How Many Cards Do You Use?

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Abstract:
This paper investigates how buyers allocate their spending among debit, credit, and prepaid cards. Using the 2012 Diary of Consumer Payment Choice, I show that consumers tend to concentrate the majority of their transactions and a large value of their transactions on a single type of card. The paper also investigates whether buyers concentrate their spending on one of the card networks, a behavior known as "single-homing."

Keywords: payment card use, choice of payment cards, multi-homing, single-homing

JEL Classifications: D14

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This version: December 31, 2013

CONSUMER PAYMENTS
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1 Introduction

1.1 Overview

Debit, credit, and prepaid cards are payment instruments that share the following characteristics: (a) they are plastic cards with a magnetic stripe (or an EMV chip); (b) they may bear a familiar logo of one card network brand such as Visa, MasterCard, Discover, or American Express; (c) most cards are issued by financial institutions (banks) with or without a merchant logo; and (d) cards issued with a network logo are accepted worldwide. This paper uses transaction-level data from the 2012 Diary of Consumer Payment Choice to investigate how individual consumers (not businesses) allocate their transaction volume and transaction value among the three types of cards. The results show that consumers tend to concentrate the majority of their transactions and a large value of their transactions on a single type of card.

The literature on payment cards and telecommunication has developed terminology to describe this consumer behavior. The commonly used terms, single-homing and multi-homing, will also be used in this paper, as follows:

- *single-homing on a card type*: Refers to buyers who concentrate all their transactions on one type of card (debit, credit, or prepaid).

- *single-homing on a card network*: Refers to buyers who concentrate all their transactions on cards that belong to the same network brand (Visa, MasterCard, Discover, or American Express).

This paper investigates homing behavior in terms of card *use* (how many times each card type is used in a given period), which should be distinguished from card *adoption* (the types of card a consumer has in his possession regardless of use). The decision to use a card type and to adopt a card type are related, so for this reason, Section 6 examines the connection between use and adoption.

As context for the analysis, Table 1 provides a rough overview of consumers' tendency to home on a single card type, based on survey transaction data described in Section 2. This table shows that 45.2 percent of the respondents who made at least one purchase with a payment card (of any

type) used only debit cards, and 29.3 percent used only credit cards.

1.2 Why homing matters?

The main contribution of this article is the development of a method of measuring the degree of homing on a particular card type (debit, credit, or prepaid) in addition to homing on a particular card network (Visa, MasterCard, American Express, or Discover). This investigation allows us to gain some insights on consumers' payment decision process, which is not directly observable by the researcher.

The decision to home on a single card type may be related to consumers' varied preferences regarding the functions and attributes associated with the different card types. A debit card offers fast clearing and settlement of each transaction and is tied to a particular bank account. The buyer must have sufficient funds to cover for the transaction and other authorizations that may not materialize if the transaction is not finalized.

In contrast to debit cards, credit cards can be obtained from other financial institutions even if the card holder does not maintain a checking account with the card-issuing bank. Credit cards provide the consumer with income smoothing in the sense that the settlement is generally postponed to a particular date of the month when the consumer wants to pay (for example, the day of the month when the consumer receives his salary). Credit card transactions can also be extended as debt on which consumers pay interest and penalties for late payment. Credit cards may also offer rewards to their users in the form of cash back and airline mileage. Although this paper focuses on the consumer side, merchants pay higher fees for payments made with credit cards than for payments made with debit cards, a fact that not all consumers know.

Prepaid cards differ from debit and credit cards because they are prefunded. That is, consumers must buy them and pay in full before using them. In many cases, the buyer has a time limit for using the card to avoid penalties or losing the amount loaded onto the card. Some prepaid cards can be loaded with additional funds.

What can we learn about consumer behavior from observing their homing tendency? One possible conclusion would be that consumers prefer to organize their card payment behavior around a single set of attributes that are associated with a particular card type. Policymakers and regulators

could learn from this because even if the aggregate data show that the three types of cards are substitutes, this paper shows that the degree of substitution at the individual level is low, because an individual consumer tends to single-home on one card type with the consumer's most preferred set of attributes.[1]

1.3 Literature review

In the economics literature, Hyytinen and Takalo (2004) analyze single-homing behavior with respect to all payment media (which include cash and phone in addition to all payment cards) among young people in Finland. They find that 53 percent of the surveyed population used more than one payment medium with a mean of 1.6 payment instruments. In contrast, this paper restricts the analysis to card transactions and therefore shows a much higher percentage of consumers who home on a single card type. Snyder and Zinman (2008) use data from the Survey of Consumer Finances (SCF) to investigate multi-homing. However, their results cannot be compared with ours because the SCF is based on aggregate household information and not individuals.

Rysman (2007) provides an empirical analysis of single- and multi-homing among card networks. His investigation uses credit card data only, which means that the analysis of homing on card types conducted in this paper cannot be compared with his results. Therefore, considering credit card transactions only, the results in this paper are consistent with Table VII in Rysman (2007), which shows that, in 85.4 percent of the cases, a consumer who uses the Visa network will use Visa again in the following quarter, and somewhat lower percentages for MasterCard (78.4 percent), American Express (73.1 percent), and Discover (77 percent). The 2012 diary data generated similar numbers to Rysman (2007): Visa (88.5 percent versus 85.4 percent), MasterCard (87.8 percent versus 78.4 percent), American Express (86.5 percent versus 73.1 percent), and Discover 89.3 percent versus 77 percent). The higher numbers of the 2012 DCPC data could stem from the fact that Rysman's data are dated back to 1994–2001.

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[1]For papers analyzing consumers' choice of payment instruments based on attributes and relative costs, see, Santomero and Seater (1996), Shy and Tarkka (2002), Borzekowski, Kiser, and Ahmed (2008), Klee (2008), Zinman (2009), Ching and Hayashi (2010), Koulayev et al. (2012), and their references.

Cohen and Rysman (2013) investigate the incidence of single-homing in three types of payment instruments: cash, checks, and cards. In contrast, this paper focuses on single-homing among card types (credit, debit, and prepaid). The second difference is that this paper focuses on individual consumers' homing behavior, whereas Cohen and Rysman (2013) investigate homing behavior at the household level. For this reason, Cohen and Rysman (2013, p. 11) find that households rarely use a single payment instrument for 100 percent of their shopping trips, whereas this paper identifies a significant fraction of individual consumers who place 100 percent of their transactions on one type of card (see Table 2).

1.4 Organization

The paper is organized as follows. Section 2 briefly describes the data sources. Sections 3 and 4 analyze how buyers allocate their transactions volume and value among debit, credit, and prepaid cards. Section 5 analyzes how consumers allocate their spending among the major card networks. Section 6 investigates how and whether card adoption influences transaction allocations among the different payment cards. Section 7 presents probit regression analyses to examine whether single-homing on a card type can be related to demographic variables. Section 8 concludes. Appendices A and B provide more formal definitions of buyers' primary card.

2 Data

The data used in this analysis are taken from the Boston Fed's Diary of Consumer Payment Choice (DCPC), taken in October 2012. The DCPC collects data on the dollar value, payment instrument used, and type of expense (consumer expenditure category) of each purchase and bill payment, to complement the information in the Survey of Consumer Payment Choice (Foster et al. 2011). In the 2012 diary, there were 2,468 respondents who recorded their transactions over a three-day period per respondent. Since respondents were spread over the entire month of October 2012, this sampling methodology should provide reasonable probability estimates of all consumers. In addition to the transactions' dollar amount, respondents were asked to specify the exact card type (debit, credit, or prepaid), and the card network's brand name (Visa, MasterCard, Discover, or

American Express). The diary recorded 14,772 transactions (purchases and bill payments) from which we deleted 73 transactions with the highest 0.5 percent dollar value, thereby leaving 14,699 transactions to work with. Of the 73 deleted transactions, only 13 were made with a card, which means that trimming the data had little or no effect on the results.

In the 2012 diary there were 1,813 respondents who made at least one transaction with a plastic payment card. These respondents made 3,599 debit card transactions, 2,651 credit card transactions, and 289 prepaid transactions. With the exception of Section 7 (demographic regressions), all computations and graphs are based on weighted data to match the U.S. population. The diary provides all the necessary data to analyze single-homing with respect to card type and card network.

