Steering Consumer Payment Choice

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Motivation for this research

Observations

a. Merchants pay higher fees on credit card transactions compared with debit card and cash transactions.
b. Recent legislation and court settlements in the United States allow merchants to steer customers to pay with means of payments that are less costly to them.
c. Merchants are now allowed to give price discounts to buyers who pay with debit cards and cash (allowed before).
d. Credit card surcharges are still prohibited in the United States.

Research questions

1. Why steering via price discounts is not widely observed among merchants?
2. Can merchants enhance their profit by providing price discounts to consumers who pay debit and cash?

Methodology and main results

Methodology

a. Use data from Boston Fed's 2010 Diary of Consumer Payment Choice to calibrate the maximum price discounts that merchants can profitably give to debit card and cash payers in order to steer buyers away from credit cards.
b. Construct an analytical model of buyers who have preferences for paying credit, debit, and cash, and re-calibrate the profitable debit and cash price discounts.

Results

1. Merchants cannot enhance their profits by giving price discounts to buyers who pay debit card or cash.
2. Conclusion: Credit card surcharges may be the only remaining profitable action for steering purposes (Koboldt et al. 2011, for the U.K.).

Are merchants allowed to steer? Recent regulatory changes

U.S. DOJ settlement with Visa and MC (July 2011)

Requires the two networks to allow merchants to influence their customers' choice of payment method by offering discounts, incentives, and information to consumers to encourage the use of payment methods that are less costly to the merchants.

Dodd-Frank Wall Street Reform Act: The Durbin Amendment

"A payment card network shall not ...inhibit the ability of any person to provide a discount or in-kind incentive for payment by the use of cash, checks, debit cards, or credit cards."

Remark: Card surcharges are still prohibited !

Behavioral aspects of steering payment choice

Confusing customers: Customers don't know credit cards are more costly to merchants than debit cards and cash.

Distrust: Buyers may suspect that the merchant attempts to extract higher surplus.

Delay: Discussions between the merchants and buyers at the point of sale about different prices for different payment instruments may increase the time buyers spend at checkout counters.

Lack of information: Merchants currently lack comprehensible and complete information on the full and exact merchant fees for their customers' specific credit cards, Schuh et al. (*JCLE*, 2012)

Is steering profitable? Price discounts reduce revenue from buyers who anyway pay debit and cash.

Some “wrong” calculations

Consider the following simple example:

- A merchant’s average transaction value is \$30.
- 2% credit card merchant fee equals $0.02 \times \$30 = 60¢$.
- 25¢ fixed per-transaction merchant fee on a debit card transaction.

Conjecture 1

Because $60¢ > 25¢$, steering average customers to pay with debit cards instead of paying credit cards is always profitable.

Problem: Credit card users won’t switch to paying debit unless given some monetary incentives !

More “wrong” calculations

- The merchant provides 1% price discount to buyers who pay with debit cards.
- Assume that all credit card users switch to paying debit.
- Merchant “saves” 2% credit card merchant fee equals $0.02 \times \$30 = 60¢$.
- Merchant pays 25¢ for each buyer who switches from credit to debit, and
- Merchant “loses” 1% which equals $0.01 \times \$30 = 30¢$.

Conjecture 2

Because $60¢ > 25¢ + 30¢$, giving the average buyer a one percent discount on paying with debit cards is always profitable.

Problem: The computed “loss” $25¢ + 30¢$ does not take into account the revenue loss from existing debit card users.

Some "correct" calculations

- Merchant is visited by $n^c = 600$ customers who pay with credit cards
- and, $n^d = 200$ buyers who pay with debit cards..

The gain to this merchant from eliminating all credit card transactions is:
Gain $= 600 \times 0.02 \times \$30 = \$360$,

The merchant's loss from providing one percent price reduction on debit card transaction is:

$$\text{Loss} = \underbrace{600 \times \$0.25}_{\text{debit merchant fees}} + \underbrace{(600 + 200)0.01 \times \$30}_{\text{1\% revenue reduction}} = \$390 > \$360 = \text{Gain}.$$

In general (ϕ^d = fixed fee on debit trans., μ^c = proportional fee on credit):

$$\text{Gain (steering)} \geq \text{Loss} \quad \text{if} \quad \left(\frac{n^d}{n^c}\right) \leq \left(\frac{N^d}{N^c}\right) \stackrel{\text{def}}{=} 100\mu^c - \frac{10\phi^d}{3} - 1.$$

Unequal transaction values

Purpose of this demonstration: To show that

increasing mean-preserving spread of transaction values, at a given merchant, makes steering more effective and potentially more profitable.

