Consumer Homing on Payment Cards:  
From Theory to Measurement

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Abstract: The extent to which consumers will and do use multiple platforms is a crucial parameter in theories of payment card platforms as two-sided markets. But payment card “homing” behavior is rarely measured in practice. Moving from theory to measurement requires defining what types of multi-homing, and whose multi-homing, matter. We highlight several related issues and present an extensive set of new results on multi-homing prevalence and trends. On balance we find that multi-homing is more prevalent than single-homing, particularly if one counts substitution between credit and debit cards as multi-homing. Multi-homing trends vary across different measures, and the dramatic rise in households using both credit and debit cards is especially noteworthy.

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1. Introduction

We need to figure out empirically whether the case of single-homing or that of multi-homing is more descriptive.


Consumer “homing” behavior matters greatly in theories of payment card platforms as two-sided markets. In Guthrie and Wright (2007) variation in the extent to which consumers use multiple platforms can produce a full range of price equilibria. When consumers always multi-home, platform competition pushes the interchange fee—the marginal price that the platform charges merchants—down to the socially optimal level. Otherwise the equilibrium fee is too high. Consumer homing also impacts equilibrium prices in Rochet and Tirole (2003), and in some versions of the model (Rochet and Tirole 2006a) multi-homing produces interchange fees that are socially too low.

But consumer payment homing is rarely measured in practice. Consequently the empirical question raised in the introductory quote—whether single-homing or multi-homing is more descriptive—remains open. Rysman (2007) finds prevalent multi-homing in credit card network membership, but infrequent multi-homing in credit card network usage, using data from the Visa Payment Systems Panel Study (PSPS). We expand on Rysman’s work using complementary data from the 1992-2004 Surveys of Consumer Finances (SCFs).1 Our objective is to measure multi-homing in ways that inform theoretical models and related policy analysis.2 Moving from theory to measurement highlights several issues for theorists, empiricists, and regulators interested in payment card platforms.

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1 Klee (2006) also uses SCF data to explore consumer payment multi-homing, but considers payment media more broadly (whereas we consider payment cards only). Klee also focuses on identifying the determinants of multi-homing (whereas we simply describe the prevalence of multi-homing and discuss implications for theory).

2 [recent policy actions/issues here].
One critical issue is whether multi-homing on credit cards is distinct from multi-homing on credit and debit. In theoretical models credit and signature debit are typically assumed to be homogenous payment devices; in reality they seem to be increasingly close but not necessarily perfect substitutes (Zinman 2007a). We present new evidence on multi-homing on credit and debit and find high prevalence that has been increasing over time.

A second definitional issue is whether to define multi-homing based on actual or potential card use. Theories have focused on the latter, with Rochet and Tirole (2006b) stating explicitly: “What matters here is membership multi-homing rather than usage multi-homing.” But the “single-homing index” in Rochet and Tirole (2003) highlights the more general importance of consumer willingness (and/or ability) to substitute across networks (or more broadly across payment media). Low actual multi-homing may indicate low substitutability. So we present evidence on both potential and actual multi-homing. Notably we find that multi-homing on credit and debit is prevalent in actual as well as potential terms.

A third issue is whose homing behavior matters. Both broad and narrow groups of consumers are relevant. Theorists and policymakers are often interested in the entire population of consumers, since platform pricing can impact the prices of final goods faced by consumers who do not own or use cards. But for other applications card users may be the marginal consumers and hence the agents of greatest interest. We report estimates of multi-homing prevalence for groups ranging from the entire U.S. population to card users. We find that while multi-homing was far more prevalent among card users at the beginning of our sample period, relatively strong growth in the population at-large had generally narrowed the gap by 2004.

A final issue is how homing behavior is changing over time. Trends may be of particular interest to policymakers and regulators. We find that multi-homing has changed substantially
over 1992-2004 for many definition*sample combinations. The rise in multi-homing in credit and debit usage has been especially dramatic.

In all, the available evidence suggests that multi-homing is a better description of consumer payment card choices than single-homing, particularly if one considers households that use both credit and debit as multi-homers. But we find that potential multi-homing on credit cards is substantially less prevalent in the SCF than the PSPS. Also the results vary across the many definition*sample combinations, and data limitations preclude measuring yet more combinations that may be important. This suggests the need for additional data collection and modeling that homes in on what types of multi-homing, and whose multi-homing, matter most.

Section II outlines the importance of consumer multi-homing in theory, and details the issues that arise when moving from theory to measurement. Section III describes the SCF and its strengths and weaknesses relative to the PSPS, and estimates the prevalence of consumer payment card multi-homing under many different definition*sample combinations. Section IV interprets the results and highlights some directions for further research.
2. Background

2.1. Theoretical Literature on Consumer Multi-Homing

We start by briefly outlining the role and implications of consumer (a.k.a. “buyer”) homing behavior in theoretical models of payment card networks as two-sided markets. We focus on models that are meant to describe payment card platforms in particular, and where consumer homing behavior is allowed to vary. The relevant models have focused on how platforms set prices (interchange fees), and on the conditions under which prices will be socially efficient.

Models of competing payment platforms suggest that the extent of consumer multi-homing is important. In Rochet and Tirole (2006a) interchange fees are too high under single-homing and too low under multi-homing. More generally, in Rochet and Tirole (2003) “the impact of platform competition on price structure depends on the fine characteristics of the demand functions of final users”. High consumer substitutability across platforms, captured in part by a low “single-homing index”, creates an incentive for platforms to steer sellers (a.k.a. merchants, who are faced with the choice of accepting a card/platform or not), thereby putting downward pressure on interchange fees. In Guthrie and Wright (2007) variation in homing can produce a full range of price equilibria. When consumers always multi-home, competition between

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3 For more general reviews of the theory of payment networks see, e.g., Chakravorti (2003) and Hunt (2003).
4 So, e.g., we do not consider Armstrong (2006). Although in this model “It makes a significant difference to outcomes whether groups single-home or multi-home” (p. 669), the model’s assumptions on tariffs and costs are not meant to fit card platforms (p. 671).
5 So, e.g., we do not consider Chakravorti and Roson (2006), where consumers are assumed to single-home (p. 123).
6 Rochet and Tirole (2006c) finds that multi-homing (or more specifically the degree of substitutability between debit and credit) is also a critical determinant of the welfare effects of the Honor-All-Cards (HAC) rule. Proposition 9 in that paper finds that the HAC rule may decrease welfare when credit and debit are strong substitutes (and the total profit margin of banks is large).
8 Sometimes overlooked is that higher elasticities of consumer demand may induce price competition for consumers, putting upward pressure on interchange fees and making the net effect of consumer substitutability on prices in Rochet and Tirole (2003) ambiguous.
payment schemes lowers interchange fees all the way to the socially optimal level. Otherwise
the equilibrium still contains some upward bias (p. 51).

