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Low-Income Consumers and Payment Choice

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Abstract: Low-income consumers are not only constrained with spending, but also with the type and variety of payment methods available to them. Using a representative sample of the U.S. adult population, this paper analyzes the low possession (adoption) of credit and debit cards among low-income consumers who are also unbanked. Using a random utility model, I estimate the potential welfare gains associated with policy options suggested in the literature to provide subsidized and unsubsidized debit cards to this consumer population.

JEL classification: D9, E42

Key words: consumer payment choice, household income, financial inclusion, unbanked consumers, random utility analysis

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1. Introduction

Payments for purchases of goods and services and bill payments are made with the use of payment instruments such as cash, checks, credit cards, debit cards, prepaid cards, and account-to-account money transfers. However, as shown in this article, low-income consumers tend to have a lower variety of payment methods, and a smaller fraction of them own a bank account relative to high-income consumers. Therefore, low-income consumers are not only constrained with spending, but also with the type and variety of payment methods available to them.

This short article has two goals: First, to investigate the strong correlation between household income and the ownership of credit cards, debit cards, and bank accounts. Second, to analyze some policy proposals that have been discussed in the literature regarding the provision of debit cards to unbanked consumers who rely mainly on cash to make payments.

Both goals are accomplished with the use of a representative sample of the US adult population. This sample contains information on bank account ownership, availability of credit and debit cards, individual assessments of each payment instrument, household income, and other demographic variables. In addition, the sample records actual payments made by the respondents including payment dollar amount, payment method, merchant type.

The policy analysis focuses on estimating a random utility model from which I can compute the utility a consumer derives from paying with each payment instrument. Note that the utility derived from paying is different from the utility derived from consuming the product or service for which the payment is made. It is the utility (or disutility) derived from the process of having to pay. This utility is computed by regressing individuals' payment choice at the point of sale on individuals' assessments of cost, security, and convenience of each payment instrument. The counterfactual policy analysis adds a new payment instrument (debit card with funding options) which unbanked do not have, and then recomputes the utility of paying using the estimated regression coefficients of cost, security, and convenience.

This article is organized as follows. Section 2 characterizes banked and unbanked consumers' possession of credit or debit cards belonging to different household income groups. Section 3 constructs a random utility model to measure consumer utility from making payments using each

payment instrument. Section 4 conducts a counterfactual analysis of welfare effects associated with introducing subsidized and nonsubsidized debit cards (with funding options) to unbanked consumers. Section 5 concludes.

2. Household income and payment methods

This section analyzes the correlation between household income and the type and variety of payment instruments that consumers own.

2.1 Data

The data are taken from the 2017 and 2018 Survey and Diary of Consumer Payment Choice (SCPC and DCPC).[1] Both, the SCPC and the DCPC are representative samples of US (18 and older) consumers. The DCPC records transactions during three consecutive days. Transactions include purchases, bill payments, ATM withdrawals and deposits. Respondents' three day diaries were evenly distributed throughout the months of October 2017 and October 2018 in a way that resembles a three-period overlapping generations model.

Both, the SCPC and the DCPC have a large number of variables describing all sorts of demographics and transactions. For the purpose of this article, I focus only on a subset of variables, some of them are described below. From the SCPC, I use assessment variables where consumers rate on the scale of 1 to 5 key features of each payment instrument, such as cost, security, and convenience. I also use four binary variables "cc_adopt", "dc_adopt", "svc_adopt", and "bnk_acnt_adopt" indicating whether the respondent has a credit card, debit card, prepaid (store-value) card, and a bank account, respectively.

Most of the variables are taken from the DCPC which records actual transactions. I restrict the analysis to payments made using the five major payment methods (pi $= 1$ to 5): "cash," "check," "credit card," "debit card," and "prepaid card." Other variables used include "amnt"

[1] The survey and the diary are conducted in collaboration of the Federal Reserve Banks of Atlanta, Boston, Richmond, and San Francisco. The data and assisting documents (codebooks) are publicly available for downloading from the Federal Reserve Bank of Atlanta Website: https://www.frbatlanta.org/banking-and-payments/consumer-payments.aspx. The data and the R-code used in this analysis are available for downloading from the author's Webpage: www.ozshy.com (click on "Recent articles").

