant types M1, M2, M3, M4, M6, and M7. Respondents reported low transaction volumes (or none) on other merchant types. Merchants M1 (grocery, pharmacy) had the largest transaction volume whereas merchants M7 (fast food, beverage) had the lowest transaction values. Therefore, the examination of merchant type M7 is very important for the investigation of the impact of the debit card interchange fee

[8]In 2010 (2011), respondents recorded 2,040 (2,396) transactions in all payment instruments over a period of three days (not counting type M5 merchants), which means that debit card transactions amounted to 26.6 percent ($= 543/2040$) of all payments in 2010 and 23.4 percent ($= 560/2396$) in 2011.

Type	M1	M2	M3	M4	M6	M7	M8	M9	M10	M11	M12	M13	M14
Transactions (#)	144	100	75	43	65	60	1	12	12	10	0	2	19
Signature (#)	30	39	26	18	45	47	1	8	6	5	0	1	8
PIN (#)	114	61	49	25	20	13	0	4	6	5	0	1	11
Mean ($)	50.20	26.56	59.53	42.67	26.84	9.14	12.00	16.39	43.98	43.23	n/a	35.90	60.82
Std. Dev. ($)	53.63	16.96	114.89	67.11	56.47	8.91	n/a	13.70	28.49	25.07	n/a	15.41	64.06
Highest ($)	270.00	75.00	833.60	417.50	450.00	50.90	12.00	50.00	93.00	95.00	n/a	46.80	220.00
Median ($)	30.62	26.05	27.80	22.46	14.19	6.75	12.00	15.21	36.50	40.47	n/a	35.90	26.81
Lowest ($)	1.49	2.88	1.07	0.96	2.81	1.37	12.00	1.05	15.00	13.60	n/a	25.00	4.90

Source: Federal Reserve Bank of Boston 2010 Diary of Consumer Payment Choice.

Table 4: Detailed debit card transactions by merchant type.

reform.

To reduce the number of tables in the paper, the 2011 equivalent of Table 4 is not displayed here. The analysis that follows is based on the 2010 data. The 2011 data analysis is reported in Section 5.

3.2 Losers and gainers from the interchange fee reform

This section uses the 2010 dairy data, described in Section 3.1, to compute the interchange fees by merchant type and payment type (signature debit and PIN debit). I compare the fees paid by each merchant type before and after the debit card interchange fee reform was implemented and characterize the merchant types that may pay higher or lower interchange fees after reform. These comparisons yield the same results regardless of whether total fees or per-transaction fees are compared, because all the fee schedules listed in (2) and (3) are linear functions of the transaction value.

As mentioned earlier, the computations in this section are based on a simplifying assumption that pre-reform interchange fees did not vary with the merchant type. That is, the following calculations assume that all merchants paid the same average interchange fees described in (2) prior to October 2011, when the new uniform fees became mandatory. In addition to simplicity, the main advantage of this computation method is that it does not require matching the merchant categories commonly used by card networks to the merchant categories used in the DCPC. However, Section 4 reproduces all the computations and results reported in this section using the merchant type-specific fee structure that prevailed prior to the reform as well as after the reform for card issuers that are exempt from this reform.

Let $M \stackrel{\text{def}}{=} \{\text{M1}, \text{M2}, \text{M3}, \text{M4}, \text{M6}, \ldots, \text{M14}\}$ be the set of merchant types that are listed in Table 4. Also, let m denote the index of merchant type, $m \in M$. $\bar{p}_m$, $\bar{p}_m^{\text{Sig}}$, and $\bar{p}_m^{\text{PIN}}$ denote the average transaction *values* of merchant m, (averages from total, signature, and PIN, respectively). t_m, t_m^{Sig}, and t_m^{PIN} denote the *number* of transactions recorded with merchant type m, (total, signature, and PIN, respectively).

Using this notation, in view of (3), the average *per-transaction* interchange fees paid by merchant

$m \in M$ on signature and PIN transactions after the reform was implemented are:

$$\begin{aligned} nif_m^{\text{Sig}} &= 0.6\left(0.21 + 0.0005 \cdot \bar{p}_m^{\text{Sig}}\right) + 0.4\left(0.0153 \cdot \bar{p}_m^{\text{Sig}}\right) \\ nif_m^{\text{PIN}} &= 0.6\left(0.21 + 0.0005 \cdot \bar{p}_m^{\text{PIN}}\right) + 0.4\left(0.0058 \cdot \bar{p}_m^{\text{PIN}}\right), \end{aligned} \tag{5}$$

where *nif* stands for "new" interchange fees. The total amounts of the new fees paid by merchant m, denoted by capital letters, are therefore $NIF_m^{\text{Sig}} = nif_m^{\text{Sig}} \cdot t_m^{\text{Sig}}$ and $NIF_m^{\text{PIN}} = nif_m^{\text{PIN}} \cdot t_m^{\text{PIN}}$.