Assumptions

- 2 buyers: Buyer 1 spends $p_1 = \$50$ per transaction whereas buyer 2 spends $p_2 = \$10$ per transaction.
- Hence, average transaction value remains the same: $p_1 + p_2 = \$30$.
- In the absence of debit card price discounts, all buyers prefer to pay with a credit card over a debit card.
- Moreover, each consumer attaches a value equivalent to 40¢ to paying credit relative to a debit card.

Unequal transaction values

Homogeneous buyers: Equal transaction values ($p_1 = p_2 = \$30$)

In the absence of steering (0% debit card price discount), buyers' loss is:

$$L = \begin{cases} L^c = \$30.00 - \$0.40 = \$29.60 & \text{if pays credit} \\ L^d = \$30.00 & \text{if pays debit,} \end{cases} \implies \text{Pays credit}$$

Steering by giving 1% debit card price discount, buyers' loss becomes:

$$\hat{L} = \begin{cases} \hat{L}^c = \$30.00 - \$0.40 = \$29.60 & \text{if pays credit} \\ \hat{L}^d = (1 - 0.01)\$30.00 = \$29.70 & \text{if pays debit.} \end{cases} \implies \text{Pays credit}$$

Conclusion If $p_1 = p_2 = \$30$, merchants will not be able to steer buyers by giving a 1% debit price discount.

Unequal transaction values: $p_1 = \$50$ and $p_2 = \$10$

Merchant tries to steer from credit to debit via a 1% price discount:

$$\hat{L}_1 = \begin{cases} \hat{L}_1^c = \$50.00 - \$0.40 = \$49.60 & \text{pays credit} \\ \hat{L}_1^d = (1 - 0.01)\$50.00 = \$29.50 & \text{pays debit,} \end{cases} \Longrightarrow \text{Pays debit}$$

$$\hat{L}_2 = \begin{cases} \hat{L}_2^c = \$10.00 - \$0.40 = \$9.60 & \text{pays credit} \\ \hat{L}_2^d = (1 - 0.01)\$10.00 = \$9.90 & \text{pays debit.} \end{cases} \Longrightarrow \text{Pays credit}$$

Is steering via a 1% debit price discount profitable for this merchant?

$$\Delta\pi = 0.02 \times \$50 - \$0.25 = \$1.75 > 0.$$

Conclusion: Unequal transaction values increases the effectiveness and potential profit increase from steering.
Remark: Before steering, all buyers used credit (which eliminated the loss from debit-card price reduction).

Boston Fed's 2010 diary of consumer payment choice

For each purchase, 353 respondents recorded (over 3 days) the type of merchant, payment method they used, and the location of the transaction (in person, Internet, mail delivery, phone, and other).

Goods		*Services*	
M1:	Grocery, pharmacy (364)	M6:	Restaurants, bars (220)
M2:	Gas station, convenience store (271)	M7:	Fast food, beverage (250)
M3:	General merchandise store, Websites (198)	M8:	Transportation, tolls, parking (54)
M4:	All other retail (115)	M9:	Recreation, entertain., travel (63)
		M10:	Health, medical, personal care (45)
Other		M11:	Maintenance, repairs (28)
M5:	Payments to people (56)	M12:	Education, day care (9)
	(M5 is excluded from this research)	M13:	Nonprofit, charity, religious (28)
	(M5 not really a merchant)	M14:	Other services (67)

Remark: See paper for detailed statistics on payment methods used as reported on the diary.

Maximum debit card price discount rate ($0 \le d_m^d < 1$)

Without steering, revenue (net of merchant fees) by type m merchants:

$$R_m = \underbrace{n_m^c \left[(1-\mu_m^c)p_m^c - \phi_m^c\right]}_{\text{from credit card transactions}} + \underbrace{n_m^d \left[(1-\mu_m^d)p_m^d - \phi_m^d\right]}_{\text{from debit card transactions}}.$$

Steering to pay debit cards using a debit price discount rate d_m^d:

$$R_m^s = \underbrace{n_m^c \left[(1-\mu_m^d)(1-d_m)p_m^c - \phi_m^d\right]}_{\text{from buyers steered from credit to debit}} + \underbrace{n_m^d \left[(1-\mu_m^d)(1-d_m)p_m^d - \phi_m^d\right]}_{\text{from buyers who always pay debit}}.$$

Steering via d_m^d debit card discount is revenue enhancing $R_m^s \ge R_m$ for merchant m if

$$d_m \le \hat{d}_m^d \stackrel{\text{def}}{=} \frac{n_m^c \left[p_m^c(\mu^c - \mu^d) + \phi^c - \phi^d\right]}{(1-\mu^d)(n_m^c p_m^c + n_m^d p_m^d)}.$$

Using the diary data, we are able to calibrate $\hat{d}_m^d$.