(dollar amount of each payment), "age," "income_hh" (household income), "hh_size" (number of persons in the household), "work," "gender," and "education."

The data contain weights for all respondents that can be used to match the data with the adult US population (18 and older). I indicate when the reported statistics are computed with weights either by (weighted) or (w) inside tables.

2.2 Who doesn't have a card? Card ownership and household income

This section identifies which payment instruments were available to the survey respondents. These consumers are then grouped into card adoption (and nonadoption) profiles and according to whether they had a bank account. Note that by card adoption (equivalently, possession or ownership) I refer to credit and debit cards only and not to prepaid cards. This is because prepaid cards can always be purchased with cash at most retail and pharmacy stores and are therefore accessible to all consumers.

Figure 1 displays the shares of consumers who have both credit and debit cards, no credit card (but may have debit cards), no debit card (buy may have credit cards), and none (no credit and no debit cards), as functions of household income. Table 1 provides additional information by separating banked from unbanked consumers who do not have credit or debit cards. Table 1 is divided into columns according to respondents' household income group. The first row shows that 67.2 percent of all respondents have both credit and debit cards. However, this percentage varies widely and monotonically among the income groups: from 31.8 percent of the lowest income group all the way up to 82.7 percent of the highest income group.

The second row in Table 1 shows that the percentage of consumers with no credit cards declines sharply with income from 38.3 percent in the lowest income group down to 2.4 percent in the highest income group. This is not surprising given the fact that credit card issuers use household income and credit scores as their main criteria for issuing credit cards to consumers. The third row shows that the percentage of respondents with no debit cards does not vary much with household income.

The fourth row in Table 1 shows that consumers who have bank accounts but no credit or debit cards account for only 0.6 percent of all respondents. They will not be analyzed because

they have the option of getting a debit card, but for some reason chose not to have it. The fifth row shows that the percentage of unbanked respondents with no cards varies significantly with household income: from 13.9 percent in the lowest income group down to zero percent in the highest income group. On average, the percentage of unbanked respondents with no cards is 3.4 percent. This finding is consistent with FDIC (2018) that 6.5 percent of US households do not have bank accounts. Hayashi and Minhas (2018) analyze which household characteristics beyond income are also associated with household's probability of being unbanked.

3. Estimating utility from payment choice: A random utility model

In order to measure the effectiveness of any policy directed towards unbanked consumers who do not have credit or debit cards, there is a need to perform some estimations of consumer surplus. Therefore, the analysis in this section serves as a preparation for the policy analysis presented in Section 4 by constructing a random utility model based on consumer cost and benefit associated with paying using each payment method.

3.1 Measuring consumers' benefit and cost of different payment methods

Discrete choice estimations of utility consumers derive from a given a set of alternatives rely on known prices that consumers pay for choosing each alternative. For example, random utility models of commuters' choice among transportation modes (bus, car, subway, train, or air) are based ticket prices (fares) and travel time that passengers endure using each transportation mode.

In contrast, researchers who study consumer payment choice are unable to figure out the exact price or cost of paying with each payment instrument. There are two reasons for that: First, it is very hard to separate variable from fixed costs associated with adopting and using a particular payment instrument. For example, the cost of paying cash is heavily influenced by ATM fees and their nearest location. Similarly, the cost of paying with prepaid cards depends heavily on the cost of reloading funds onto the cards. Second, some costs of payment instruments vary among consumers. In other words, the cost of using a particular payment method tends to be consumer specific. Consumer cost of paying with credit cards depends on whether the consumer is a borrower or a convenience user (who may also earn cash back). The cost of using debit cards depends

on checking account maintenance fees charged by the card issuing bank.[2]

For this reason, following Koulayev et al. (2016), Huynh et al. (2019) and Shy (2019), the analysis in this article uses respondent-specific assessments of each payment instrument to identify consumer-specific cost and benefit derived from using each payment instrument.[3]

Table 2 shows that 66.7 ($58.3 + 8.3$) percent of unbanked respondents assess cash to be a low payment instrument. 60.3 ($27.3 + 33.1$) percent of unbanked respondents assess debit cards to be a low cost payment instrument. Note that respondents' ratings 1 to 5 are not ranking in the sense that more than one payment method can be assessed as low cost. In other words, each assessment can take any number between 1 to 5 independently of the assessment ratings assigned to other payment instruments. Examining the "Median" column in Table 2, the median rating of the cost of cash is 1, followed by debit card 2, then by prepaid card 3, and then credit card 4.