In view of the interchange fee schedule (2), the average per-transaction interchange fees paid by merchant $m \in M$ on signature and PIN transactions before the reform was implemented were

$$oif_m^{\text{Sig}} = 0.0153 \cdot \bar{p}_m^{\text{Sig}} \quad \text{and} \quad oif_m^{\text{PIN}} = 0.0058 \cdot \bar{p}_m^{\text{PIN}}, \tag{6}$$

where *oif* stands for "old" interchange fees. Total old fees paid by merchant m, denoted by capital letters, were $OIF_m^{\text{Sig}} = oif_m^{\text{Sig}} \cdot t_m^{\text{Sig}}$ and $OIF_m^{\text{PIN}} = oif_m^{\text{PIN}} \cdot t_m^{\text{PIN}}$.

Equations (5) and (6) imply that merchant $m \in M$ pays higher (lower) interchange fees under the new rule if and only if $nif_m^{\text{Sig}} > (<) oif_m^{\text{Sig}}$ and $nif_m^{\text{PIN}} > (<) oif_m^{\text{PIN}}$.

The remainder of this section analyzes the differences between new and old *per-transaction* signature and PIN interchange fees for each merchant type $m \in M$, which are formally defined as

$$\Delta_m^{\text{Sig}} \stackrel{\text{def}}{=} nif_m^{\text{Sig}} - oif_m^{\text{Sig}} \quad \text{and} \quad \Delta_m^{\text{PIN}} \stackrel{\text{def}}{=} nif_m^{\text{PIN}} - oif_m^{\text{PIN}}. \tag{7}$$

Hence, $\Delta_m^{\text{Sig}} > 0$ (< 0) indicates that the reform raised (lowered) the average interchange fee on a signature transaction for type m merchants. $\Delta_m^{\text{PIN}} > 0$ (< 0) indicates the same for PIN transactions.

Table 5 displays the average new and old interchange fees per signature transaction by merchant type as well as the differences between the two. Table 5 implies the following result.

Result 3. *Subject to the limitations of the diary data listed in Section 6, the reform of debit card interchange fees may have increased the signature interchange fees paid by type M7 merchants (fast food, beverage) by 5 cents per transaction and reduced interchange fees of all other sampled merchants.*

Result 3 is consistent with Table 4, which shows that type M7 merchants handle on average transactions of $9.14, which Figure 2 shows to be below the threshold of $14.19 needed to make the

Type	M1	M2	M3	M4	M6	M7	M8	M9	M10	M11	M12	M13	M14
nif_m^{Sig}	0.39	0.31	0.55	0.54	0.33	0.18	0.20	0.24	0.36	0.51	n/a	0.29	0.63
oif_m^{Sig}	0.64	0.43	1.02	0.99	0.48	0.12	0.18	0.28	0.56	0.91	n/a	0.38	1.19
Δ_m^{Sig}	-0.24	-0.12	-0.46	-0.45	-0.15	$\boxed{0.05}$	$\boxed{0.02}$	-0.03	-0.20	-0.40	n/a	-0.10	-0.57

Source: Author's calculations. *Note*: $\Delta_m^{\text{Sig}} > 0$ (< 0) indicates increase (decrease) in per-transaction interchange fee.

Table 5: A comparison of per-transaction signature interchange fee after and before the reform ($).

Type	M1	M2	M3	M4	M6	M7	M8	M9	M10	M11	M12	M13	M14
nif_m^{PIN}	0.26	0.19	0.27	0.20	0.17	0.16	n/a	0.16	0.26	0.20	n/a	0.25	0.25
oif_m^{PIN}	0.30	0.15	0.32	0.16	0.10	0.08	n/a	0.08	0.30	0.16	n/a	0.27	0.28
Δ_m^{PIN}	-0.04	$\boxed{0.04}$	-0.05	$\boxed{0.04}$	$\boxed{0.07}$	$\boxed{0.08}$	n/a	$\boxed{0.08}$	-0.04	$\boxed{0.04}$	n/a	-0.02	-0.03

Source: Author's calculations. *Note*: $\Delta_m^{\text{PIN}} > 0$ (< 0) indicates increase (decrease) in per-transaction interchange fee.

Table 6: A comparison of per-transaction PIN interchange fee after and before the reform ($).

Type	M1	M2	M3	M4	M6	M7	M8	M9	M10	M11	M12	M13	M14
nif_m	0.29	0.24	0.37	0.34	0.28	0.17	n/a	0.21	0.31	0.35	n/a	0.27	0.41
oif_m	0.37	0.26	0.56	0.50	0.36	0.11	n/a	0.21	0.43	0.53	n/a	0.33	0.66
Δ_m	-0.08	-0.02	-0.19	-0.16	-0.08	$\boxed{0.06}$	n/a	0.00	-0.12	-0.18	n/a	-0.06	-0.25

Source: Author's calculations. *Note*: $\Delta_m > 0$ (< 0) indicates increase (decrease) in per-transaction fee.