Thus consumer multi-homing has different welfare effects in the Rochet and Tirole and
Guthrie and Wright models, but is critical in either setup. This motivates developing empirical
evidence on multi-homing that will inform theoretical modeling and policy analysis.

2.2. Definitional and Sampling Issues

Providing evidence that speaks to the models requires attention to several conceptual and
technical issues regarding the measurement of multi-homing.

First, how exactly should we define multi-homing? One related issue is whether multi-
homing in credit cards is distinct from multi-homing across credit and debit. In theoretical
models credit and signature debit are typically assumed to be homogenous payment devices; in
reality they are probably increasingly close but not necessarily perfect substitutes (Zinman
2007a). Moreover theory has yet to incorporate the complications introduced by PIN (“online”)
debit, where there are additional platforms, consumers are relatively captive (e.g., nearly all
ATM cards are compatible with the Visa and MasterCard platforms), and merchants must be
induced to install costly PIN terminals (Rochet and Tirole 2003).

A second definitional issue is whether to define multi-homing based on actual or potential
use. One important definition of potential multi-homing is the ownership of cards from multiple
networks. Guthrie and Wright and Rochet and Tirole both emphasize this definition, with
Rochet and Tirole (2006b) stating explicitly: “What matters here is membership multi-homing

9 [a bit here on online vs. offline debit, diffusion of PIN terminals and signature/offline/check cards, and hence
virtually identical acceptance].
highlights the more general importance of consumer willingness (and/or ability) to substitute across networks (or more broadly across payment media). Low actual multi-homing may indicate low substitutability. So below we present evidence on both potential and actual multi-homing, following and expanding on Rysman (2007).

Another question that arises in moving from theory to measurement is whose homing behavior matters? Rochet and Tirole and Guthrie and Wright take the natural approach of considering all consumers. The models assume that holding a card is costless, and that all consumers hold cards (or are indifferent between holding and not). But in practice payment cards are rationed due to credit risk and fixed costs. More generally substitutability might be different for those with and without cards, and for card users and non-users. So below we present evidence on several different segments of consumers.

A third question is how to measure the extent of multi-homing? As noted above, in Rochet and Tirole the single-homing index is critical. As Rysman notes, this index is difficult to measure in practice. But evidence on consumer price sensitivity in payment choice is clearly related, and we discuss it below. In Guthrie and Wright multi-homing is a discrete choice. Below we focus on discrete measures of multi-homing. Describing multi-homing in terms of prevalence sheds light on the question raised at the outset: “whether the case of single-homing or that of multi-homing is more descriptive.”

3. Model

In this section, we construct a model that will help us understand and interpret our later empirical results. The model will allow us to determine what policy- and theory-relevant conclusions can

10 Debit cards are effectively rationed as well as credit cards, since consumers deemed severe credit/fraud risk are denied checking accounts.
be drawn from multi-homing percentages and what assumptions are needed for drawing these conclusions.

The market has $I$ consumers indexed by $i = 1, \ldots, I$. Within the period under consideration (a month, for example), the consumer makes a continuum of retail purchasing decisions, indexed by the date $t$ at which each is made. The retail purchase decisions are made at a sequence of different merchants and are independent. The consumer can use cash for the purchase, providing a benefit normalized to zero, or can use one of two payment networks, indexed by $n = 1, 2$. The two might be competing credit card networks or a credit card network competing against a debit card network.

Let $b_{itn}$ be a random variable measuring the net benefit to consumer $i$ from using network $n$ for transaction $t$ relative to using cash. The net benefit may be negative—in which case the consumer would prefer using cash to network $n$—or positive—in which case the consumer would prefer network $n$ to cash. The net benefit includes the relative convenience of using the card, any interest float (if the consumer does not have a revolving balance on a credit or charge card) or interest charge (if the consumer has a revolving balance on a credit or charge card). The net benefit also includes any per-transaction fees charged to the consumer, or any per-transaction payment in the other direction, from the network to the consumer benefits such as cash back, frequent-flyer miles, or other benefits. The baseline benefit from using cash for a given transaction $t$ is positive, so all transactions are consummated using some sort of payment method, if not one of the two payment networks then certainly cash.

Assume $b_{itn}$ is independently and identically distributed across $t$. Let $F_{in}$ be its cumulative distribution function and $[b_{in}, \bar{b}_{in}]$ its support. For ease of exposition, we will also
assume that the distributions of $b_{it1}$ and $b_{it2}$ are independent. (In Section 3.4 we will argue
that, since we are not placing any restrictions on the supports of the distributions, the
independence assumption does not impair the generality of the results.)

As we will see, a crucial element in determining what we can learn about the distributions
of $b_{itn}$ from observing consumers’ homing behavior is whether merchants accept both networks
for payment or whether there are some merchants that accept only one or the other in
equilibrium. That is, knowledge of merchants’ homing behavior is crucial in learning about
consumers’ homing behavior. We will proceed by analyzing two cases, one in which all
merchants accept all network cards and one in which some merchants accept only one and some
only the other. The subsequent analysis relies on a series of revealed-preference arguments.

3.1. Merchants Accept Both Networks

We begin by analyzing the case in which all merchants accept both networks as well as cash.
The assumption of a continuum of transactions and independence between the net benefits across
the two networks tells us a lot about the underlying distributions of consumer $i$’s net benefits
from observing whether or not $i$ multi-homes.