The other two assessments used in this analysis are security and convenience. Table 2 shows that the median rating of security does not vary much among payment instruments. However, the median rating of convenience by unbanked respondents is slightly higher for cash than for other payment methods. Overall, Table 2 shows high variations in unbanked respondents' rating of security and convenience.

The advantage of using cost, security, and convenience assessments as explanatory variables for consumers' utility of using each payment instrument is that the data provide assessments by each individual separately. Therefore, the change in consumer surplus is computed from the perspective of each consumer (and also each transaction) separately. The data show that assessments tend to differ among respondents.

[2]For payment instruments' cost studies see: Schmiedel, Kostova, and Ruttenberg (2012), Krüger and Seitz (2014), Kosse et al. (2017), and references therein. Hayashi and Keeton (2012) and Shampine (2012) compare several payment cost studies and highlight the need for developing standards for cost estimation to facilitate comparisons across time and countries.

[3]Klee (2008) uses transaction time (ring time) in a multinomial logit payment choice model using scanner data from grocery stores where transaction time can be measured. Borzekowski and Kiser (2008) use three attributes: checkout time, whether the payment instrument is electronic, and whether it draws funds from a liquid account. Ching and Hayashi (2010) regress on 11 consumer-perceived attributes of each payment method. Arango, Huynh, and Sabetti (2015) regress on an index that combines perceptions of costs, acceptance, record keeping, ease of use, and risk of financial loss.

3.2 Implications for consumer welfare: A random utility model

This section constructs a random utility model as a preparation for Section 4 that analyzes the welfare consequences of making debit cards (with funding options) available to unbanked consumers. It should be emphasized that, for this purpose of this article, the terms *consumer welfare*, *utility*, and *consumer surplus* all refer to the net gain (benefit minus cost) consumers derive from the *paying* using a particular payment instrument. Here, the use of these three terms is substantially different from the widespread use of these terms to measure the benefits derived from *consuming* products or services that consumers purchase.

This section computes consumers' utility derived from each payment, where payments made by the same individual will be assigned the same cost, security, and convenience assessments made by the respondent who reported the payment.

Consider consumers who own several payment instruments. For each payment, a consumer selects payment instrument $i \in I$ to pay for the transaction, where I is the set of instruments the consumer has. For example, unbanked consumers have access to two payment instruments so $I = \{\text{cash}, \text{prepaid card}\}$. In a random utility model, the utility derived by respondent n from paying with payment instrument i for transaction t is defined by

$$U_{n,i,t} = V_{n,i,} + \epsilon_{n,i,t}, \quad \text{where} \tag{1}$$

$$V_{n,i} = \beta_C \, \text{cost}_{n,i} + \beta_S \, \text{security}_{n,i} + \beta_E \, \text{convenience}_{n,i}. \tag{2}$$

$\epsilon_{n,i,t}$ is the random component of the utility (1) which is assumed to be distributed Type I Extreme Value.

The second column in Table 3 displays values of the coefficients β_C, β_S, and β_E estimated without the constant term from a subsample of 120 unbanked respondents who made 352 payments (301 with cash and 51 with prepaid cards). Payment observations by the same individual n were assigned the same cost, security, and convenience assessments of the particular respondent.[4]

Table 3 shows that $\beta_C = -0.33 < 0$ which indicated that the utility of paying declines with the

[4]The estimation used the `mlogit` R-package. The three mixed logit random coefficients were estimated using drawings from a uniform distribution.

assessed cost of the payment instrument. Conversely, $\beta_E = 0.454 > 0$ which implies the utility of paying increases with the convenience of the payment instrument. The estimated values of β_S are small and are not statistically significant, which imply that utility is less sensitive to consumers' assessed security level relative to the other two attributes. The latter finding is consistent with the security assessments exhibited in Table 2.