Table 7: A comparison of per-transaction (signature and PIN combined) interchange fee after and before the reform ($).

reform cost reducing. Table 4 shows that all other merchant types handle on average much higher transaction values, which, by Figure 2, reduced the interchange fees after the reform. Note that the number of observations is insufficient to make the same assertion for type M8 merchants even though Table 5 shows a fee increase of 2 cents per transaction.

Table 6 displays the average new and old interchange fees per PIN transaction by merchant type. Table 6 implies the following result.

Result 4. *Subject to the limitations of the data listed in Section 6, the reform in debit card interchange fees may have increased the per-transaction PIN interchange fees paid by merchant types M2 (gas stations, convenience stores) by 4 cents, M4 (Other retail) by 4 cents, M6 (restaurants, bars) by 7 cents, M7 (fast food, beverage) by 8 cents, M9 (recreation, entertainment, travel) by 8 cents, and M11 (maintenance, repair) by 4 cents and have reduced interchange fees paid by all other sampled merchants.*

Comparing Result 4 with Result 3 reveals that the reform has increased interchange fees of more merchant types when considering only PIN transactions than when considering only signature transactions. This follows from the old fee schedule (2), which shows that signature interchange fees were almost three times as high as PIN interchange fees.

It remains to investigate the effects of the reform on the average (signature and PIN combined) per-transaction interchange fee paid by each merchant type. To do so, the average per-transaction interchange fee (signature and PIN combined) for type m merchants after and before the reform was implemented is computed by averaging (5) and (6) according to the number of PIN and signature transactions given in Table 4. Thus,

$$nif_m = \frac{nif_m^{\text{Sig}} \cdot t_m^{\text{Sig}} + nif_m^{\text{PIN}} \cdot t_m^{\text{PIN}}}{t_m^{\text{Sig}} + t_m^{\text{PIN}}} \quad \text{and} \quad oif_m = \frac{oif_m^{\text{Sig}} \cdot t_m^{\text{Sig}} + oif_m^{\text{PIN}} \cdot t_m^{\text{PIN}}}{t_m^{\text{Sig}} + t_m^{\text{PIN}}}. \tag{8}$$

Similar to (7), for each merchant type m, the difference in per transaction interchange fee (signature and PIN combined) associated with the reform is denoted by $\Delta_m = nif_m - oif_m$. These differences are computed in the bottom row of Table 7. Table 7 implies the following result.

Result 5. *The reform may have increased the average (signature and PIN) per-transaction interchange fee paid by type M7 merchants (fast food, beverage) by 6 cents and reduced it for all other sampled merchant types.*

Section 3.3 shows that the conclusion about type M7 merchants is statistically significant. The reader should bear in mind that Results 3, 4, and 5 are based on the Dairy of Consumer Payment Choice in 2010. Consequently, more datasets are needed to confirm the results. The reader is referred to Section 6 for a discussion of the limitations of the data.

3.3 Confidence intervals

This section computes the 95-percent confidence intervals around the average transaction value of each merchant type. The goal is to compare each confidence interval with the merchant type's cutoff transaction value (below which the merchant pays higher interchange fees as a result of the reform). This procedure will determine the degree of confidence in identifying the merchant types that pay higher or lower interchange fees as a result of the reform. The analysis in this section omits merchant types M8, M12, M13, and M14 because of low transaction records and because M14 (other services) does not correspond to any particular merchant type.

Table 8 displays the confidence intervals and the cutoff transaction values below which the reform increases the interchange fees. The row labeled "Signature (%)" in Table 8 displays the fraction of signature transactions out of total debit card transactions, where the number of signature transactions is taken from Table 4. This ratio is needed to compute the cutoff transaction values below which merchants pay higher fees after the reform. To see how the cutoff levels are computed, the weighted (by signature and PIN) per-transaction interchange rate paid by M1 merchants before the reform was $0.208 \cdot 0.0153 + (1 - 0.208)0.0058 = 0.00779$ (0.779 percent), where the old signature and PIN fee schedules are taken from (2). Using the new fee schedule (1), the cutoff transaction value for M1 merchants is determined by solving

$$0.00779 \cdot \text{cutoff} = 0.21 + 0.0005 \cdot \text{cutoff}, \qquad \text{yielding} \quad \text{cutoff} = \$28.8, \tag{9}$$

which is displayed in Table 8 under merchant type M1.