In addition, of the 1,813 diary respondents who made at least one card transaction, 1,690 also took the Boston Fed's 2012 Survey of Consumer Payment Choice (SCPC), which is a 30-minute survey asking respondents to list all the payment instruments they have in their possession, among other things. In addition, the SCPC contains detailed demographic information on each respondent. Using a respondent's unique key number, we were able to match the diary answers with the SCPC answers for each respondent separately. Section 6 uses the card adoption profiles from the SCPC, and Section 7 uses demographic information from the SCPC, to regress the probability of single-homing on demographics.

3 Spending Allocation Among Debit, Credit, and Prepaid Cards, When Primary Card Is Defined by Transaction Volume

This section uses the transactions data described in Section 2 to compute buyers' allocation of spending among debit, credit, and prepaid cards. This analysis is centered around a precise definition of a *primary* card type for each respondent. The following definition is provided here for the general reader. More technically oriented readers are referred to Appendix A for the mathematical definitions. The following terminology will be used:[2]

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[2]There are three separate definitions for debit, credit, and prepaid because of ordering priorities in the case of ties. Because most transactions use debit, debit becomes primary when it ties with credit and prepaid transactions. The second priority is given to credit cards.

DEFINITION 1. *(a) We say that debit is a consumer's **primary card type by transaction volume** if the number of transactions this consumer places on debit cards is greater than or equal to the number of transactions the consumer places on any other type of card (either credit or prepaid).*

(b) A credit card is primary by volume if the consumer places a strictly higher number of transactions on credit cards than on debit, and a higher or equal number of transactions as on prepaid.

(c) Prepaid cards are primary if the consumer places a strictly higher number of transactions on prepaid than on either debit or credit cards.

The group of three bars labeled as "debit" on the left part of Figure 1 shows the distribution of transactions by card type made by respondents whose primary card is debit. The remaining groups show the distribution of transactions by card type of respondents whose primary card is credit and prepaid, respectively. These observations lead to the following set of results:

Result 1. *Let a consumer's primary card be determined by volume (Definition 1). Then, on average,*

(a) Consumers concentrate 91 to 92.3 percent of their transactions on their primary card type (either debit, credit, or prepaid).

(b) Consumers whose primary card type is either debit or credit place the smallest share of transactions on prepaid cards (2 to 2.7 percent).

(c) Consumers whose primary card type is prepaid place a slightly higher share of transactions on debit cards than on credit cards (4.4 percent versus 3.8 percent).

Two things are worth noting about Result 1. First, this result is about card use and does not take into account what types of cards are held by the respondents. Section 6 analyzes the relationship between card adoption and card use.

Second, to test whether the three-day period per respondent had an effect on the above result, we compared it with homing information based on data taken from the 2010 Survey of Consumer Payment Choice (SCPC), where respondents were asked to recall their transactions conducted during October 2010 (rather than being used on transactions data provided by the DCPC). The SCPC shows that respondents whose primary card is debit placed 88 percent of their transactions on debit cards. For respondents whose primary card is credit, 89.4 percent of the transactions used

credit cards. For prepaid card, the number was 86.5 percent. Although these numbers are slightly lower than the numbers reported in Result 1(a), they basically confirm the validity of the 2012 DCPC data.

The right panel of Figure 1 displays average transaction values according to respondents' primary card. This graph may explain why some card users choose to allocate some of their spending to their nonprimary cards.

Result 2. *Let a consumer's primary card be given by Definition 1. Then, on average,*

(a) Primary debit card users place higher-valued transactions on credit cards ($71.57 on credit versus $44.40 on debit).

(b) Primary credit card users place slightly lower-valued transactions on debit cards ($42.38 on debit versus $53.93 on credit)

(c) Primary prepaid card users place higher-valued transactions on debit and credit cards ($28.55 on debit and $38.47 on credit versus $24.58 on prepaid).

Figure 1 and Results 2(a) and 2(b) show that regardless of a consumer's primary card type, all consumer groups, on average, pay for their highest-value transactions with credit, their mid-value transactions with debit, and their lowest-value transactions with prepaid cards. This may be because consumers prefer not to be charged immediately for high-valued transactions but do prefer to be charged immediately for small transactions. All three results are significant at the 95- or 99-percent levels.

So far, the analysis has focused on how buyers distribute their transactions on their primary and nonprimary cards. An interesting question to ask at this point is what percentage of the respondents concentrated 100 percent of their transactions (or other percentage range) on their primary card type. The top part of Table 2 reveals the following results:

Result 3. *(a) 76.6 percent (15.1 + 61.5) of respondents whose primary card is debit concentrated all their transactions on debit cards (and none on any other card). Similarly,*

(b) 81.5 percent (16.1 + 66.4) of respondents whose primary card is credit concentrated all their transactions on credit cards; and

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(c) 86.3-percent (33.3 + 55.0) of respondents whose primary card is prepaid concentrated all their transactions on prepaid cards.

Result 3 shows that the majority (around 80 percent) of card users concentrated all of their transactions on their primary card. The bottom panel of Table 2 reveals similar percentages when primary cards are defined by dollar value (see the next section) rather than by the number of transactions. Table 2 shows the breakdown of the roughly 20 percent of consumers who put less than 100 percent on their primary card as well as the breakdown between single-card users and multiple-card users who put 100 percent on their primary card. For example, the first row in Table 2 shows that only 5.6 percent of primary debit card users concentrated between 80 and 99 percent of their transactions on their primary (debit) card, whereas 11.3 percent put 60 to 79 percent of their transactions on their primary (debit) card, 6.1 percent put 40 to 50 percent on their primary (debit) card, and fewer than 6.4 percent put less than 40 percent on their primary (debit) card.

Note that the information provided in Table 2 is different from the information provided in Figures 1 and 2. Table 2 focuses on the percentage of card *users*, whereas the left panels of Figures 1 and 2 display the percentage of *transactions*. Table 2 shows that consumers whose primary card is debit have, on average, 1.6 cards, regardless of whether they concentrate 100 percent or any other share of their transactions on debit. This is as expected, given that a debit card must be tied to a checking account. The slightly greater variability of the number of cards held by primary credit card users suggests some correlation between the number of adopted credit cards and the concentration of transactions on credit cards.

4   Spending Allocation Among Debit, Credit, and Prepaid Cards, When Primary Card Is Defined by Transaction Value

Definition 1 classifies a respondent's card type as primary if the respondent makes more transactions using this card type than when using any other type of card. However, there is another way to define a primary card type which is by the total dollar amount placed on each type of card. The "by value" analog to Definition 1 can be stated as follows:

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DEFINITION 2. *(a) We say that debit is a consumer's **primary card type by value** if the total dollar value this consumer places on debit cards during the three-day diary period is greater than or equal to the total dollar value the respondent places on any other type of card (either credit or prepaid). (b) A credit card is a consumer's primary card by value if the consumer spends a higher dollar value using credit cards than using debit and a greater or equal amount as with prepaid. (c) A consumer's primary card is prepaid if the consumer spends more dollars using a prepaid card than with any other card type.*

The left panel of Figure 2 can be summarized as follows:

Result 4. *Let a consumer's primary card be determined by dollar value (Definition 2). Then, on average,*

(a) Consumers concentrate 84.1 to 92.6 percent of their transactions on their primary card type (debit, credit, or prepaid).

(b) Consumers whose primary card type is either debit or credit place the smallest share of transactions on prepaid cards (1.6 to 3.1 percent).

(c) Consumers whose primary card type is prepaid place a higher share of transactions on debit cards than on credit cards (14.3 percent versus 1.6 percent).

Result 4 complements Result 1 by showing that consumers tend to concentrate their spending on their primary card regardless of whether the primary card is determined by volume (Definition 1) or by value (Definition 2). All three results are significant at the 95- or 99-percent levels.

The right panel of Figure 2 displays the average transaction value of each card type for each group of primary card type buyers. The following result complements Result 2 for the case where primary cards are defined by value instead of volume:

Result 5. *Let a consumer's primary card be determined by dollar value (Definition 2). Then, on average, buyers whose primary card is credit concentrate a higher transaction value on credit than on debit cards.*

The right panel of Figure 2 shows that the average credit transaction value of buyers whose primary card by value is credit is $57.19, which is more than twice than $25.86, the average transaction value they place on their debit card. This shows that heavy credit card users use debit for low-value transactions. In contrast, buyers whose primary card is debit place on average $46.10

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on debit, which is only 18-percent higher than the average value they place on their nonprimary credit cards ($38.75).