Merchant Fees				Merchant Type (m)					
ϕ^c	μ^c	ϕ^d	μ^d	M1	M2	M3	M4	M6	M7
\$0.00	0.02	\$0.25	0.0005	0.005	0.004	0.007	0.006	0.003	−0.003
\$0.00	0.03	\$0.25	0.0005	0.008	0.007	0.012	0.010	0.007	0.001
\$0.00	0.04	\$0.25	0.0005	0.012	0.011	0.017	0.014	0.010	0.004
\$0.10	0.02	\$0.25	0.0005	0.006	0.005	0.008	0.007	0.005	0.001
\$0.10	0.03	\$0.25	0.0005	0.009	0.009	0.013	0.011	0.008	0.005
\$0.10	0.04	\$0.25	0.0005	0.013	0.012	0.018	0.015	0.012	0.008
\$0.25	0.02	\$0.25	0.0005	0.007	0.007	0.009	0.008	0.007	0.007
\$0.25	0.03	\$0.25	0.0005	0.010	0.010	0.014	0.012	0.010	0.010
\$0.25	0.04	\$0.25	0.0005	0.014	0.014	0.018	0.016	0.014	0.014
$\frac{\text{debit}}{\text{credit + debit}}$		(% of volume)		65.45	63.69	53.19	58.90	65.66	64.52
		(% of value)		70.25	59.04	45.52	31.16	63.34	61.15

Maximum cash price discount rate ($0 \le d_m^h < 1$)

Without steering, revenue (net of merchant fees) by type m merchants:

$$R_m = \underbrace{n_m^c \left[(1-\mu_m^c)p_m^c - \phi_m^c\right]}_{\text{from credit card transactions}} + \underbrace{n_m^d \left[(1-\mu_m^d)p_m^d - \phi_m^d\right]}_{\text{from debit card transactions}} + \underbrace{n_m^h \left[p_m^h - \phi_m^h\right]}_{\text{from cash transactions}} .$$

Steering to pay cash using cash price discount rate d_m^h: $R_m^s =$

$$= \underbrace{n_m^c \left[(1-d_m)p_m^c - \phi_m^h\right]}_{\text{steered from credit to cash}} + \underbrace{n_m^d \left[(1-d_m)p_m^d - \phi_m^h\right]}_{\text{steered from debit to cash}} + \underbrace{n_m^h \left[(1-d_m)p_m^h - \phi_m^h\right]}_{\text{buyers who always pay cash}}$$

Steering via d_m^h cash discount is revenue enhancing $R_m^s \ge R_m$ for merchant m if

$$d_m \le \hat{d}_m^h \stackrel{\text{def}}{=} \frac{n_m^c \left(p_m^c \mu^c + \phi^c - \phi^h\right) + n_m^d \left(p_m^d \mu^d + \phi^d - \phi^h\right)}{n_m^c p_m^c + n_m^d p_m^d + n_m^h p_m^h}.$$

Using the diary data, we are able to calibrate $\hat{d}_m^h$.

Merchant Fees			Merchant Type (m)					
ϕ^c	μ^c	ϕ^h	M1	M2	M3	M4	M6	M7
\$0.00	0.02	\$0.05	0.008	0.009	0.009	0.009	0.007	0.010
\$0.00	0.04	\$0.05	0.014	0.0014	0.018	0.016	0.011	0.013
\$0.10	0.02	\$0.05	0.009	0.010	0.010	0.010	0.008	0.011
\$0.10	0.04	\$0.05	0.014	0.015	0.018	0.017	0.012	0.015
\$0.25	0.02	\$0.05	0.009	0.011	0.011	0.011	0.009	0.014
\$0.25	0.04	\$0.05	0.015	0.016	0.019	0.018	0.013	0.018
\$0.00	0.02	\$0.10	0.007	0.007	0.008	0.008	0.006	0.007
\$0.00	0.04	\$0.10	0.013	0.013	0.017	0.015	0.010	0.010
\$0.10	0.02	\$0.10	0.010	0.010	0.012	0.012	0.008	0.009
\$0.10	0.04	\$0.10	0.014	0.013	0.017	0.016	0.011	0.012
\$0.25	0.02	\$0.10	0.009	0.010	0.010	0.010	0.008	0.012
\$0.25	0.04	\$0.10	0.014	0.015	0.018	0.017	0.012	0.015
$\frac{\text{cash}}{\text{credit} + \text{debit} + \text{cash}}$		(% of volume)	39.56	42.07	28.79	36.52	55.00	62.80
		(% of value)	16.86	25.41	12.30	8.53	37.60	49.55