Table 8 displays the 95-percent confidence intervals around the mean transaction values, where the means are displayed in Table 4. The bottom row in Table 8 indicates the "location" of the computed cutoff transaction value relative to the confidence interval. If the cutoff value is below the interval, merchants pay lower fees after the reform. If the cutoff value is above the interval,

Type	M1	M2	M3	M4	M6	M7	M9	M10	M11
Transactions (#)	144	100	75	43	65	60	12	12	10
Signature (%)	20.8	39.0	34.7	41.9	69.2	78.3	66.7	50.0	50.0
Cutoff ($)	28.8	23.3	24.4	22.6	17.7	16.5	18.1	20.9	20.9
95% interval ($)	41.4–59.0	23.2–29.9	33.1–86.0	22.0–63.3	12.8–40.8	6.8–11.4	7.7–25.1	25.8–62.1	25.3–61.2
Cutoff	Below	Inside	Below	Inside	Inside	Above	Inside	Below	Below

Source: Author's calculations.

Table 8: Confidence intervals around mean transaction values versus cutoff transaction values.

interchange fees are higher following the reform. If the cutoff is inside the confidence interval, then we cannot rule out higher or lower fees after the reform. Bearing in mind that these interchange fees refer to a weighted average of signature debit and PIN debit, the following results summarize this investigation.

Result 6. *With 95-percent confidence, the debit card interchange fee reform*

(a) lowered interchange fees for merchant types M1 (grocery, pharmacy), M3 (general merchandise stores and Websites), M10 (health, medical, personal care), and M11 (maintenance and repair),

(b) increased interchange fees for merchant type M7 (fast food, beverage),

(c) produced inconclusive results for merchant types M2 (gas station, convenience store), M4 (other retail), M6 (restaurants, bars), and M9 (recreation, entertainment, travel).

4. Analysis by Merchant Type, Using Unequal Pre-Reform Fees

The computations in Section 3 were based on a simplifying assumption that pre-reform interchange fees did not vary with the merchant type. That is, the calculations in Section 3 assumed that all merchants paid the same average interchange fees described in (2) prior to October 2011 when the new uniform fees became effective. In addition to simplicity, an important advantage of the calibrations performed in Section 3 over those performed in this section is that in the earlier calculations there was no need to match the merchant categories used by card networks to merchant categories used in the DCPC. This is an advantage because, as is demonstrated below, these merchant categories cannot be matched perfectly. In contrast, the advantage of using a merchant-specific fee structure is that the results concerning gains and losses to merchants can be associated with whether the merchant paid a base fee or a Tier 1 fee.[9]

This section introduces into the computations different interchange fees that vary by merchant type. An added complexity arises from the fact that, before the reform, interchange fees varied not

[9]Card networks may offer merchants lower fees grouped into tiers that are set according to merchants' aggregate dollar value of card activity. Tier 1 interchange fees are lower than base fees because they embed some kinds of volume or value discounts. See Mastercard's 2012 interchange fees as an example of how interchange fees may depend on a merchant's total transaction value, available at `http://www.mastercard.com/us/merchant/pdf/MasterCard_Interchange_Rates_and_Criteria.pdf`.

only by merchant type, but also by the network on which transactions were cleared.[10] To simplify this complexity, the computations in this section are based on weighted averages of interchange fees imposed by the major networks.

Not all merchant categories used in the DCPC can be matched with the merchant categories used by card networks for interchange fee classifications. Therefore, this section focuses on a smaller number of merchant categories than those analyzed in Section 3. Table 9 shows how the DCPC merchant categories and the networks' merchant classifications are matched for the computations made in this section.

Diary (DCPC)	*Debit Card Networks*
M1 (Grocery, pharmacy)	Supermarket
M2 (Gas station, convenience store)	Petroleum
M3 (General merchandise stores, Websites)	Retail
M4 (All other retail)	Retail
M7 (Fast food, beverage)	Quick-service restaurants (QSR)

Source: Table 3 and the list of sources described in Footnote 11.

Table 9: Matching the DCPC's and the debit card networks' merchant classifications.

Table 10 displays the interchange fees associated with signature transactions for the five merchant categories described in Table 9.[11] Tier 1 rates on some networks can be lower than base rates for some merchant types because they correspond to some types' volume or value discounts offered to large merchants. The entries under old fees replace the average values described in (2), which were used in the previous computations. The "new exempt" fees replace the right-hand term in (3), which represents the interchange fees charged on the 40 percent of the transactions that are

[10]Signature transactions are cleared via the Visa and MasterCard networks, which are the two major credit card networks in the United States. Visa holds a 75 percent market share, and MasterCard holds a 25 percent share. PIN debit card transactions in the United States are routed over 14 PIN debit networks. Interlink, Star, and Pulse are the top three PIN debit networks, holding 40, 30, and 11 percent of the PIN debit market share, respectively. The largest PIN network, Interlink, is operated by Visa. See Wang (2010) for more details.