Also, comparing the right panels of Figure 1 and Figure 2 reveals that for respondents whose primary card is credit, the differences between average transaction values on their primary cards and their nonprimary cards is greater when primary cards are defined by value rather than volume. This may imply that some respondents place a high value on credit cards because they can use them to pay for high-value transactions. This difference is lower for respondents whose primary card by value is debit because credit cards are still useful for large-value transactions.

5   Spending Allocation Among Card Networks

The Industrial Organization literature described in the Introduction investigates single- and multi-homing in terms of card networks (Visa, MasterCard, American Express, or Discover) and focuses less on single- and multi-homing with respect to card types (debit, credit, or prepaid), which is the primary focus of this article. This is a consequence of attempts by regulating authorities to investigate whether interchange fees determined by the networks have anticompetitive consequences.

Table 3 shows the respondents' shares of use of the four major card networks by card type. Our data show that Visa's share in both volume and value dominates (with about 70 percent), followed by MasterCard (about 20 percent). A natural question that arises is whether network concentration is correlated with consumers' tendency to concentrate their spending on a single card from a particular network. The analysis below shows that this is not the case.

Figures 3, 4, and 5 display the results computed from the transactions data described in Section 2. For each card type, we define a primary *network* (such as Visa or MasterCard) by the number of transactions and show how consumers distribute their transactions among their primary and nonprimary networks. The data shown in Figures 3, 4, and 5 can be summarized as follows:

Result 6. *(a) Buyers whose primary debit network is Visa concentrate 95.2 percent of their transactions on Visa cards, on average. Buyers whose primary debit network is MasterCard concentrate 95.8 percent of their transactions on MasterCard, on average. Respondents who reported that their primary debit card is no logo concentrated 100 percent of their transaction on no logo cards.*

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(b) Buyers whose primary credit network is Visa place 88.5 percent of their transactions on Visa cards, on average. Buyers whose primary credit network is MasterCard place 87.8 percent of their transactions on MasterCard, on average. Buyers whose primary credit network is Discover, place 89.3 percent of their transactions on Discover cards. Buyers whose primary credit network is American Express, place 86.5 percent of their transactions on American Express.

(c) Primary prepaid card users concentrate 95 to 100 percent of their transactions on their primary network, on average.

Comparing parts (a) and (b) of Result 6 reveals that debit card users are slightly more concentrated around one network brand relative to credit card users (compare 90–95 percent to 87–89-percent). One explanation could be that consumers tend to have a larger number of credit cards than debit cards because debit cards are tied to bank accounts. These multiple credit cards may have different logos.

Table 4 replicates Table 2 for primary *network* cards (as opposed to primary card types) and shows the percentage of respondents who concentrated x-percent of their transactions (by volume and value) on their primary *network* card. Table 4 shows that 92 to 100 percent of debit and prepaid users single-homed on a single card network. Single-homing is slightly lower for credit card users, where 78 to 92 percent of the respondents single-homed on one network. Note that for credit cards, single-homing of respondents whose primary network card is either Visa or MasterCard is higher than single-homing of respondents whose primary network card is American Express or Discover.

6 Card Adoption Versus Card Use

This section adds the adoption dimension into the analysis in order to investigate the sensitivity of the results described in previous sections to the number of cards held by the respondents. This is accomplished by matching the 2012 diary data (which provides transaction-level data) with the 2012 Survey of Consumer Payment Choice (SCPC), where respondents state how many debit, credit, and prepaid cards they possess (see Section 2 for details of these datasets). This matching is possible because all the diary respondents also participated in the SCPC using a unique respondent identification number.

6.1 Adoption and use by card type

Each column in Table 5 corresponds to a particular combination of card types adopted by respondents. For example, [Debit, Credit] indicates respondents who reported having debit and credit cards and no prepaid cards. The numbers on the top panel of Table 5 show how respondents allocated their transactions among debit, credit, and prepaid cards as a function of the combination of cards they have. Consumers who had all three cards placed 49.9 percent of their transactions on debit, 45 percent on credit, and 5.1 percent on prepaid cards. The percentage of debit transactions increased to 60.9 percent for consumers had only two cards (debit and credit), and to 88.9 percent for consumers who had only debit and prepaid cards.

The bottom panel of Table 5 shows the percentages of consumers for whom debit, credit, or prepaid was their primary card by volume as a function of the combination of card types the consumers held: of respondents who had all three card types, 56.8 percent had debit as their primary card whereas 40.3 percent had credit as their primary card (where primary is defined by the number of transactions). Note that only 2.9 percent of respondents who had all three types of card used prepaid cards as their primary card type.

6.2 Adoption by card type and use by card network

The 2012 Survey of Consumer Payment Choice can tell us how many cards of each type (debit, credit, and prepaid) respondents have. Unfortunately, the 2012 survey cannot tell us how many of these cards bear the Visa logo and how many bear the MasterCard logo separately. Therefore, although the diary does tell us the card network that cleared each transaction, we cannot investigate how adoption of multiple cards with the same network logo affects buyers' decision to concentrate their transactions on a single card network (same brand logo). For this reason, the analysis in this section is limited to investigating how having multiple cards within each type (debit, credit, and prepaid) affects concentration of transactions on a single card network (Visa, MasterCard, American Express, or Discover).

For each card type (debit, credit, and prepaid) separately, Table 6 display the percentage of respondents who concentrated all their transactions on a single card network (Visa, MasterCard,

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American Express, or Discover). The column labeled "1" in Table 6 shows that respondents who have only one debit card (similarly, one credit or prepaid card), not surprisingly, put 100 percent of their transactions on *one* network debit card. The column labeled "2" shows that 98 percent of respondents with two debit cards placed all their transactions on debit cards with the same network logo. This percentage barely drops to 95 percent of respondents with four debit cards (column 4), and to 64 percent of respondents with five debit cards.

The row labeled "credit" in Table 6 shows that 91 percent of the respondents with two credit cards concentrate all their transactions on one credit card network (Visa, MasterCard, Discover, or American Express). This percentage drops to 85 percent for respondents with three credit cards, to 78 percent for respondents with four credit cards, and to 74 percent for respondents with five credit cards. Finally, almost 100 percent of the respondents with prepaid cards place all their transactions on a single prepaid card network, regardless of how many prepaid cards they have.

This discussion, together with Table 6 can be summarized as follows:

Result 7. *(a) A higher proportion of respondents with multiple credit cards spread their transactions over several card networks compared with the proportion of respondents with multiple debit cards.*

(b) A higher proportion of respondents with multiple prepaid cards concentrate their transactions on a single prepaid card network compared with the proportions of debit and credit cards with multiple cards.

7 Card Type Single-Homing and Demographics

For policy (and marketing) purposes, it may be important to investigate whether homing behavior is uniform throughout the U.S. population or whether we can identify specific groups of consumers who home on a specific card type more than other groups. This section describes probit regressions that characterize the relationship between single-homing on a card type and the demographic variables listed in Table 7.

Let i denote a particular respondent and t a particular card type ($t = D, C, P$). The analysis is based on three probit regressions for each of the dependent variables y_i^D (debit), y_i^C (credit), and

y_i^P (prepaid) listed in Table 7, defined as follows:

$$^*y_i^t = \alpha + \vec{\beta}_G^t \, G\vec{E}N_i + \vec{\beta}_A^t \, A\vec{G}E_i + \vec{\beta}_L \, L\vec{A}T_i + \vec{\beta}_O \, OR\vec{I}G_i + \vec{\beta}_E \, ED\vec{U}_i + \vec{\beta}_I \, IN\vec{C}_i, \tag{1}$$

where $t = D, C, P$ and $^*y_i^t$ are three latent variables so that $y_i^t = 1$ if $^*y_i^t > 0$ (respondent i homed on a card type t), and $y_i^t = 0$ otherwise.

Table 8 displays the marginal effects results of three separate probit regressions: single-homing on debit cards, on credit cards, and on prepaid cards. Table 8 reveals the following results:

Result 8. *(a) Single-homing on debit declines with age whereas single-homing on credit increases with age.*

(b) single-homing on debit generally declines with education whereas single-homing on credit increases with education.