Suppose, for example, that consumer $i$ is observed to single-home, say only using
network 1 or cash but never using network 2. Since the consumer undertakes a continuum of
transactions, and the net benefits are independently distributed across networks, every pair of net
benefits $(b_{it1}, b_{it2})$ in the set of possible pairs $[\underline{b}_{i1}, \bar{b}_{i1}] \times [\underline{b}_{i2}, \bar{b}_{i2}]$ is drawn for at least one of
consumer $i$’s transactions during the period. In particular, the pair $(\bar{b}_{i1}, \underline{b}_{i2})$ is drawn. But the
consumer does not use network 2 even for this draw of net benefits. So it must be the case that
network 1 or cash is better than network 2 even for this extreme draw:
\[
\bar{b}_{i2} < \max(0, \underline{b}_{i1})
\]  

(1)

On the other hand, since the consumer uses network 1 for at least one transaction, it must be the case that there exists a pair \((b_{it1}, b_{it2})\) such that the consumer prefers network 1 to either cash or network 2 given these net benefits: \(b_{it1} > \max(0, b_{it2})\). Now \(b_{it1} > \max(0, b_{it2})\) implies \(\bar{b}_{it1} > 0\), which, put in combination with equation (1) in turn implies

\[
\bar{b}_{i1} > \max(0, \bar{b}_{i2})
\]

(2)

We can express the relations more succinctly (i.e., without the max notation) by defining a new variable, \(m_{itn}\), which equals the net benefit from using network \(n\) or cash, whichever the consumer prefers. That is, \(m_{itn} = \max(0, b_{itn})\). The distribution of \(m_{itn}\) is similar to the distribution of \(b_{itn}\) except it is truncated with all the mass to the left of 0 instead piled up at 0. The support of \(m_{itn}\) is \([\underline{m}_{in}, \overline{m}_{in}]\), where \(\underline{m}_{in} = \max(0, \underline{b}_{in})\) and \(\overline{m}_{in} = \max(0, \bar{b}_{in})\). In this new notation, it can be shown that equations (1) and (2) imply

\[
\overline{m}_{i2} \leq \underline{m}_{i1} \quad \text{and} \quad \overline{m}_{i1} > \overline{m}_{i2}.
\]

(3)

In sum, this condition says that if consumer \(i\) is observed to single-home on network 1, then the whole support of \(m_{it1}\) must lie above the support of \(m_{it2}\).

Suppose now that consumer \(i\) multi-homes on networks 1 and 2. Then there must be pair of net benefits \((b'_{it1}, b'_{it2})\) such that \(b'_{it2} > \max(0, b'_{it1})\) since network 2 is sometimes chosen over both network 1 and cash and another pair \((b''_{it1}, b''_{it2})\) such that \(b''_{it1} > \max(0, b''_{it2})\) since network 1 is sometimes chosen over both network 2 and cash. Expressed in terms of the bounds on the distributions’ supports, these conditions are equivalent
to $\bar{b}_{i2} > \max(0, \underline{b}_{i1})$ and $\bar{b}_{i1} > \max(0, \underline{b}_{i2})$. Using the succinct $m_{i\text{nm}}$ notation (recall measuring the net benefits of the using the better of network $n$ and cash), we can write these conditions as

$$\bar{m}_{i2} > m_{i1} \text{ and } \bar{m}_{i1} > m_{i2}. \quad (4)$$

In sum, these conditions say that if consumer $i$ multi-homes, then the supports of consumers’ net benefits overlap in the positive region, so that sometimes one and sometimes the other is chosen.

### 3.2. Merchants Accept Only One Network

Next we analyze the case in which all merchants only accept one of the two networks, some accepting network 1 and some network 2. We again will investigate the implications of consumer $i$’s single- and multi-homing behavior for the distribution of $i$’s net benefits. Suppose first that the consumer single-homes, only using network 1 or cash but never network 2. Since the consumer always prefers cash to network 2, even for the highest net benefit from the network, $\bar{b}_{i2} < 0$. Since the consumer sometimes prefers network 1 to cash, there must be a range of positive net benefits from network 1: $\bar{b}_{i1} > 0$. Using the succinct $m_{i\text{nm}}$ notation, these conditions imply

$$\bar{m}_{i2} = 0 \text{ and } \bar{m}_{i1} > 0. \quad (5)$$

A comparison of equations (3) and (5) reveals that (5) is a stronger condition. Thus, consumer single-homing tells us more about the distributions of consumer net benefits when merchants each accept only one network than when all accept both. To provide some intuition for this conclusion, note that, regardless of merchants’ acceptance behavior, observing that the consumer single-homes indicates that the support of the net benefits from using either network 1 or cash lies completely above the corresponding support for network 2. When some merchants...
only accept network 2, and still the consumer never uses this network, we know that the net benefit from using that network can never be positive. When merchants accept both networks, we do not know for sure that the net benefit from network 2 is non-positive. It could be that the net benefit from network 2 is positive but the net benefit from network 1 is yet higher.

Suppose now that the consumer multi-homes. While we cannot learn about the consumer’s relative net benefits from the two networks, we do know that network 2 is sometimes preferred to cash, so that \( \bar{b}_{i2} > 0 \), and similarly that network 1 is sometimes preferred to cash, so that \( \bar{b}_{i1} > 0 \). Using the succinct \( m_{in} \) notation, these conditions imply

\[
\bar{m}_{i2} > 0 \quad \text{and} \quad \bar{m}_{i1} > 0.
\] (6)

A comparison of equations (4) and (6) reveals that (4) is a stronger condition. Thus, consumer multi-homing tells us more about the distributions of consumer net benefits when merchants accept both networks than when each accept only one. (This is the reverse of what we found with consumer single-homing, where more is learned when merchants each accepted only one network.) When, given a choice between networks because merchants accept both, the consumer multi-homes, this indicates that the supports of net benefits from the networks must overlap. When merchants each accept only one network, consumer multi-homing indicates nothing about the networks’ relative net benefits. The support of one network’s distribution of net benefits may lie completely above the other and yet the consumer still multi-homes because he is not allowed to choose between them.