[11]The data displayed in Tables 10 and 11 were complied from several sources: Wang (2010), Visa Inc. and MasterCard Worldwide Web sites, EFT Data Book 2008 and 2009 Editions, Vantage Card Services, Inc. `http://www.vantagecard.com/price/interchange05.html`, Nationwide Payment Solutions `http://www.nationwidepaymentsolutions.com/docs/PIN-based_Interchange_Rate_Fee_Schedule.pdf`, and Pacific Island Payment Solutions `http://pacificisland.publishpath.com/Default.aspx?shortcut=interchange-charts`.

		Base Rates		*Tier 1 Rates*	
Merchant	Network	Old (2011/9)	New Exempt (2011/10)	Old (2011/9)	New Exempt (2011/10)
M1	MC (25%)	$\min\{0.0105p + 0.15, 0.35\}$	$\min\{0.0105p + 0.15, 0.35\}$	$\min\{0.07p + 0.15, 0.35\}$	$\min\{0.07p + 0.15, 0.35\}$
M1	Visa (75%)	$\min\{0.0095p + 0.20, 0.35\}$	$\min\{0.0095p + 0.20, 0.35\}$	$\min\{0.0065p + 0.13, 0.35\}$	$\min\{0.0095p + 0.20, 0.35\}$
M2	MC (25%)	$\min\{0.007p + 0.17, 0.95\}$	$\min\{0.007p + 0.17, 0.95\}$	n/a	n/a
M2	Visa (75%)	$\min\{0.0075p + 0.17, 0.95\}$	$\min\{0.0075p + 0.17, 0.95\}$	n/a	n/a
M3, M4	MC (25%)	$0.0105p + 0.15$	$0.0105p + 0.15$	$0.007p + 0.15$	$0.007p + 0.15$
M3, M4	Visa (75%)	$0.0095p + 0.20$	$0.0095p + 0.20$	$0.0062p + 0.13$	$0.0095p + 0.20$
M7	MC (25%)	$0.0155p + 0.04$	$0.0155p + 0.04$	n/a	n/a
M7	Visa (75%)	$0.0155p + 0.04$	$0.016p + 0.04$	n/a	n/a

Source: See list in Footnote 11. *Note*: "Exempt" refers to card issuers that are not covered by the reform, as described in Section 2.4.

Table 10: Networks' merchant type-specific interchange fee schedules on a signature transaction value of $\$p$.

exempt from the new rule.

Table 11 displays the interchange fees set by the three largest PIN debit card networks corresponding to the five merchant categories described in Table 9.

Table 12 displays the average new and old interchange fees per signature transaction by merchant type as well as the differences between the two. The difference between Table 12 and Table 5 is that Table 12 uses the merchant-specific interchange fee schedule given in Table 10, whereas Table 5 uses the average fee paid by all merchant types defined in (2) and (3). Table 12 implies the following result:

Result 7. *The reform of debit card interchange fees may have increased the signature interchange fees paid by type M7 merchants (fast food, beverage) by 3 cents per transaction, and reduced interchange fees of all other sampled merchants.*

Comparing Result 7 with Result 3 demonstrates the robustness of the main conclusion of this paper, in which type M7 merchants pay 3 to 5 cents higher interchange fees on each signature transaction after the reform was implemented, whereas other sampled merchant types pay lower fees. That is, whether the computations are based on the average fees across all merchant types as in Result 3, or on merchant M7-specific interchange fees as in Result 7, both computations yield an increase in fees paid by M7 merchants, although using merchant-specific fees yields a 2 cents lower increase than using the average fee.

Next, Table 13 displays the average new and old interchange fees per PIN transaction by merchant type. Note that Table 13 is based on merchant type-specific PIN interchange fees, whereas Table 6 uses the same average PIN interchange fee for all merchants. Table 13 implies the following result:

Result 8. *The reform in debit card interchange fees has decreased interchange fees on PIN transactions charged according to base rates. However, the reform may have increased by 5 cents the per-transaction PIN interchange fees on transactions charged according to Tier 1 rates paid by merchants of type M1 (grocery), by 2 cents for fees paid by merchants of type M4 (other retail), and by 2 cents for fees paid by merchants of type M7 (fast food, beverage).*