(c) High-income respondents are less likely to single-home on debit and more likely to single-home on credit relative to low-income respondents.

(d) Male respondents are less likely to single-home on debit and are more likely to single-home on credit relative to female.

(e) Very-low-income respondents are more likely to home on prepaid cards than other income groups.

(f) Latino respondents are more likely to single-home on debit and less likely to single-home on credit relative to non-Latino respondents.

The marginal effects reported in Result 8 are based on regressions of all card transactions. To examine whether the results are robust to respondents' pattern of card adoption, Table 9 displays the marginal effects of the same regressions restricted to users who had adopted all three types of cards (debit, credit, and prepaid), showing similar results.

8 Conclusions and Policy Implications

This paper presents evidence from the Diary of Consumer Payment Choice on single-homing with respect to three card types (debit, credit, and prepaid), as well as card networks (Visa, MasterCard, Discover, and American Express). The diary collects data from consumers only and therefore does

not cover the entire market because it excludes business and government use. This paper adds a dimension to the investigation of how consumers choose to pay, by showing that most consumers concentrate their card payments on a single card type. One might conjecture that this is because the type they use most or exclusively has a consumers' most preferred set of attributes. It is also possible that the choice is arbitrary with respect to attributes but made because consumers find it more convenient to use a single card or card type or network. In contrast, consumers who multi-home with respect to card types are probably those who gain from being able to choose from a variety of attributes (preference for variety). Multi-homing behavior may imply that consumers do not view the three card types as perfect substitutes because of the different functions and attributes that are unique to a card type.

If single-homing behavior is caused by consumers' need to select only one set of attributes that is associated with only one card type, future research would benefit from consumer surveys that ask respondents to rank among sets (bundles) of card attributes. Most surveys ask consumers to rank the degree of importance of each payment attribute separately. However, in reality, consumers cannot gain from an attribute that is not available on a particular card type. Similar to choosing among cable-TV providers (where each provider may offer only a limited set of TV channels), by choosing to home on a single card type, the consumer is restricted to choice from among only three limited sets of attributes.

Appendix A   Formal Definition of Primary by Transaction Volume

Let $I \stackrel{\text{def}}{=} \{1, 2, \ldots, i, \ldots N\}$ be the set (names) of N respondents. In the empirical investigation, we use survey data from $N = 1813$ respondents who used at least one card type (either debit, credit, or a prepaid card).

Let t_i^D, t_i^C, and t_i^P denote the total number of transactions respondent $i \in I$ placed on debit, credit, and prepaid cards, respectively, over the respondent's three-day diary period. A more rigorous formulation of Definition 1 is as follows:

DEFINITION A1. *(a) We say that debit is a **primary card type by transaction volume** for respondent i if $t_i^D \geq \max\{t_i^C, t_i^P\}$. (b) A credit card is primary by volume for respondent i if $t_i^C > t_i^D$ and $t_i^C \geq t_i^P$.*

(c) A prepaid card is primary by volume if $t_i^P > \max\{t_i^D, t_i^C\}$.

Let I_D, I_C, and I_P denote the sets of respondents whose primary card types by volume are debit, credit, and prepaid, respectively. Formally,

$$I_D \overset{\text{def}}{=} \left\{ i \in I \,\middle|\, t_i^D \geq \max\{t_i^C, t_i^P\} \right\}, \quad I_C \overset{\text{def}}{=} \left\{ i \in I \,\middle|\, t_i^C > t_i^D \quad \& \quad t_i^C \geq t_i^P \right\},$$

$$\text{and} \quad I_P \overset{\text{def}}{=} \left\{ i \in I \,\middle|\, t_i^P > \max\{t_i^D, t_i^C\} \right\}. \quad \text{(A.1)}$$

Note that the sets form a partition of the set of respondents, I.

Using Definition 1, we compute the total number of transactions all respondents placed on their primary, and nonprimary cards as follows:

$$\overbrace{T_D^D = \sum_{i \in I_D} t_i^D, \quad T_D^C = \sum_{i \in I_D} t_i^C, \quad T_D^P = \sum_{i \in I_D} t_i^P;}^{\text{Debit card is primary by volume}} \quad \overbrace{T_C^D = \sum_{i \in I_C} t_i^D, \quad T_C^C = \sum_{i \in I_C} t_i^C, \quad T_C^P = \sum_{i \in I_C} t_i^P;}^{\text{Credit card is primary by volume}}$$

$$\overbrace{T_P^D = \sum_{i \in I_P} t_i^D, \quad T_P^C = \sum_{i \in I_P} t_i^C, \quad T_P^P = \sum_{i \in I_P} t_i^P.}^{\text{Prepaid card is primary by volume}} \quad \text{(A.2)}$$

For example, T_D^C is the total number of credit card transactions made by respondents whose primary card is debit. Similarly, T_C^P is the total number of prepaid card transactions by respondents whose primary card is credit.

Appendix B   Formal Definition of Primary by Transaction Dollar Value

Let v_i^D, v_i^C, and v_i^P denote the sum of dollar value of transactions respondent $i \in I$ placed on debit, credit, and prepaid cards, respectively, over the respondent's three-day diary period. A more rigorous formulation of Definition 2 is as follows:

DEFINITION B2. *(a) We say that debit is a **primary card type by transaction value** for respondent i if $v_i^D \geq \max\{v_i^C, v_i^P\}$. (b) A credit card is primary by value for respondent i if $v_i^C > v_i^D$ and $v_i^C \geq v_i^P$. (c) A prepaid card is primary by value if $v_i^P > \max\{v_i^D, v_i^C\}$.*

Let J_D, J_C, and J_P denote the sets of respondents whose primary card types by value are debit, credit, and prepaid, respectively. Formally,

$$J_D \overset{\text{def}}{=} \left\{ j \in I \,\middle|\, v_j^D \geq \max\{v_j^C, v_j^P\} \right\}, \quad J_C \overset{\text{def}}{=} \left\{ j \in I \,\middle|\, v_j^C > v_j^D \quad \& \quad v_j^C \geq v_j^P \right\},$$

$$\text{and} \quad J_P \overset{\text{def}}{=} \left\{ j \in I \,\middle|\, v_j^P > \max\{v_j^D, v_j^C\} \right\}. \quad \text{(B.1)}$$

Note that the sets form a partition of the set of respondents, I.

Using Definition 2, we compute the total dollar value of transactions all respondents placed on their primary, and nonprimary cards as follows:

$$\overbrace{V_D^D = \sum_{j \in J_D} v_j^D, \quad V_D^C = \sum_{j \in J_D} v_j^C, \quad V_D^P = \sum_{j \in J_D} v_j^P;}^{\text{Debit card is primary by value}} \quad \overbrace{V_C^D = \sum_{j \in J_C} v_j^D, \quad V_C^C = \sum_{j \in J_C} v_j^C, \quad V_C^P = \sum_{j \in J_C} v_j^P;}^{\text{Credit card is primary by value}}$$

$$\overbrace{V_P^D = \sum_{j \in J_P} v_j^D, \quad V_P^C = \sum_{j \in J_P} v_j^C, \quad V_P^P = \sum_{j \in J_P} v_j^P.}^{\text{Prepaid card is primary by value}} \quad \text{(B.2)}$$

References

Borzekowski, Ron, Elizabeth Kiser, and Shaista Ahmed. 2008. "Consumers' Use of Debit Dards: Patterns, Preferences, and Price Response." *Journal of Money, Credit and Banking* 40 (1):149–172.

Ching, Andrew and Fumiko Hayashi. 2010. "Payment Card Rewards Programs and Consumer Payment Choice." *Journal of Banking and Finance* 34 (8):1773–1787.

Cohen, Michael and Marc Rysman. 2013. "Payment Choice with Consumer Panel Data." Federal Reserve Bank of Boston, Working Paper No. 13–6.

Foster, Kevin, Erik Meijer, Scott Schuh, and Michael Zabek. 2011. "The 2009 Survey of Consumer Payment Choice." Federal Reserve Bank of Boston, Public Policy Discussion Paper No. 11–1.