To help visualize the results, refer to Figure 1, which diagrams three possible configurations for the supports of the distributions of consumer net benefits \( m_{in} \). To limit cases, the graphs are all for the case in which the support of network 1 is a greater interval than the support of network 2, meaning that the minimum and maximum of the interval are higher
than the minimum and maximum of the other interval. Consumer single-homing is consistent with both Panels A and B when merchants accept both networks; Panel A is ruled out leaving only Panel B when merchants each accept only one network. Consumer multi-homing is consistent with both Panels A and C when merchants each accept only one network; Panel A is ruled out leaving only Panel C when merchants accept both networks.

3.3. Hybrid Merchant Acceptance Behavior

Perhaps the most realistic case is a hybrid of the preceding two subsections, in which some merchants accept both networks, some accept only network 1, and some accept only network 2. Assume that the researcher only knows merchants’ acceptance policies in the aggregate and cannot observe the merchant’s policy for individual transactions $t$ by consumer $i$.

How much the researcher learns from an observation of consumer’s single- or multi-homing behavior depends on the correlation between the consumer’s net benefits and merchants’ acceptance policies. Let us begin by extending the independence maintained so far yet further to the assumption that consumer’s net benefits from each network are also distributed independently of merchants’ acceptance decisions. Then it turns out that observing the consumer’s homing behavior provides the same information in this subsection with hybrid merchant acceptance behavior that it provided in the previous section in which merchants each accepted only one network.

This result is most easily seen by referring to Figure 1. Suppose the consumer is observed to single-home, say on network 1. Then of the three configurations in the figure, only Panel B would be consistent with this observation. Panel A would be ruled out because the consumer always chose cash over network 2 when given the choice just between those two
options. Suppose the consumer is observed to multi-home. Then we cannot distinguish between Panels A and C. In particular, Panel A is not ruled out. The consumer would end up using network 2 even in this configuration because he would use this network at merchants who only accepted this network.

On the other hand, if consumer net benefits are correlated with merchants’ acceptance policies in an unrestricted way, then the hybrid model provides no more than the crudest information from either of the two previous subsections. That is, we can only conclude that condition (3) holds—the weaker of conditions (3) and (5)—when the consumer is observed to single-home and that condition (6) holds—the weaker of conditions (4) and (6)—when the consumer is observed to multi-home. Referring to Figure 1, one could construct correlations between merchant acceptance and consumer net benefits such that both Panels A and B would produce single-homing. In particular, the consumer’s net-benefit supports could look like Panel A when buying from merchants who accept both cards and Panel B when buying from merchants who accept only one network. One could similarly construct correlations between merchant acceptance and consumer net benefits such that both Panels A and C would produce multi-homing. In particular, the consumers’ net-benefit supports could look like Panel A when buying from merchants who accept only network 2 and Panel C when buying from other merchants.

3.4. Linking Observed Homing Behavior to the Single-homing Index

In this section we show how empirical observations of homing behavior can be tied to central concepts in the theoretical literature. In particular, we will focus on the single-homing index proposed by Rochet and Tirole (2003). The importance of this index for theory and policy was discussed in the Introduction.
Let $S_n$ be the set of consumers observed to single-home on network $n = 1, 2$ and $M$ be the set of consumers observed to multi-home. Let $|S_n|$ be the number of elements in set $S_n$ (i.e., the number of consumers who single-home on network $n$) and $|M|$ the the number of elements in set $M$ (i.e., the number of consumers who multi-home). Many of our empirical findings are related to the proportion of consumers that single-home on either network, denoted by $s = (|S_1| + |S_2|) / (|S_1| + |S_2| + |M|).

We will relate this proportion to Rochet and Tirole’s (2003) single-homing index, denoted $\sigma_n$. Conceptually, $\sigma_n$ measures the sales that merchants would counterfactually lose if, instead of accepting payment on either network, they stopped accepting network $n$, where these lost sales are expressed as a percentage of the quantity bought using network $n$. Formally, let $q_n$ be the quantity bought from merchants using network $n$ when they accept both networks and $Q_n$ the quantity bought using the network when (counterfactually) merchants accept only network $n$ (in addition to cash). Then $\sigma_n = (q_1 + q_2 - Q_1) / (q_1 + q_2)$.

It is useful to disaggregate sales in each category into sales to single-homing and to multi-homing consumers. Let $q_n^s$ and $Q_n^s$ be the actual and counterfactual sales to consumers who single-home on network $n$ and $q_n^m$ and $Q_n^m$ be the actual and counterfactual sales to multi-homing consumers. Then $q_n = q_n^s + q_n^m$ and $Q_n = Q_n^s + Q_n^m$. Substituting into one of the single-homing indexes, for concreteness say that for network 1, we have

$$\sigma_1 = \frac{q_1^s + q_1^m + q_2^s + q_2^m - (Q_2^s + Q_2^m)}{q_1^s + q_1^m}.$$

(7)
We proceed by first noting that the demand of consumers who single-home on network 2 will not be affected by the elimination of network 1. Hence \( Q_2^s = q_2^s \). Further, \( Q_2^m \leq q_1^m + q_2^m \), where the equality would only be achieved if multi-homing consumers switched all of their purchases via network 2 if network 1 were eliminated. If some of these purchases were made in cash, then the inequality would be strict. Substituting these conditions into equation (7) yields

\[
\sigma_1 \geq \frac{q_1^s}{q_1^s + q_1^m}.
\] (8)

Equation (8) provides a lower bound on the single-homing index, which can be deduced from survey data that has information on purchases by payment type. If we are willing to impose a sufficient amount of symmetry, we can express the lower bound in terms of percentages of individuals exhibiting certain homing behaviors. Assume that the two networks are symmetric, so that \( q_n^s = (q_1^s + q_2^s) / 2 \) and \( q_n^m = (q_1^m + q_2^m) / 2 \). Assume further that quantity involved in each transaction is distributed independently from consumers’ net benefits from using the two networks. Normalizing this quantity to unity, \( q_1^s + q_2^s = |S_1| + |S_2| \) and \( q_1^m + q_2^m = |M| \). Substituting these and the previous equalities into equation (8) yields

\[
\sigma_1 \geq \frac{|S_1| + |S_2|}{|S_1| + |S_2| + |M|} = s.
\] (9)