		Base Rates		*Tier 1 Rates*	
Merchant	Network	Old (2011/9)	New Exempt (2011/10)	Old (2011/9)	New Exempt (2011/10)
M1	Interlink (40%)	$\min(0.008p + 0.15, 0.33\}$	$\min\{0.008p + 0.15, 0.33\}$	20	$\min\{0.008p + 0.15, 0.33\}$
M1	Star (30%)	0.275	0.275	0.185	0.185
M1	Pulse (11%)	0.26	0.26	0.15	0.15
M2	Interlink (40%)	$\min\{0.0075p + 0.17, 0.95\}$	$\min\{0.008p + 0.15, 0.95\}$	n/a	n/a
M2	Star (30%)	$0.008p + 0.13$	$0.008p + 0.13$	n/a	n/a
M2	Pulse (11%)	$\min\{0.007p + 0.13, 0.95\}$	$\min\{0.008p + 0.11, 0.95\}$	n/a	n/a
M3, M4	Interlink (40%)	$0.0095p + 0.20$	$0.008p + 0.15$	$\min\{0.005p + 0.10, 0.60\}$	$0.008p + 0.15$
M3, M4	Star (30%)	$0.008p + 0.185$	$0.008p + 0.185$	$\min\{0.0055p + 0.08, 0.55\}$	$\min\{0.0055p + 0.08, 0.55\}$
M3, M4	Pulse (11%)	$0.0085p + 0.13$	$0.0085p + 0.13$	$\min\{0.005p + 0.08, 0.45\}$	$\min\{0.0055p + 0.07, 0.45\}$
M7	Interlink (40%)	$0.0095p + 0.20$	$0.008p + 0.15$	$\min\{0.005p + 0.10, 0.60\}$	$0.008p + 0.15$
M7	Star (30%)	$0.0125p + 0.15$	$0.0125p + 0.15$	n/a	n/a
M7	Pulse (11%)	$0.0155p$	$0.0155p$	n/a	n/a

Source: See list in Footnote 11.

Table 11: Networks' merchant type specific interchange fee schedules on a PIN transaction value of $\$p$.

	Base Rates					*Tier 1 Rates*				
Type	M1	M2	M3	M4	M7	M1	M2	M3	M4	M7
nif_m^{Sig}	0.28	0.29	0.48	0.47	0.20	0.28	0.29	0.46	0.45	0.20
oif_m^{Sig}	0.35	0.38	0.83	0.82	0.17	0.35	0.38	0.56	0.55	0.17
Δ_m^{Sig}	-0.07	-0.09	-0.35	-0.34	$\boxed{0.03}$	-0.07	-0.09	-0.10	-0.10	$\boxed{0.03}$

Source: Author's calculations. *Note*: $\Delta_m^{\text{Sig}} > 0$ (< 0) indicates an increase (decrease) in per-transaction interchange fee.

Table 12: A comparison of per-transaction signature interchange fees after and before the reform ($), under unequal pre-reform merchant fees.

	Base Rates					*Tier 1 Rates*				
Type	M1	M2	M3	M4	M7	M1	M2	M3	M4	M7
nif_m^{PIN}	0.26	0.27	0.39	0.28	0.24	0.24	0.27	0.34	0.25	0.24
oif_m^{PIN}	0.30	0.34	0.68	0.42	0.30	0.19	0.34	0.38	0.23	0.22
Δ_m^{PIN}	-0.04	-0.07	-0.29	-0.14	-0.06	$\boxed{0.05}$	-0.07	-0.04	$\boxed{0.02}$	$\boxed{0.02}$

Source: Author's calculations. *Note*: $\Delta_m^{\text{PIN}} > 0$ (< 0) indicates an increase (decrease) in per-transaction interchange fee.

Table 13: A comparison of per-transaction PIN interchange fee after and before the reform ($), under unequal pre-reform merchant fees.

Comparing Result 8 with Result 4 reveals that the increase in interchange fees for some merchant types can be attributed to an increase in Tier 1 rates.

Finally, Table 14 combines Table 12 and Table 13, using the formula (8) to obtain the total net change in interchange fees on each merchant type. Thus,

	Base Rates					*Tier 1 Rates*				
Type	M1	M2	M3	M4	M7	M1	M2	M3	M4	M7
nif_m	0.26	0.27	0.42	0.37	0.20	0.25	0.28	0.38	0.33	0.21
oif_m	0.31	0.36	0.73	0.59	0.19	0.22	0.36	0.44	0.36	0.18
Δ_m	-0.04	-0.08	-0.31	-0.22	$\boxed{0.01}$	$\boxed{0.03}$	-0.08	-0.06	-0.03	$\boxed{0.03}$

Source: Author's calculations. *Note*: $\Delta_m > 0$ (< 0) indicates an increase (decrease) in per-transaction fee.

Table 14: A comparison of per-transaction (signature and PIN combined) interchange fees after and before the reform ($), under unequal pre-reform merchant fees.

Table 14 implies the following result:

Result 9. *The reform in debit card interchange fees may have increased the base interchange fees paid by type M7 merchants (fast food, beverage) by 1 cent per transaction and reduced base interchange fees of all other sampled merchants. In addition, the reform may have increased the per-transaction interchange fees on transactions charged according to Tier 1 rates by 3 cents for merchants of type M1 (grocery) and merchants of type M7 (fast food, beverage).*

5. Comparing the 2011 DCPC Data with the 2010 Data

So far, the conclusions of the paper were derived from the 2010 DCPC data. The advantage of the 2010 data over later diaries is that the transaction data reflect pre-reform payment patterns. This section reproduces all the calibration results of Section 4 using the 2011 DCPC data instead of the 2010 DCPC data. There are two potential benefits from this exercise. First, looking at the 2011 data is useful for validating (or invalidating) the suitability of the diary data to conclude how the reform may have changed the interchange fee burden on each merchant type. Second, observing changes in these burdens may hint that merchants may be trying to steer buyers to pay

with instruments that are less costly to the merchants.