Buyers' preferences over payment methods

- Continuum of consumers, indexed by $i \in [0, n_m]$.
- ρ^c, ρ^d credit and debit card reward rates (e.g., $\rho^c = 0.01 = 1\%$ cash-back).
- Each consumer buys one good from each merchant m, so $U_i = \sum_{m \in M} u_{im}$, where

$$u_{im} = \begin{cases} v_m - p_m(1-\rho^c) + \beta_m^c + \varepsilon_i^c & \text{if pays with a credit card} \\ v_m - p_m(1-\rho^d)(1-d_m^d) + \beta_m^d + \varepsilon_i^d & \text{if pays with a debit card} \\ v_m - p_m(1-d_m^h) + \varepsilon_i^h & \text{if pays with cash.} \end{cases}$$

- β_m^c and β_m^d measure the average benefit of paying credit and debit over paying cash at type m merchant.
- Individual i's specific additional benefits ε_i^c, ε_i^d, and ε_i^h from using credit, debit, and cash, respectively (i.i.d. type I extreme value randomly distributed) .

Buyers' choice of payment method

Consumer i will pay with credit card at merchant m if

$$
\begin{aligned}
v_m - p_m(1-\rho^c) + \beta_m^c + \varepsilon_i^c &\geq v_m - p_m(1-\rho^d)(1-d_m^d) + \beta_m^d + \varepsilon_i^d \\
v_m - p_m(1-\rho^c) + \beta_m^c + \varepsilon_i^c &\geq v_m - p_m(1-d_m^h) + \varepsilon_i^h.
\end{aligned}
$$

Which can be solved for the shares of credit, debit, and cash transactions:

$$
\begin{aligned}
\frac{n_m^c}{n_m} &= \frac{\exp\{-p_m(1-\rho^c)+\beta_m^c\}}{\exp\{-p_m(1-\rho^c)+\beta_m^c\}+\exp\{-p_m(1-\rho^d)(1-d_m^d)+\beta_m^d\}+\exp\{-p_m(1-d_m^h)\}} \\
\frac{n_m^d}{n_m} &= \frac{\exp\{-p_m(1-\rho^d)(1-d_m^d)+\beta_m^d\}}{\exp\{-p_m(1-\rho^c)+\beta_m^c\}+\exp\{-p_m(1-\rho^d)(1-d_m^d)+\beta_m^d\}+\exp\{-p_m(1-d_m^h)\}} \\
\frac{n_m^h}{n_m} &= \frac{\exp\{-p_m(1-d_m^c)\}}{\exp\{-p_m(1-\rho^c)+\beta_m^c\}+\exp\{-p_m(1-\rho^d)(1-d_m^d)+\beta_m^d\}+\exp\{-p_m(1-d_m^h)\}}.
\end{aligned}
$$

Using the diary data, we calibrate the payment preference parameters: β_m^c, β_m^d, and β_m^h .

Merchants' choice of debit and cash price discount rates

Type m merchants choose d_m^d and d_m^h to solve $\max\limits_{d_m^d, d_m^h \in [0,1]} \pi_m =$

$$p_m(1-\mu^c)n_m^c + p_m(1-d_m^d)(1-\mu^d)n_m^d + p_m(1-d_m^h)n_m^h \\ - \phi^c n_m^c - \phi^d n_m^d - \phi^h n_m^h,$$

subject to buyers' payment choice constraints.