These same symmetry assumptions also imply \( \sigma_2 \geq s \). In sum, under sufficient symmetry assumptions, we have that the proportion of single-homing consumers observed in the data is a lower bound on Rochet and Tirole’s (2003) single-homing index for each of the two networks. In the absence of these symmetry assumptions, we need to revert to the more precise bound in equation (8), which requires data on consumer purchases by payment network to identify.
3.5. Robustness

In this subsection we will provide a series of remarks about the robustness of the results if various of the assumptions are relaxed. One assumption was that the consumer makes a continuum of purchases. This assumption allowed us to wring more information out of observations of consumer homing behavior. For example, it allowed us to rule out configurations such as in Panel C of Figure 1 for a single-homing consumer. With a large enough number of transactions, given that the supports overlap and the distributions of net benefits are independent, the consumer would eventually experience transactions for which each network provided higher positive surplus than the other, and so the consumer would multi-home. With a small number of transactions, Panel C could be consistent with single-homing: for example, the net benefit from network 1 may happen to be higher than network 2 for these. As the number of transactions increases, the probability that the reverse outcome (network 2 providing higher net benefit than 1) never occurs becomes vanishingly small. Connecting the theory back to what our empirical results will be, based on consumer finance survey data, the longer the period referred to by the survey question, moving from the past week to past month to past year, the better approximation the continuum of transactions is.

Another assumption was that the distributions of the consumer’s net benefits from the two networks were independent. This assumption allowed us to simplify the exposition, but because we have not placed any restrictions on the supports of the distributions, the assumption does not impair the generality of our results. Rich correlation structures between \( b_{it1} \) and \( b_{it2} \) can be mimicked in the independent case by varying the overlap between their supports. For example, suppose \( b_{it1} \) is a normal random variable and \( b_{it2} = b_{it1} + a \) for some positive constant...
a. With these distributions, we would observe the consumer’s always choosing network 2 or cash and never network 1. Similar observations would be generated if \( b_{it1} \) and \( b_{it2} \) were independent, but the support of \( b_{it2} \) were entirely above the support of \( b_{it1} \): i.e., \( b_{it2} > b_{it1} \).

The model implicitly assumed that the consumer had access to both networks when making a purchase decision and left aside the network membership (i.e., card holding) decision. Thus the theoretical results are most applicable to empirical results that measure homing behavior in terms of payment-card use for consumers that carry both types of payment card.

If it is assumed that merchants are atomistic in the sense that the consumer’s network-membership decision is independent of any single merchant’s acceptance policy, then a consumer’s membership in only one network will certainly serve as a barrier to using the other network for a transactions. Empirical results characterizing single-homing as holding (rather than using) only one card would then provide a more conservative bound on the single-homing index from theory.

4. Data

4.1. Survey of Consumer Finances

The SCF only reports credit card information at the household-card type level. SCF Households reports their aggregate holdings and usage of general purpose credit cards (Visa, MasterCard, Discover, and American Express cards with revolving credit), charge cards (primarily American Express cards without revolving credit), and debit cards.

The SCF data is useful despite lacking information on network membership. Card holdings are interesting in and of themselves, to the extent that substitutability across cards (e.g., credit and debit) matters in theory and practice. Card holding can also be used to measure potential
multi-homing on networks. Households that are sufficiently creditworthy to hold multiple general purpose credit cards presumably *could* hold credit cards from different networks at little cost. Households that hold both a credit card and debit card presumably *could* hold cards from different networks, given the ubiquity of Visa and MasterCard debit cards.

Table 1 presents the breakdown of our sample into various subsamples that we will use throughout the remainder of the analysis. As the table shows, we will be analyzing five repeated cross sections of data from 1992 to 2004. The table shows that 88% of the households either had a checking account or some type of payment card in 1992, rising to 94% by 2004. As one moves to lower rows and more demanding definitions to be in the subpopulation (for example, moving toward particular types of payment cards or from holding to use), the subpopulation naturally shrinks. The most dramatic change is shown by the last row, where the percentage of the population that used its credit card during the survey period rises from 18% in 1995 (the question was not asked in 1992) to 59% in 2004. Debit card use has expanded dramatically over time, opening up the possibility for multihoming across debit and credit use in these later periods.

4.2. Comparison to PSPS

Rysman (2007) measures multi-homing using the Visa Payment Systems Panel Study (PSPS). Here we produce some comparable estimates of multi-homing using the Survey of Consumer Finances (SCF), along with several additional measures of multi-homing. The PSPS and SCF each have their advantages.

The PSPS’ main advantage for measuring the *prevalence* of multi-homing is that it contains household-card level information on card holding, network membership, and usage.\textsuperscript{11} In

\textsuperscript{11} The PSPS also has a panel component and transaction-level detail that the SCF lacks. PSPS is a diary survey where households record their entire spending activity for each quarter. See Rysman for additional details.
contrast the SCF only reports credit card information at the household-card *type* level. SCF Households reports their aggregate holdings and usage of general purpose credit cards (Visa, MasterCard, Discover, and American Express cards with revolving credit), charge cards (primarily American Express cards without revolving credit), and debit cards.

The SCF data is useful despite lacking information on network membership. Card holdings are interesting in and of themselves, to the extent that substitutability across cards (e.g., credit and debit) matters in theory and practice. Card holding can also be used to measure potential multi-homing on networks. Households that are sufficiently creditworthy to hold multiple general purpose credit cards presumably *could* hold credit cards from different networks at little cost. Households that hold both a credit card and debit card presumably *could* hold cards from different networks, given the ubiquity of Visa and MasterCard debit cards.

The SCF does have several advantages relative to the PSPS. The SCF is publicly available. Its relevant data on credit and debit cards is available over a longer timeframe than reported in Rysman, facilitating analysis of trends in multi-homing. And it samples the entire U.S. population, whereas the PSPS only samples payment card holders. The SCF thus permits analysis of potential payment card holders and users (e.g., the “cash users” who figure prominently in many theoretical models) who are excluded from the PSPS by design.12

5. Results on Multi-Homing

5.1. Credit Card Multi-homing

5.1.1. Multi-homing in Credit Card Holding

We start by reporting estimates of multi-homing in credit card holding (Table 2).