Table 15 displays the average new and old interchange fees per signature transaction by merchant type as well as the differences between the two.

	Base Rates					*Tier 1 Rates*				
Type	M1	M2	M3	M4	M7	M1	M2	M3	M4	M7
nif_m^{Sig}	0.28	0.30	0.50	0.33	0.24	0.28	0.30	0.48	0.32	0.24
oif_m^{Sig}	0.35	0.41	0.89	0.49	0.26	0.35	0.41	0.60	0.33	0.26
Δ_m^{Sig}	-0.07	-0.11	-0.39	-0.16	-0.02	-0.07	-0.11	-0.12	-0.01	-0.02

Source: Author's calculations.

Table 15: A comparison of per-transaction signature interchange fees after and before the reform ($), under unequal pre-reform merchant fees using the 2011 DCPC data.

Comparing Table 15 (2011 data) with Table 12 (2010 data) reveals that the interchange fee reform has lowered the fees paid by type M7 merchants by 2 cents for a signature transaction, whereas according to the 2010 data the reform has increased this fee by 3 cents per signature transaction. One possible explanation for this difference would be that type M7 merchants may have been able to steer consumers away from signature debit to PIN debit and cash after October 2011, when the interchange fee reform became effective.

Next, Table 16 displays the average new and old interchange fees per PIN transaction by merchant type. Table 16 (2011 data) and Table 13 (2010 data) are very similar with respect to

	Base Rates					*Tier 1 Rates*				
Type	M1	M2	M3	M4	M7	M1	M2	M3	M4	M7
nif_m^{PIN}	0.26	0.27	0.32	0.32	0.22	0.24	0.27	0.28	0.28	0.22
oif_m^{PIN}	0.30	0.34	0.50	0.51	0.26	0.19	0.34	0.28	0.28	0.19
Δ_m^{PIN}	-0.04	-0.07	-0.18	-0.19	-0.04	$\boxed{0.05}$	-0.07	0.00	0.00	$\boxed{0.03}$

Source: Author's calculations.

Table 16: A comparison of per-transaction PIN interchange fee after and before the reform ($), under unequal pre-reform merchant fees using the 2011 DCPC data.

how the reform has affected merchants' burden of interchange fees. According to both tables,

base interchange fees on PIN transactions have fallen, whereas Tier 1 interchange fees on PIN transactions have increased for type M1 and M7 merchants (but not for M4 merchants).

Finally, Table 17 combines Table 15 and Table 16, using the formula (8) to obtain the total net change in interchange fees on each merchant type. Thus,

	Base Rates					*Tier 1 Rates*				
Type	M1	M2	M3	M4	M7	M1	M2	M3	M4	M7
nif_m	0.26	0.28	0.38	0.33	0.23	0.25	0.28	0.34	0.30	0.23
oif_m	0.31	0.37	0.63	0.50	0.26	0.23	0.37	0.37	0.31	0.24
Δ_m	-0.05	-0.09	-0.25	-0.17	-0.03	$\boxed{0.02}$	-0.09	-0.03	-0.01	-0.01

Source: Author's calculations.

Table 17: A comparison of per-transaction (signature and PIN combined) interchange fees after and before the reform ($), under unequal pre-reform merchant fees using the 2011 DCPC data.

Comparing Table 17 with Table 14 shows some differences with respect to type M7 merchants. According to the 2010 data, the average base interchange fee on debit has increased by 1 cent and the Tier 1 rate has increased by 3 cents per debit transaction for type M7 merchants. Using the 2011 data reveals declines in both fees. Again, this finding may hint at the possibility that type M7 merchants may have been able to steer some signature debit transactions into PIN debit and cash transactions. In fact, Table 18 in the next section shows that the percentage of signature debit (by volume) has fallen from 78.3 percent in the 2010 DCPC to 74.6 percent in the 2011 DCPC.

6. Possible Limitations of the Data

The mapping of the number of transactions and transaction values into merchant types and interchange fee structures constitutes the basis for the results obtained in this paper. Therefore, a natural question to ask is how representative are the diary data for the U.S. market as a whole, and for debit card transactions in particular. For example, Table 8 shows a relatively narrow confidence interval of $4.60 around the mean transaction value of type M7 merchants for whom Results 3, 4, and 5 show that the reform may have increased per-transaction interchange fees. However, all other transaction types in Table 8 exhibit larger confidence intervals, and others that are not listed

have very low transaction records. Note also that all results are conditional on the assumption that there have not been significant changes in transaction patterns since late 2010, when the survey was taken. However, Section 5 shows that some conclusions change using the 2011 DCPC data. This discussion highlights the need for more observations, which are hard to obtain because of the need to work with individual transaction records.