Hyytinen, Ari and Tuomas Takalo. 2004. "Multihoming in the Market for Payment Media: Evidence from Young Finnish Consumers." *Bank of Finland Research Discussion Paper* (25).

Klee, Elizabeth. 2008. "How People Pay: Evidence from Grocery Store Data." *Journal of Monetary Economics* 55 (3):526–541.

Koulayev, Sergei, Marc Rysman, Scott Schuh, and Joanna Stavins. 2012. "Explaining Adoption and Use of Payment Instruments by US Consumers." Federal Reserve Bank of Boston, Working Paper No. 12–14.

Rysman, Marc. 2007. "An Empirical Analysis of Payment Card Usage." *Journal of Industrial Economics* 55 (1):1–36.

Santomero, Anthony and John Seater. 1996. "Alternative Monies and the Demand for Media of Exchange." *Journal of Money, Credit and Banking* 28 (4):942–960.

Shy, Oz and Juha Tarkka. 2002. "The Market for Electronic Cash Cards." *Journal of Money, Credit, and Banking* 34 (2):299–314.

Snyder, Chris and Jonathan Zinman. 2008. "Consumer Homing on Payment Cards: From Theory to Measurement." Dartmouth College, Unpublished.

Zinman, Jonathan. 2009. "Debit or Credit?" *Journal of Banking and Finance* 33 (2):358–366.

Debit	Credit	Prepaid	% Resp
1	1	1	1.3
1	1	0	14.6
1	0	1	3.0
0	1	1	2.6
1	0	0	45.2
0	1	0	29.3
0	0	1	3.9

Table 1: Percentage of respondents who use 1, 2, or 3 card types. *Source*: Author's calculations based on the 2012 Diary of Consumer Payments Choice.

		Percentage of transactions card users place on their primary card type						
% Resp	Primary	1 type	2+ types	2+ types	2+ types	2+ types	2+ types	
	by Volume	100%	100%	80–99%	60–79%	40–59%	< 40%	Total
59.2	Debit	15.1 (1.7)	61.5 (1.6)	5.6 (1.6)	11.3 (1.4)	6.1 (1.5)	0.4 (1.7)	100 (1.6)
36.2	Credit	16.1 (4.4	66.4 (4.8)	7.7 (4.1)	7.1 (4.9)	2.7 (5.4)	0 (na)	100 (4.7)
4.5	Prepaid	33.3 (2.2)	55.0 (3.7)	1.5 (2.0)	10.3 (3.0)	0 (na)	0 (na)	100 (3.1)
% Resp	Primary	1 type	2+ types	2+ types	2+ types	2+ types	2+ types	
	by Value	100%	100%	80–99%	60–79%	40–59%	< 40%	Total
55.3	Debit	16.2 (1.7)	66.1 (1.6)	5.9 (1.7)	8.4 (1.5)	2.9 (1.5)	0.5 (1.0)	100 (1.6)
39.9	Credit	14.5 (4.4)	59.8 (4.8)	6.9 (4.1)	5.9 (5.0)	7.5 (4.7)	5.3 (4.6)	100 (4.7)
4.9	Prepaid	31.4 (2.2)	51.9 (3.7)	1.4 (2.0)	5.5 (2.9)	2.7 (1.7)	7.1 (1.7)	100 (2.9)

Table 2: Percentage of card users who placed x-percent of their transactions on their primary card. The number is parentheses is the number of cards of this type respondents have. *Source*: Author's calculations based on the 2012 Diary of Consumer Payments Choice.

	Visa	Mastercard	AmEx	Discover	No Logo	Other	HHI
	Market Shares by Total Number of Transactions (Percentages)						
All	69.6	19.1	3.9	2.6	2.4	2.4	5241
Debit	79.7	19.5	(na)	(na)	0.8	(na)	
Pin debit	82.0	17.2	(na)	(na)	0.8	(na)	
No-pin debit	77.1	22.1	(na)	(na)	0.8	(na)	
Credit	50.0	20.4	15.0	10.2	(na)	4.4	
Prepaid	7.1	0.6	0.5	(na)	54.3	37.4	
	Market Shares by Total Value of Transactions (Percentages)						
All	66.3	20.8	5.2	3.3	1.5	2.9	4873
Total debit	77.7	21.3	(na)	(na)	1.0	(na)	
Pin debit	80.3	18.8	(na)	(na)	0.9	(na)	
No-pin debit	74.6	24.3	(na)	(na)	1.1	(na)	
Credit	46.2	20.8	15.9	10.0	(na)	7.1	
Prepaid	9.2	3.5	0.6	(na)	50.5	36.1	
	Market Shares by Total Value (2013:Q2 SEC filings) (Percentages)						
All	55.8	25.3	13.1	5.8			
Debit	66.3	26.9	(na)	6.8			
Credit	45.6	23.8	25.8	4.8			

Table 3: Network shares by card type. *Source*: Author's calculations based on the 2012 Diary of Consumer Payments Choice.

Primary network card		Primary network card by volume — Percentage of consumers					Primary network card by dollar value — Percentage of consumers				
	card	100%	80–99%	60–79%	40–59%	<40%	100%	80–99%	60–79%	40–59%	<40%
All	Visa	79.5	6.8	6.9	6.7	0.1	85.1	6.8	4.9	2.3	1.0
	MC	85.1	5.1	4.4	5.4	0.0	81.4	4.5	3.4	6.4	4.3
	Other	77.9	4.6	16.1	1.5	0.0	63.5	3.4	10.4	16.2	6.5
Debit	Visa	96.9	0.5	1.2	1.4	0.0	97.5	0.4	1.1	0.8	0.3
	MC	96.2	0.6	2.4	0.7	0.0	95.7	0.6	1.3	1.5	0.8
	No logo	100.0	0.0	0.0	0.0	0.0	64.1	0.0	0.0	26.3	9.6
Credit	Visa	82.2	4.7	6.1	6.9	0.1	87.4	4.4	4.6	2.2	1.5
	MC	85.0	2.9	4.1	7.6	0.4	88.6	2.7	3.4	3.4	1.9
	AE	78.1	4.9	10.9	6.2	0.0	69.5	3.7	8.9	14.5	3.4
	DC	81.9	0.7	16.9	0.6	0.0	69.9	0.6	11.9	14.2	3.4
	Other	92.0	0.0	6.4	1.6	0.0	80.3	0.0	3.5	10.9	5.3
Prepaid	Visa	93.9	0.0	6.1	0.0	0.0	92.1	0.0	6.0	2.0	0.0
	MC	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
	AE	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
	No logo	96.5	0.6	0.0	2.9	0.0	96.5	0.6	0.0	2.9	0.0
	Other	92.3	0.0	7.7	0.0	0.0	92.3	0.0	7.7	0.0	0.0

Table 4: Percentage of card users who placed x-percent of their transactions on their primary *network* card. *Left*: Primary card by volume. *Right*: Primary card by value. *Source*: Author's calculations based on the 2012 Diary of Consumer Payments Choice.

Card types used (percentages)

Combinations of card types held

	[Debit, Credit, Prepaid]	[Debit, Credit]	[Debit, Prepaid]	[Credit, Prepaid]	[Debit]	[Credit]	[Prepaid]
	Transaction allocation among debit, credit, and prepaid cards						
Debit	49.9	60.9	88.9	0.0	100	100	100
Credit	45.0	39.1	0.0	91.1	100	100	100
Prepaid	5.1	0.0	11.1	8.9	100	100	100
Total	100	100	100	100	100	100	100
	Choice of primary cards among debit, credit, and prepaid cards						
Debit	56.8	65.7	85.3	0.0	100	100	100
Credit	40.3	34.3	0.0	91.5	100	100	100
Prepaid	2.9	0.0	14.7	8.5	100	100	100
Total	100	100	100	100	100	100	100
Num. Resp.	673	537	171	86	120	87	16

Table 5: Respondents' card use as a function of the combination of card types they have. *Note:* Based on 1,690 (of 1,813) diary respondents who also took the SCPC. *Source:* Author's calculations based on the 2012 Diary of Consumer Payments Choice.