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12 Both surveys claim to be nationally representative of their different sample frames; see Section III-B for related discussion.
Table 2 shows various estimates of potential multi-homing. Recall that the SCF lacks information on network membership. So we define potential multi-homing as either (holding two or more general purpose credit cards) or (holding one or more general purpose credit cards and holding at least one charge card).\textsuperscript{13} Row 1 estimates the proportion of SCF households satisfying this definition of multi-homing in the entire U.S. population. It was only 39% in 1992, and has been relatively constant at nearly 50% over 1995-2004. Row 2 limits the sample to those with a checking account or payment card. Referring back to Row 2 of Table 1, this subsample has comprised a very large, 88-94%, and rising share of the U.S. population. Households in this sample likely have a higher average ability and preference for using electronic payments than the population at-large. The proportion of potential multi-homers in Row 2 of Table 2 is again stable over 1995-2004, and now rises above 50% after 1992.

Row 3 presents estimates on the sample frame used in Rysman: households holding one or more payment cards. Following the PSPS we include households that own any credit, charge, or ATM card.\textsuperscript{14} Row 2 of Table 1 shows that this sample represents a large (90% in 2004) and growing (vs. 79% in 1992) segment of the U.S. population. Row 3 of Table 2 suggests that proportion of SCF payment card holders who were potential multi-homers was stable at around 55% over the 1995-2004. Rysman does not examine the trend, but finds that 64% of households multi-homed in network membership over 1994-2001.

The size of the difference between the SCF and PSPS estimates of potential multi-homing is striking, and almost certainly understated to a substantial degree. The 55% in the SCF should represent an upper bound on the proportion of households who actually hold credit cards from

\textsuperscript{13} The proportion of households with a charge card is small and falling (from 11% to 7% over 1992-2004).
\textsuperscript{14} This definition produces higher prevalence of SCF households with a payment card than is reported in Rysman. Row 2 of our Table 1 shows that the percentage has been at least 84% since 1995. Rysman (footnote 11) reports that 81% of SCF households hold at least one payment card.
different networks. The 64% represents the proportion of PSPS who do hold credit cards from different networks. More generally Rysman (in his footnote 11) finds higher credit card holdings in the PSPS than in the SCF. The discrepancies could be due to any of several factors. As Rysman notes, the PSPS has a slightly more inclusive definition of a household. The PSPS is also more detailed and may capture cards that SCF households neglect to report. On the other hand, new evidence suggests that aggregated SCF account holdings match up well with counts reported by issuers (Zinman 2007b). This suggests that perhaps the PSPS is not a representative sample of payment card holders. In any case the finding that potential credit card multi-homing is substantially lower in the SCF than the PSPS is notable and should motivate additional data collection and scrutiny.

Row 4 of Table 2 narrows the sample to households owning a credit or charge card. This is a relevant sample if the proportion of credit or charge card holders (Row 3 of Table 1) continues to hold steady (at around 70%), due to credit rationing or other factors. Row 4 of Table 2 shows that potential multi-homing in this sample has been stable since 1995, and is markedly higher in this sample (at nearly 70%) than in the other population segments considered thus far.

Rows 7-9 limit the sample based on card use rather than card holding. This sample might be particularly relevant for card issuers who are interesting in retaining or stealing active customers. Row 7 considers SCF households that use a credit, charge, or debit card. We define credit and charge use as positive charges on the most recent billing cycle(s), and debit use as responding affirmatively to SCF question x7582: “Do you[/your family] use any debit cards?” This question did not emphasize use the first year it was asked, so we do not report any results based on debit use for 1992. Row 6 of Table 1 shows that the proportion of households using a

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15 We do not report results for the broader sample of payment card users because the SCF lacks a precise measure of ATM use.
credit, charge, or debit card has been increasing steadily and rapidly. Row 7 of Table 2 shows that the percentage of potential credit card multi-homers in this sample has been falling steadily, from 68% in 1995 to 57% in 2004. This probably due in part to a composition effect (as marginally creditworthy households with only one credit card enter the sample), and in part due to the growing substitutability between credit and debit discussed below.

Row 8 limits the sample to those using credit or charge cards. Row 7 of Table 1 shows that the prevalence of households meeting this condition has grown from 48% to 59% since 1992 (but only from 55% to 59% since 1995). Meanwhile the prevalence of potential multi-homers with credit/charge card users has held relatively steady, at around 70%.

5.1.2. Multi-Homing in Credit Card Use

The SCF’s lack of card-level data makes it difficult to construct useful estimates of multi-homing in credit card usage. Close examination of Rysman’s findings on usage provokes a question for future research. Rysman reports that 75% of consumer-months in the Visa PSPS put more than 87% of their spending on a single card in a given month. This suggests that single-homing is a fair description of typical card credit card usage. But this finding is based (we surmise) only on the sample of households with nonzero card payments. But what of households who are not using a card (at the moment)? Presumably these consumers are the “cash users” included in some models and have some margin of substitutability between cash and card(s). In fact cash users who hold a card(s) may be the marginal consumers in some cases. So (how) should we classify the actual homing behavior of cash users? They are relevant for many models yet clearly neither single- nor multi-homing in card usage.
5.2. Multi-Homing across Credit and Debit Cards

We now present some evidence on multi-homing across credit and debit cards. Recall again that the SCF does not indicate the network affiliations of payment cards. As such our measures of potential debit and credit multi-homing estimate upper bounds on the prevalence of multi-homing in network membership, and our measures of multi-homing in debit and credit usage estimate upper bounds on the prevalence of multi-homing in network usage. Rysman does not tabulate any results on debit cards so we have no way of comparing our SCF results to the PSPS.