The bottom five rows in Table 3 display coefficients and their standard deviations estimated from a mixed logit model. The estimated coefficients are slightly larger in absolute value than the coefficients estimated from the fixed-effects model. However, they have lower statistical significance levels. These reflect high variations resulting possibly from the fact that most payments by unbanked respondents were made with cash and only a few with prepaid cards (351 versus 51 payments).

4. Counterfactual analysis: Debit cards for the unbanked

The random utility model estimated in Section 3 is now used to investigate some policy measures suggested in the literature dealing with financial inclusions of consumers with no credit or debit cards and unbanked consumers. This investigation is accomplished by computing and comparing median and average consumer surplus before and after the hypothetical policy measure is implemented.

4.1 Policy proposals and the problem of funding

Perhaps, the simplest policy intervention discussed in the literature is making debit cards accessible to unbanked and underbanked consumers. On this line, Rogoff (2016) (pp. 98–100) explores the possibility of introducing subsidized debit cards. These cards could also be issued with a mobile device option.

It must be emphasized, however, that merely giving payment cards (or mobile apps) to people is not a complete solution because the problem of how to fund these cards must be an integral part of the solution. In particular, if the consumer is unbanked, the consumer can fund the card only with the use of cash (except for direct deposit of income). That is, a complete solution must also specify whether such cards will be linked to (and funded by) a commercial bank account

or a government-provided (or behalf of the government) bank account, and whether these accounts maintain 100-percent reserves in order to eliminate any risk. On this line, Baradaran (2015) advocates reenlisting the US Post Office in its historic function of providing bank services. If Baradaran's proposal were implemented, there would be more than 30,000 locations in the US that could be used to deposit cash for the purpose of funding debit cards.

However, funding could also be provided by the private sector if implemented on a large scale to maintain ubiquity. The M-Pesa in Kenya provides a good example of an innovative payment instrument for the unbanked. Founded in 2007 and introduced by Safaricom mobile phone service provider, it provides a unique payment and money transfer service via mobile phones.[5] In a country with mostly unbanked consumers, the real innovation was that M-Pesa tackled directly the 'funding problem' via small kiosks that were spread out in remote villages. In these kiosks, M-Pesa users can exchange cash for mobile money and the other way around. There is no equivalent service in the US because all mobile phone payment services rely on funding via credit cards, debit card, or bank accounts, hence cannot be used by consumers who do not have payment cards.[6]

The remainder of this article estimates the effects of these policy proposals by computing consumer surplus assuming first that unbanked consumers gain access to debit cards (with funding options), and second assuming that the cost of obtaining these debit cards is subsidized.[7]

4.2 Estimating change in consumer surplus

Suppose now that unbanked consumers gain access to debit cards (with funding options), so their payment method choice set becomes $\widehat{I} = \{\text{cash, prepaid card, debit card}\}$ which is larger than the initial payment choice set $I = \{\text{cash, prepaid card}\}$. Substituting the estimated values of the three coefficients given in Table 3 into equation (2) yields consumer n's estimated utility derives from paying with instrument i for transaction t. Then, following Train (2009) (chapter 3, page 56), the *per-payment* rate of change in consumer n's surplus resulting from the hypothetical addition of a

[5] See https://www.vodafone.com/what-we-do/services/m-pesa.

[6] In the US, there are some bank-like services where consumers can fund payment cards with direct deposits, for example, Netspend https://www.netspend.com, Chime https://www.chimebank.com, and Walmart Blue Bird card https://www.bluebird.com. The latter can also be funded with cash for free at any Walmart store.