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		% who use 1 network					% respondents						
		Num. adopted cards					Num. adopted cards						
		1	2	3	4	5	1	2	3	4	5	6+	All
Card type	Debit	100	98	94	95	64	52	36	4	2	0	6	100
	Credit	100	91	85	78	74	10	15	18	12	10	35	100
	Prepaid	100	99	98	96	100	24	23	13	8	6	26	100
	All types	100	94	92	87	84	7	9	12	9	11	52	100

Table 6: *Left*: Percentages of respondents who use a single card network (Visa, MasterCard, American Express, Discover) as a function of the number of cards of each type (debit, credit, or prepaid) they have. *Right*: Percentage of respondents who adopted x number of cards of each type. *Source*: Author's calculations based on the 2012 Diary and Survey of Consumer Payment Choice.

Regression variable		Interpretation	Type
		Dependent variables (for 3 separate regressions)	
y_k^D	single_debit	singlehomes with a debit card	binary
y_k^C	single_credit	singlehomes with a credit card	binary
y_k^P	single_pp	singlehomes with a prepaid card	binary
		Explanatory variables (used in all 3 regressions)	
GEN_k	male	is male	binary
	~~female~~	~~is female~~	~~binary~~
AGE_k	age_u25	diarist's age is less than 25	binary
	age_2534	diarist's age is in the range [25,34]	binary
	age_3544	diarist's age is in the range [35,44]	binary
	~~age_4554~~	~~diarist's age is in the range [45,54]~~	~~binary~~
	age_5564	diarist's age is in the range [55,64]	binary
	age_o64	diarist's age is over 64	binary
LAT_k	latino	Hispanic or Latino	binary
	~~nonlatino~~	~~not Hispanic or Latino~~	~~binary~~
$ORIG_k$	~~white~~	~~White/Caucasian~~	~~binary~~
	black	Black/African American	binary
	other	American Indian, Alaskan Native, Asian, or Other	binary
EDU_k	edu_lhs	highest level of education is less than a high school degree	binary
	edu_hs	highest level of education is a high school degree	binary
	~~edu_sc~~	~~highest level of education is some college~~	~~binary~~
	edu_c	highest level of education is an associate or bachelor's degree	binary
	edu_pgs	highest level is a master's, professional, or doctorate degree	binary
INC_k	inc_LT25	family income is in range [0, 25k)	binary
	inc_2549	family income is in range [25k, 50k)	binary
	~~inc_5074~~	~~family income is in range [50k, 75k)~~	~~binary~~
	inc_7599	family income is in range [75k, 100k)	binary
	inc_100124	family income is in range [100k, 125k)	binary
	inc_GT125	family income is greater than 125k	binary

Table 7: Regression variable definitions. *Note*: The 6 variables with the ~~strikethrough~~ have been removed from the regression because they are implied by other variables (commonly referred to as a "singularity" problem). *Source*: Author's calculations based on the 2012 Diary and Survey of Consumer Payment Choice.

	Debit	Credit	Prepaid
male (d)	-0.0239	0.0665***	-0.00111
age_u25 (d)	0.163**	-0.129**	0.00147
age_2534 (d)	0.0449	-0.111***	0.00683
age_3544 (d)	0.0455	-0.166***	-0.00177
age_5564 (d)	-0.0175	-0.00605	-0.00341
age_o64 (d)	-0.164***	0.189***	-0.00587
latino (d)	0.150***	-0.142***	-0.00375
black (d)	0.0763	-0.0414	0.0233
other (d)	-0.108**	0.0964*	0.0119
edu_lhs (d)	-0.00653	-0.0718	0.104*
edu_hs (d)	0.000980	-0.0276	0.0219
edu_c (d)	-0.0918***	0.117***	-0.00879
edu_pgs (d)	-0.162***	0.202***	-0.00288
inc_lt25 (d)	0.0216	-0.132***	0.0580**
inc_2549 (d)	0.0416	-0.0719**	0.000551
inc_7599 (d)	-0.0693	0.0238	-0.00547
inc_100124 (d)	-0.0603	0.00918	-0.00119
inc_gt125 (d)	-0.243***	0.134***	0.00131
N	1550	1550	1550
Pseudo R-Squared	.08	.13	.25

Marginal effects

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Three probit regression results: Probability of single-homing on debit, credit, and prepaid cards. *Source*: Author's calculations based on the 2012 Diary and Survey of Consumer Payment Choice.

	Debit	Credit	Prepaid
male (d)	-0.0654	0.108***	0.0160
age_u25 (d)	0.107	-0.126	
age_2534 (d)	-0.0336	0.00353	-0.0136
age_3544 (d)	0.0267	-0.125**	-0.0140
age_5564 (d)	-0.0249	-0.0146	0.000800
age_o64 (d)	-0.125**	0.171**	-0.0110
latino (d)	0.121*	-0.130**	-0.00437
black (d)	0.238***	-0.0977	-0.00606
other (d)	-0.146**	0.187***	-0.00355
edu_lhs (d)	0.0194	0.0220	0.0971
edu_hs (d)	-0.0438	-0.0674	0.0319
edu_c (d)	-0.0898*	0.106*	-0.00622
edu_pgs (d)	-0.135**	0.156**	0.00482
inc_lt25 (d)	-0.0880	-0.196***	0.0781
inc_2549 (d)	0.0334	-0.128**	-0.00797
inc_7599 (d)	-0.0874	0.0109	
inc_100124 (d)	-0.0654	0.0519	-0.00938
inc_gt125 (d)	-0.198***	0.0914	
N	635	635	421
Pseudo R-Squared	.08	.12	.16