In principle, each debit card transaction involves three major parties: a buyer, a merchant, and a bank. Two other involved parties are processors and card networks. Ideally, getting transaction data (volume, dollar value, payment method, and merchant type) from "all" merchants could produce a true picture of the amount of interchange fees paid on debit cards. However, these data are not available to me. Therefore, resorting to consumer data (instead of merchant data), such as the Boston Fed's pilot of the Diary of Consumer Payment Choice (DCPC), is a second-best solution.

The data source, described in Section 3.1, has 2,040 purchases recorded in 2010 by the respondents; of these, 543 transactions were paid for with debit cards (234 signature and 309 PIN). In 2011 the DCPC recorded 2,396 transactions; of these, 560 were paid for with debit cards (248 signature and 312 PIN).

I now discuss some differences and similarities between the DCPC and some other data in order to gain a perspective on the degree to which the DCPC data may differ from other datasets. One difference worth studying is between the BOG (2011) cost study and the DCPC with respect to the ratios of of signature debit to total debit, shown in Table 18.

Survey data:	BOG (2011)	2010 DCPC		2011 DCPC	
	All	All	M7 only	All	M7 only
Signature volume (%)	61.8	43.1	78.3	44.3	74.6
Signature value (%)	60.1	40.0	69.1	48.8	82.2

Source: BOG (2011) and Federal Reserve Bank of Boston Diary of Consumer Payment Choice in 2010 and 2011.

Table 18: Comparing the fraction of signature debit out of total signature and PIN debit transactions between the DCPC and BOG (2011).

Table 18 shows that according to BOG (2011) there were more signature than PIN debit transactions, as measured in both volume and value. In contrast, the DCPC reports on more PIN than signature transactions, also measured in volume or value. This difference may be attributed to differences in data sources. BOG (2011) collected the data from financial institutions, card networks, and large merchants, whereas the DCPC collected the data directly from consumers.

Whether the above differences in the composition of debit transactions stem from the different types of survey respondents or whether they stem from the small samples, a natural question that follows is whether these differences invalidate the characterization of merchant types that may be paying higher interchange fees after the reform. Results 3, 4, and 5 state that the reform in debit card interchange fees has increased the interchange fees paid by type M7 merchants (fast food, beverage). Table 18 displays the fraction of signature transactions for M7 merchants and shows much higher relative use of signature debit than what is reported in BOG (2011) and the DCPC for other merchant types. Since the reform has increased interchange fees more on PIN transactions than on signature transactions (comparing Result 3 with Result 4), there is no good reason to suspect that the conclusions drawn about type M7 constitute an overestimation. In fact, the conclusions might actually underestimate the additional burden on type M7 merchants if their fraction of signature transactions was lower than 78.3 percent prior to the reform.

7. Conclusion

This paper presents a simple method for measuring the impact of interchange fee regulation on the different types of merchants, according to transaction values and merchant categories. Changes in fee structures have effects similar to changes in tax schedules; they both increase the burden on some agents and reduce the burden on others. Therefore, the results do not tell us very much about the relative efficiency of the pre- and post-reform structure of debit card interchange fees. Additional research is needed to investigate how different merchants adjust to the new interchange fees. More precisely, the shift from a mostly proportional interchange fee to an almost fixed per-transaction fee generates incentives for merchants to "pool" transactions together to avoid fixed fees. For example, merchants such as Starbucks reduce the number of swipes by having customers

pre-fund a number of transactions on their store cards.[12]

The computations in this paper are based on the assumption that all merchants currently pay the maximum permissible interchange fee (21 cents per transaction plus 0.0005 of the transaction value). However, it is possible that some large retailers may be able to negotiate reduced rates, especially for signature transactions that are routed via the large card networks. Does this mean that the computations overestimate the new fees merchants actually pay? Most likely this is not the case for the following reasons: First, the interchange fee is only one component of the "swipe" fees merchants must pay. Hence, the fees computed in this paper may underestimate the burden of the new fees. Second, it has been reported in the press that card networks may increase the fees they levy on card acquirers to offset the reduction in interchange fees that are paid to card issuers.[13] Acquirers may then pass these fees on to the merchants.

[12]See `www.starbucks.com/shop/card/starbucks-card`. Third-party payment service providers, such as Level Up (`www.thelevelup.com`) may also gain from consolidating transactions for funding purposes.

[13]See an article by Kate Fitzgerald in PaymentsSource, titled "Durbin-Required Network-Routing Pricing Details Emerge," February 27, 2012, `http://www.paymentssource.com/news/Durbin-Required-Network-Routing-Pricing-Details-Emerge-3009759-1.html`.

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