5.2.1. Multi-Homing in Credit and Debit Card Holding

Tables 3 and 4 show potential multi-homing prevalence under two alternative definitions. Table 3 counts a household as a multi-homer if it has a credit or charge card, and an ATM card. The latter condition almost perfectly reflects low-cost potential debit card use, given the diffusion of both point-of-sale PIN terminals, and Visa and MasterCard logos that allow ATM cards to function as “signature”/“offline”/“check” debit wherever credit cards are accepted. Table 4 counts a household as a potential credit and debit multi-homer if it has a credit or charge card, and a checking account. The latter condition is interesting since nearly all households with a checking account can obtain an ATM card if desired.

The first row of the two tables shows the proportion of potential credit and debit multi-homers in the U.S. population under these two definitions. The proportions are large and growing. Under the first definition involving an ATM card (second involving a checking account), 58% (71%) of the population was a potential multi-homer in 2004. The second row of the tables show multi-homer proportions in the sample of those with a payment card or checking account. By definition the proportions are (a bit) higher than in the population at-large. Row 3
further restricts the sample to those with a payment card. The proportion under the first definition involving an ATM card again grows from 1992-2004, peaking at 65%. The proportion under the second definition is now high (77%-80%) and stable throughout the sample period. Rows 5 and 6 of the two tables highlight that certain relevant segments of consumers are potential debit and credit multi-homers by definition.

The next set of rows in Tables 3 and 4 show the proportion of potential credit and debit multi-homers in samples that are defined based on card use. Among households that use credit, charge, or debit, multi-homing is prevalent (70%) and stable under the ATM-based definition (Table 4, Row 7), and very prevalent but falling (from 92% to 82%) under the checking account-based definition (Table 5, Row 7). Among households that use credit or charge, potential multi-homing is prevalent and rising (from 71% to 81%) under the ATM-based definition (Table 3, Row 8), and nearly universal under the checking-account based definition (Table 4, Row 8). Among debit users, multi-homing has held around 80% under both definitions (Row 9 of the tables).
5.2.2. Multi-homing in Credit and Debit Card Use

Table 5 reports the proportion of households who actually multi-home in each of the samples considered above. Here we count a household multi-homing if it reports using debit and having nonzero credit or charge card charges on its last bill(s). Actual multi-homing has risen dramatically over 1995-2004 in each of the samples except debit users (Row 9). The growth mirrors the general rise in debit use shown in Table 1, Row 8. The estimated 2004 prevalence of actual credit and debit multi-homing ranges from 37% (of the entire U.S. population) to 63% (among households using a credit or charge card).

5.3. Payment Card Multi-Homing

Table 6 shows the large proportion of 2004 SCF households who multi-home in some fashion—either on credit cards, and/or on credit and debit cards.

The 2004 prevalence of potential “any multi-homing” ranges from 66% to 100% of households in the eight samples of interest. We use the ATM-based definition of potential debit and credit multi-homing here; prevalence is weakly higher under the checking account-based definition. The prevalence of any multi-homing has been growing in samples based on card holding. Meanwhile it has been falling a bit (from high initial levels) in two of the three samples that are defined based on card usage.

Recall that SCF data limitations on credit card use preclude repeating the exercise for actual multi-homing. But Table 6 provides lower bounds.

6. Conclusion

So is single-homing or multi-homing is a more descriptive view of consumer payment card
choice? The short answer is that “multi-homing” is more descriptive.

The long answer depends in part on one’s preferred definition of multi-homing. If the definition includes debit as well as credit, then multi-homing gets substantially more descriptive. For example, while an estimated 54% of SCF payment card holders were potential credit card multi-homers in 2004; an estimated 75% were potential multi-homers on either credit, or credit and debit. A second definitional issue is whether to focus on potential multi-homing (or the closely related concept of multi-homing in network membership), or on actual multi-homing (card usage). Our key finding here is that multi-homing on credit and debit is prevalent in actual as well as potential terms.

The answer depends also on whose homing behavior matters. Theoretical models have tended to encompass all consumers. But practically, equilibrium outcomes and welfare effects may depend more on the homing behavior of those who already participate in payment card networks. The prevalence of potential multi-homers is high in many segments of interest, and 100% in some.

The answer may also depend greatly on the point in time. Multi-homing has changed substantially over 1992-2004 for many definition*sample combinations. The rise in multi-homing in credit and debit usage has been especially dramatic.

Coupled with related results suggesting that consumer substitution between debit and credit is strong and growing over time (Zinman 2007a), the results suggest that multi-homing is a good, and increasingly good, description of actual behavior if one considers debit a relevant margin.

The picture remains less clear if we consider multi-homing on credit cards only. We find that multi-homing in card holding is prevalent, although substantially less prevalent in the SCF than in the Visa Payment Systems Panel Study (Rysman 2007). SCF data limitations preclude us from
building on Rysman’s finding that there seems to be relatively little multi-homing in credit card usage. Nevertheless we note that clear thinking about “cash users” may be critical for interpreting the prevalence and equilibrium impacts of multi-homing in credit card usage.

More generally additional theory may be needed to define precisely what type of multi-homing, and whose multi-homing, matters most. More data—at the transaction- and network-level—may be needed to measure the prevalence and intensity of multi-homing more precisely. And more intense collaborations between theorists and empiricists may be needed to make better sense of consumer payment choices and their implications for market outcomes and optimal regulation.
References


| (1) Has checking account or payment card | 88 | 90 | 92 | 93 | 94 |
| (2) Has payment card | 79 | 84 | 86 | 88 | 90 |
| (3) Has credit or charge card | 63 | 67 | 68 | 73 | 72 |
| (4) Has checking account and either credit or charge card | 61 | 65 | 66 | 70 | 71 |
| (5) Has ATM card and either credit or charge card | 43 | 49 | 52 | 57 | 58 |
| (6) Uses payment card | — | 60 | 67 | 76 | 81 |
| (7) Uses credit or charge card | 48 | 55 | 54 | 60 | 59 |
| (8) Uses debit card | — | 18 | 34 | 47 | 59 |

Notes: Entries are population-weighted percentages from the Survey of Consumer Finances (SCF). "Payment card" refers to any type of credit, charge, debit, or ATM card; "credit card" refers to general purpose credit cards (Visa, MasterCard, and Discover cards or American Express credit); "charge card" refers to general purpose credit cards that do not offer a revolving line of credit (mainly American Express cards). Consumer categorized as using credit or charge card if reported positive credit or charge card charges during the last billing cycle. Entries involving debit card use are missing for 1992 because the relevant SCF question (x7582) did not emphasize use that year.
Table 2. Percent Multi-homers Defined As Holding Multiple Credit or Charge Cards