Calibration of the model

Merchant type	M1	M2	M3	M4	M6	M7
Avg. transaction	\$46.77	\$28.65	\$69.55	\$80.66	\$27.77	\$9.64
Credit card share	20.88%	21.03%	33.33%	26.09%	15.46%	13.20%
Debit card share	39.56%	36.90%	37.88%	37.39%	29.55%	24.00%
Cash share	39.56%	42.07%	28.79%	36.52%	55.00%	62.80%
β_m^c (calibrated)	-0.8669	-0.8423	-0.2318	-0.7115	-1.4036	-1.6074
β_m^d (calibrated)	0.0000	-0.1310	0.2744	0.0235	-0.6214	-0.9619
Debit discount	0	0	0	0	0	0
Cash discount	0	0	0	0	0	0

Remark: Negative values, $\beta_m^c < 0$, implies that lower preference for paying credit in the absence of rewards. However, given the shocks, ϵ_i^c, some buyers will always pay credit.

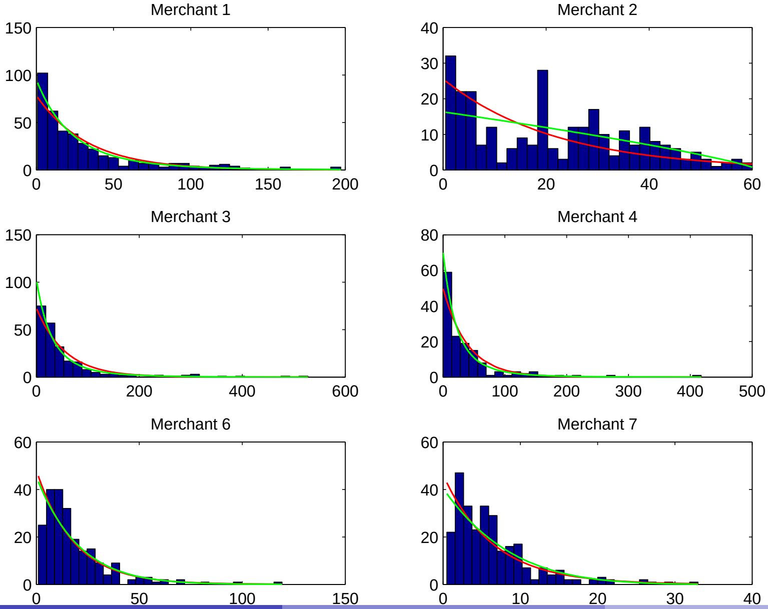
Fitting distributions: Estimation

We fit actual transaction values conducted with each type m merchants to 2 distribution functions:

$$f(p) = \frac{1}{\lambda}\exp(-\frac{p}{\lambda}) \quad \text{and} \quad f(p) = \frac{1}{\sigma}\left[1 + k\frac{p}{\sigma}\right]^{-1-\frac{1}{k}}.$$

	M1	M2	M3	M4	M6	M7
Exponential						
λ_m	31.6	21.7	47.6	32.8	17.6	6.8
Gen. Pareto						
k_m	0.2339	-0.5571	0.2621	0.2810	-0.0758	-0.1692
σ_m	24.5526	34.2413	34.9774	23.4523	18.8600	7.9072

Fitting distributions: Graphs



Fitting distributions: Calibrations and conclusion

Merchant	M1	M2	M3	M4	M6	M7
β_m^c (calibrated)	-0.8609	-0.8775	-0.4846	-0.7335	-1.4705	-1.6221
β_m^d (calibrated)	0.0000	-0.1615	0.1765	0.0760	-0.6444	-1.0004
Exponential dist.						
Debit discount	0	0	0	0	0	0
Cash discount	0	0	0	0	0	0
Generalized Pareto						
Debit discount	0	0	0	0	0	0
Cash discount	0	0	0.003	0	0	0

Conclusion: Steering via debit card or cash price discounts is not profitable for merchants. Therefore, surcharging buyers for credit cards remains the only profitable steering option (see U.K. case).

Gas stations: Steering observations vs. our calibrations

The problem

Our results did not find gas stations (M2) to be very different from other merchant types regarding unprofitable debit and cash price discounts.

Possible explanations

(a) It is possible that the DCPC data already reflects maximum-profitable steering activities towards debit and cash at various gas stations.

(b) Daily fluctuations in gasoline prices makes it harder for buyers to distinguish between price discounts and credit card surcharges.

(c) Gasoline is a perfectly homogeneous product. Price discounts may result from competition on cash sensitive consumers near universities and college towns (although, unprofitable!)

(d) Graphs show that transaction values at gas stations exhibit very different patterns than those at other merchant types, and that none of the two distribution function that we use fit these patterns.