Marginal effects

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Three probit regression results restricted to transactions by users who adopted all three types of cards: Probability of single-homing on debit, credit, and prepaid cards. *Source*: Author's calculations based on the 2012 Diary and Survey of Consumer Payment Choice.
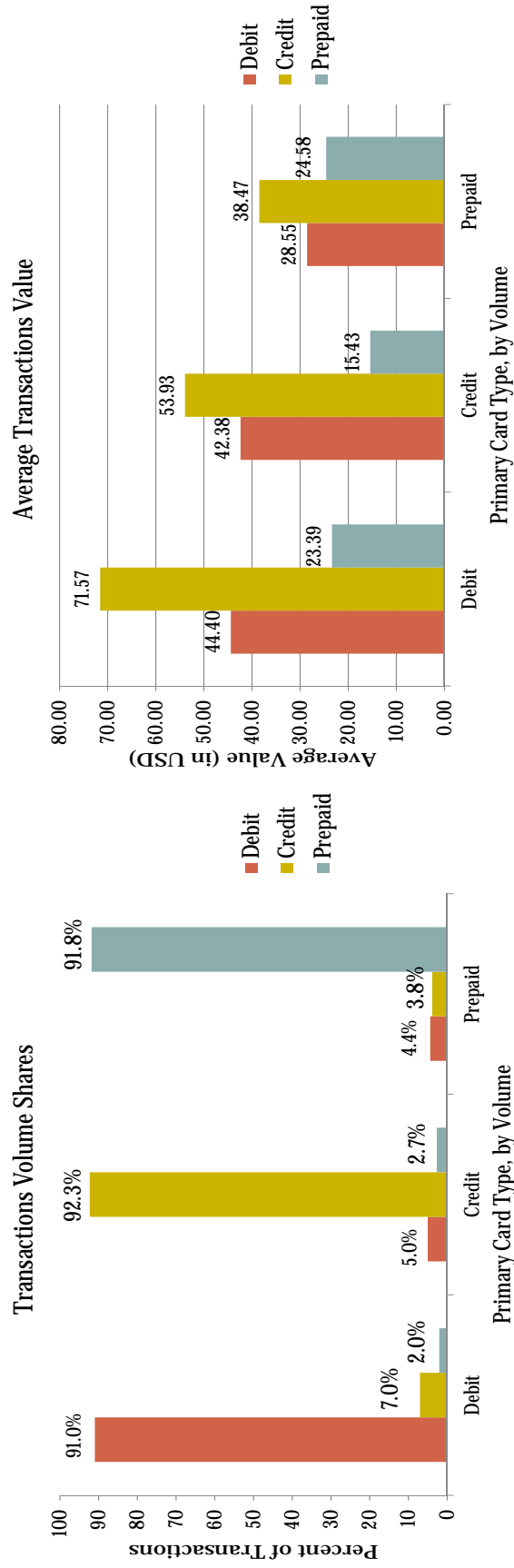
Figure 1: Primary cards (3-day period) as defined by highest number of transactions (Definition 1). *Left:* Transaction volume shares of the three cards. *Right:* Average transaction value of each card type, by primary card. *Source:* Author's calculations based on the 2012 Diary of Consumer Payment Choice.
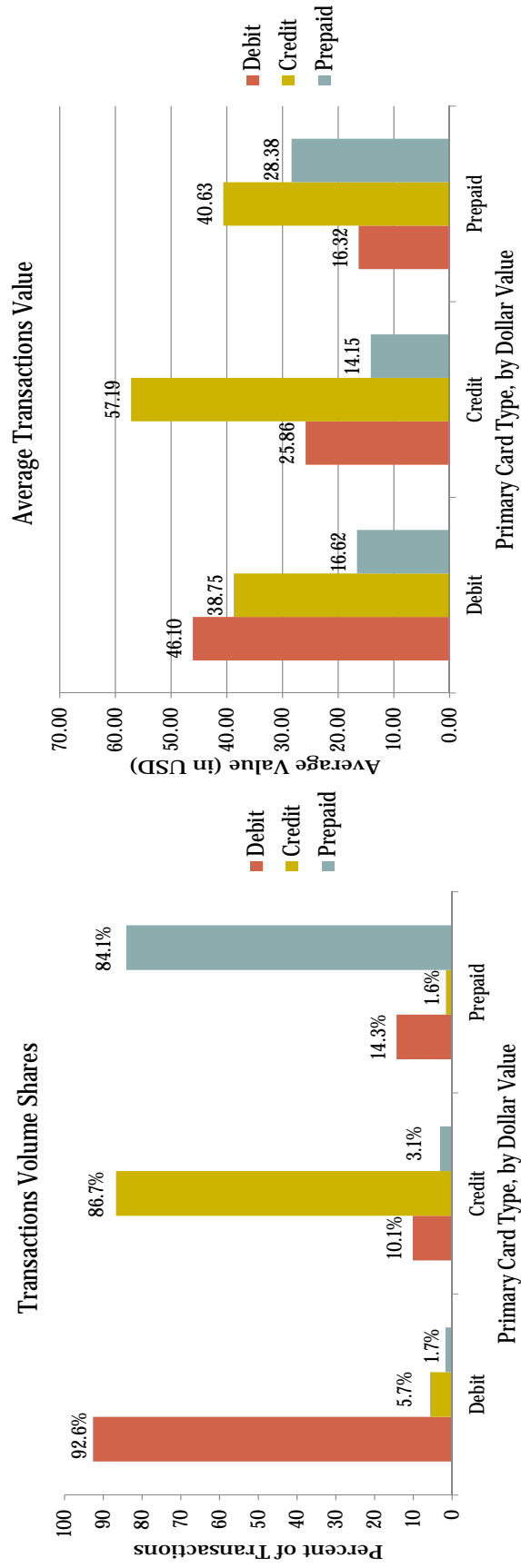
Figure 2: Primary cards (3-day period) as defined by the largest dollar value (Definition 2). *Left*: Transaction volume shares of the three cards. *Right*: Average transaction value of each card type, by primary card. *Source*: Author's calculations based on the 2012 Diary of Consumer Payment Choice.
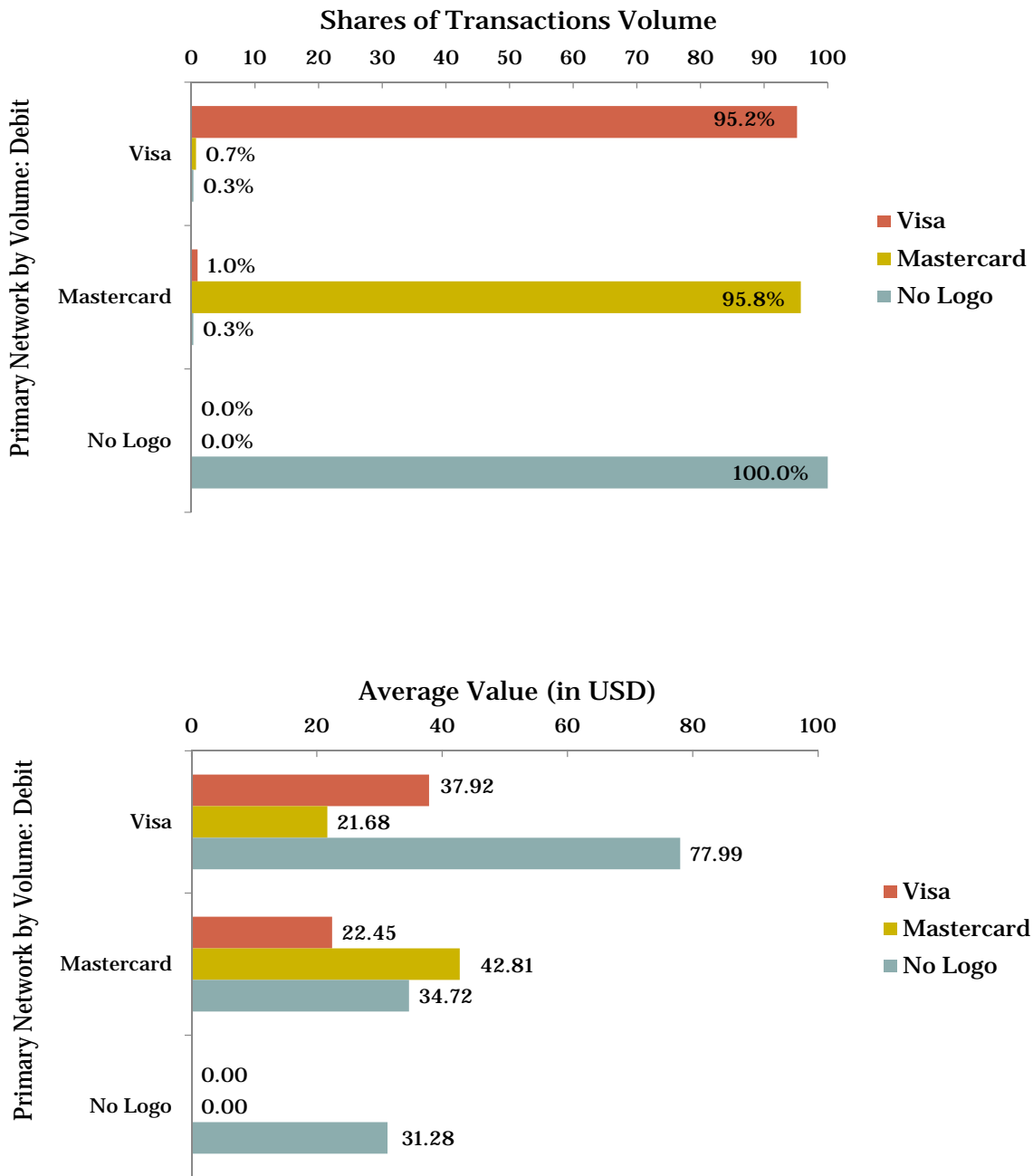
Figure 3: Share of transactions volume (top) and average transaction values (bottom) by card network of respondents whose primary card type by volume is debit. *Source*: Author's calculations based on the 2012 Diary of Consumer Payment Choice.