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>(1) U. S. population</td>
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<td>46</td>
<td>45</td>
<td>50</td>
<td>48</td>
</tr>
<tr>
<td>(2) Has checking account or payment card</td>
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<td>51</td>
<td>49</td>
<td>53</td>
<td>51</td>
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<td>(3) Has payment card</td>
<td>49</td>
<td>55</td>
<td>53</td>
<td>57</td>
<td>54</td>
</tr>
<tr>
<td>(4) Has credit or charge card</td>
<td>61</td>
<td>69</td>
<td>66</td>
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<td>67</td>
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<tr>
<td>(5) Has checking account and either credit or charge card</td>
<td>62</td>
<td>70</td>
<td>67</td>
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</tr>
<tr>
<td>(6) Has ATM card and either credit or charge card</td>
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<td>72</td>
<td>69</td>
<td>72</td>
<td>69</td>
</tr>
<tr>
<td>(7) Uses payment card</td>
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<td>68</td>
<td>62</td>
<td>61</td>
<td>57</td>
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<tr>
<td>(8) Uses credit or charge card</td>
<td>66</td>
<td>72</td>
<td>69</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>(9) Uses debit card</td>
<td>—</td>
<td>63</td>
<td>56</td>
<td>59</td>
<td>54</td>
</tr>
</tbody>
</table>

Notes: Entries are percentages of the indicated subpopulation that are multi-homers, defined in this table as holding either (a) two or more credit cards or (b) one or more credit cards and one or more charge cards. Population-weighted percentages from the Survey of Consumer Finances (SCF). See Table 1 for definitions of various subpopulations. Results are similar if multihoming based only on credit card holding because of the low prevalence of charge cards.
| (1) U. S. population | 43 | 49 | 52 | 57 | 58 |
| (2) Has checking account or payment card | 48 | 55 | 56 | 61 | 62 |
| (3) Has payment card | 54 | 59 | 60 | 64 | 65 |
| (4) Has credit or charge card | 68 | 73 | 76 | 78 | 81 |
| (5) Has checking account and either credit or charge card | 69 | 74 | 77 | 79 | 82 |
| (6) Has ATM card and either credit or charge card | 100 | 100 | 100 | 100 | 100 |
| (7) Uses credit, charge, or debit card | — | 71 | 71 | 71 | 70 |
| (8) Uses credit or charge card | 71 | 73 | 77 | 79 | 81 |
| (9) Uses debit card | — | 80 | 78 | 79 | 77 |

Notes: Entries are percentages of the indicated subpopulation that are multi-homers, defined in this table as holding both (a) a credit or charge card and (b) an ATM card. Population-weighted percentages from the Survey of Consumer Finances (SCF). See Table 1 for definitions of various subpopulations. Entries involving debit card use are missing for 1992 because the relevant SCF question (x7582) did not emphasize use that year.
Table 4. Percent Multi-homers Defined As Holding Both a Credit Card and Checking Account

<table>
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<td>65</td>
<td>66</td>
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<td>(2) Has checking account or payment card</td>
<td>69</td>
<td>72</td>
<td>72</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>(3) Has payment card</td>
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<td>79</td>
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<td>(4) Has credit or charge card</td>
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<td>97</td>
<td>96</td>
<td>98</td>
</tr>
<tr>
<td>(5) Has checking account and either credit or charge card</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
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<td>(6) Has ATM card and either credit or charge card</td>
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<td>(7) Uses payment card</td>
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</tr>
<tr>
<td>(9) Uses debit card</td>
<td>—</td>
<td>82</td>
<td>79</td>
<td>80</td>
<td>77</td>
</tr>
</tbody>
</table>

Notes: Entries are percentages of the indicated subpopulation that are multi-homers, defined in this table as holding both (a) a credit or charge card and (b) a checking account. Population-weighted percentages from the Survey of Consumer Finances (SCF). See Table 1 for definitions of various subpopulations. Entries involving debit card use are missing for 1992 because the relevant SCF question (x7582) did not emphasize use that year.
### Table 5. Percent Multi-homers Defined As Using Both a Credit and Debit Card

<table>
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<th>Description</th>
<th>1995</th>
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<th>2004</th>
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<td>(3) Has payment card</td>
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<td>(4) Has credit or charge card</td>
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</tr>
<tr>
<td>(4a) Has charge card</td>
<td>26</td>
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<tr>
<td>(4b) Revolves balance</td>
<td>19</td>
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<td>46</td>
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<tr>
<td>(4c) Does not revolve balance</td>
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<td>(5) Has checking account and either credit or charge card</td>
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<td>(6) Has ATM card and either credit or charge card</td>
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<td>(7) Uses credit, charge, or debit card</td>
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<td>(8) Uses credit or charge card</td>
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<td>(9) Uses debit card</td>
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Notes: Entries are percentages of the indicated subpopulation that are multi-homers, defined in this table as reporting both (a) positive credit or charge card charges during the last billing cycle and (b) debit card use. Population-weighted percentages from the Survey of Consumer Finances (SCF). See Table 1 for definitions of various subpopulations. The year 1992 is excluded because the relevant question about debit cards (x7582) did not emphasize use that year.
<table>
<thead>
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<th>Notes: Entries are the percentages of the indicated subpopulations that are multi-homers, defined in this table as meeting one of two conditions. They may multihome according to the definition in Table 1, and so hold either (a) two or more credit cards or (b) one or more credit cards and one or more charge cards. Or they may multihome according to the definition in Table 2, and so hold both (a) a credit or charge card and (b) an ATM card. Population-weighted percentages from the Survey of Consumer Finances (SCF). See Table 1 for definitions of various subpopulations. Entries involving debit card use are missing for 1992 because the relevant SCF question (x7582) did not emphasize use that year.</th>
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<td>(7) Uses credit, charge, or debit card</td>
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<td>(9) Uses debit card</td>
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