Shares of Transactions Volume

Primary Network by Volume: Credit

- Visa: Visa 88.5%, Mastercard 2.2%, Discover 1.9%, Amer. Exp. 2.5%
- Mastercard: Visa 2.3%, Mastercard 87.8%, Discover 1.5%, Amer. Exp. 3.1%
- Discover: Visa 6.2%, Mastercard 2.0%, Discover 89.3%, Amer. Exp. 0.2%
- Amer. Exp.: Visa 4.1%, Mastercard 2.3%, Discover 1.7%, Amer. Exp. 86.5%

Average Value (in USD)

Primary Network by Volume: Credit

- Visa: Visa 47.03, Mastercard 33.52, Discover 70.55, Amer. Exp. 74.82
- Mastercard: Visa 155.98, Mastercard 54.04, Discover 81.34, Amer. Exp. 128.19
- Discover: Visa 48.40, Mastercard 27.77, Discover 47.83, Amer. Exp. 23.73
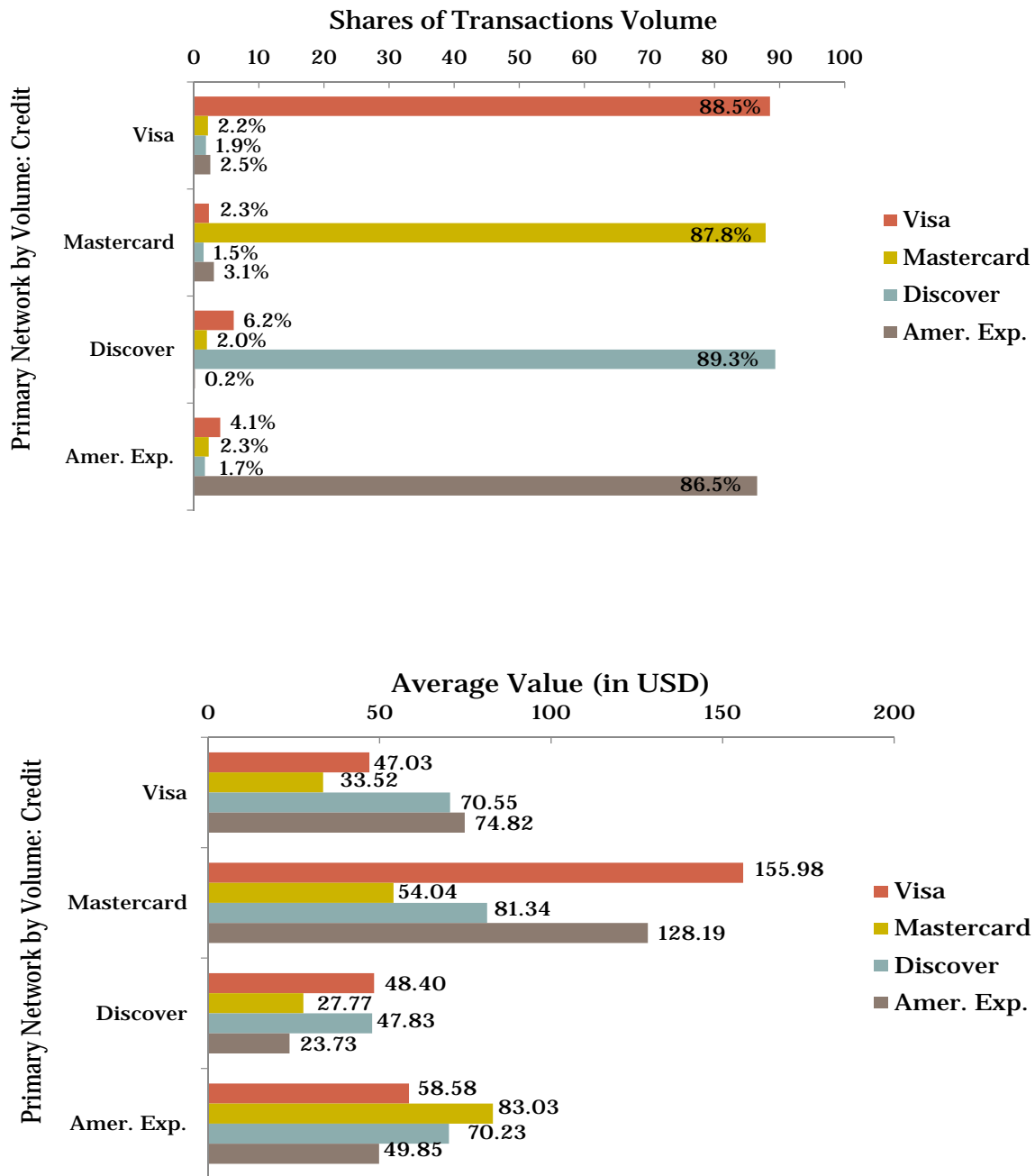- Amer. Exp.: Visa 58.58, Mastercard 83.03, Discover 70.23, Amer. Exp. 49.85

Figure 4: Share of transactions volume (top) and average transaction values (bottom) by card network of respondents whose primary card type by volume is credit. *Source*: Author's calculations based on the 2012 Diary of Consumer Payment Choice.

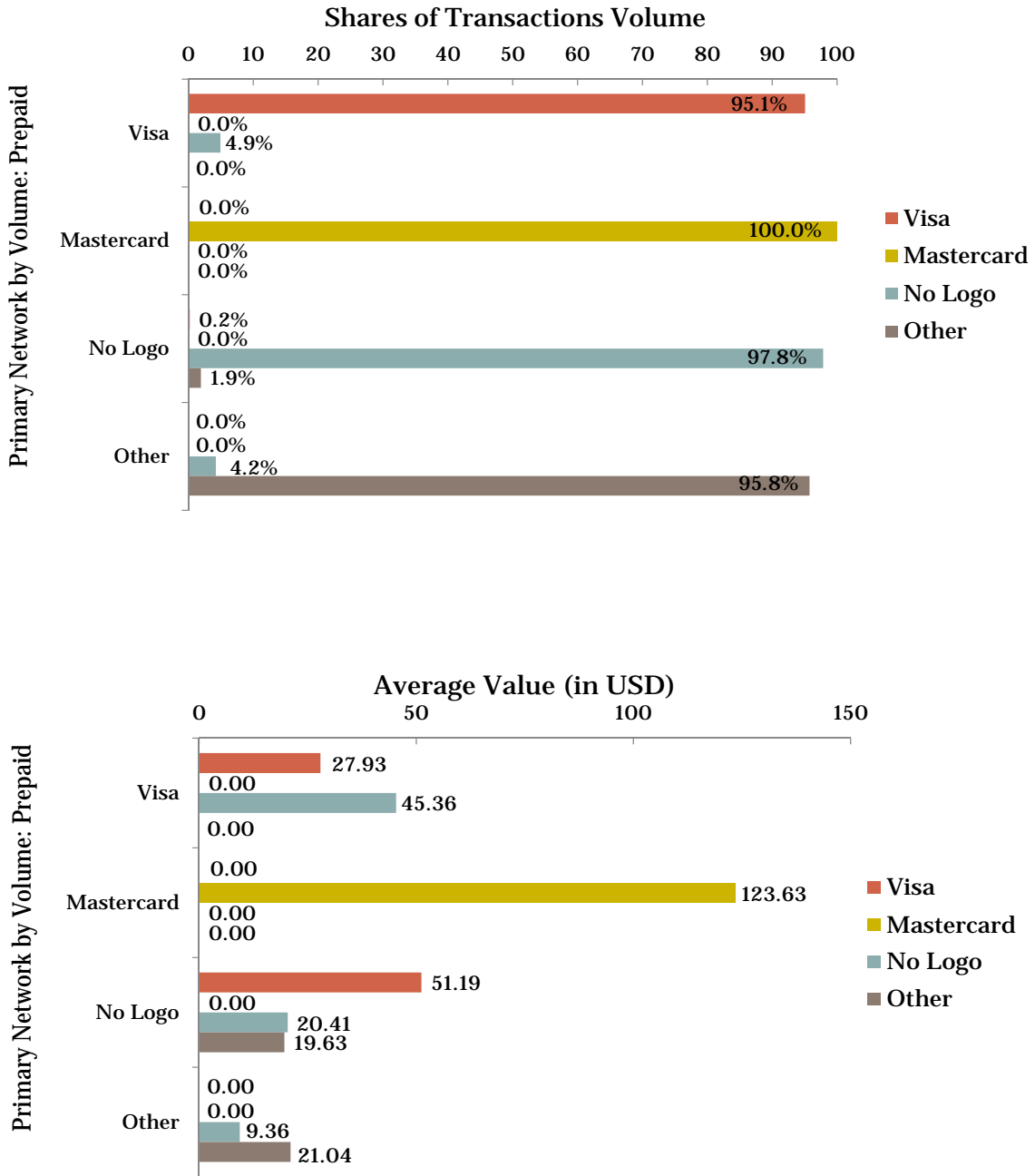**Shares of Transactions Volume**

Average Value (in USD)

Figure 5: Share of transactions volume (top) and average transaction values (bottom) by card network of respondents whose primary card type by volume is prepaid. *Source*: Author's calculations based on the 2012 Diary of Consumer Payment Choice.