[7] For similar counterfactual analyses of payments policy see Huynh et al. (2019) who estimate the effects of introducing central bank digital currency in Canada, and Shy (2019) who investigates the loss of consumer surplus assuming that all stores become cashless.

payment instrument (payment instrument i = debit) is computed by

$$\frac{\Delta CS_n}{CS_n} = \frac{\mathrm{E}(CS_n)_{\text{3PI}} - \mathrm{E}(CS_n)_{\text{2PI}}}{\mathrm{E}(CS_n)_{\text{2PI}}} = \frac{\ln\left(\sum_{i\in\widehat{I}} e^{V_{n,i}}\right) - \ln\left(\sum_{i\in I} e^{V_{n,i}}\right)}{\ln\left(\sum_{i\in I} e^{V_{n,i}}\right)}, \tag{3}$$

where $V_{n,i}$ are computed by substituting the estimated regression coefficients into (2) and evaluating $V_{n,i}$ at the assessment levels stated by respondent n. Subscript 3PI indicates the surplus with three payment instruments (cash, prepaid card, and debit card) after debit cards are added.

Two issues are worth noting about (3). First, individuals' marginal utility of income (which we do not know) are omitted from (3) because each marginal utility cancels out when expressed as a percentage change (instead of just a difference in consumer surplus). Second, the formulation (3) relies on the assumption that the estimated utilities of payment instruments $V_{n,i}$ for $i \in I$ do not change when the payment choice set expands from I to $\widehat{I}$. This assumption implies that the assessments of debit cards attributes (cost, security, and convenience) are independent of the assessments of cash and prepaid cards. This assumption is reasonable because respondents' assessments are ratings (not rankings) so each assessment can take any number between 1 to 5 independently of the numbers assigned to other payment instruments. From a technical perspective, (3) relies on the Property of Independence of Irrelevant Alternatives (IIA) in which adding or subtracting choice alternatives have no effects on the utility derived from other choice alternatives.

Expression (3) provides the formula for computing the rate of change in consumer surplus resulting from making debit cards accessible to unbanked consumers. The columns labeled "Med" and "Avg" in Table 4 display the median and average rates of change in per-payment consumer surplus. Table 4 also displays the 25$^{\text{th}}$ and 75$^{\text{th}}$ percentiles of the estimated utility rate changes.

The top row in Table 4 shows that there is a 21.4 increase in the average consumer surplus of unbanked consumers when they gain access to debit cards. This rate of increase jumps to 29.3 percent if debit cards are subsidized. Subsidized debit cards are modeled by setting consumers' cost assessment of debit cards to equal 1 instead of the values displayed on the third row in Table 2.

The fourth, fifth, and sixth rows in Table 4 display rates of change in consumer surplus of

the unbanked consumers corresponding to the mixed effect estimation. With mixed effects, providing debit cards increases average consumer surplus of unbanked consumers by 17.7 percent and a subsidy of this card brings it up to 26.1 percent. Finally, comparing the "Med" with "Avg" columns and also 25^{th} percentile with the 75^{th} percentile in Table 4 reveal large variations among the different individuals. This is expected given that, for some transactions, respondents paid with the payment instrument that they did not assess to be the lowest cost or the most convenient. This noise corresponds to the random component of the utility function (1).

5. Conclusion

This article identified strong correlations between household income and the variety of payment instruments available to consumers. The computations leading to Table 1 imply that 25.3 percent of respondents with household income not exceeding $20,000 are unbanked and do not have credit or debit cards. This percentage drops to 9.8 percent for income not exceeding $30,000 and to 7.8 percent for household income not exceeding $40,000. In general, FDIC (2018) finds that 6.5 percent of US household are unbanked.

Focusing on unbanked consumers with no credit or debit cards, this article estimates the increase in consumer utility associated with consumers' payment activities to be roughly 20 percent when these consumers gain access to debit cards (with appropriate funding options). It further increases by roughly 8 percent if the newly-introduced debit cards are subsidized. Table 4 provides the exact estimates.

Finally, the counterfactual analysis conducted in this article may be underestimating the gains from making more payment instruments available to consumer with no payment cards. This is because the addition of debit cards would likely facilitate some shift from in-person purchases and bill payments to online payments.

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Variable	0–10k	10k–20k	20k–30k	30k–40k	40k–60k	60k–80k	80k–120k	120k–180k	180k+	All
Both cards (%)	31.8	45.2	53.8	60.1	69.0	75.0	77.9	81.1	82.7	67.2
No credit (%)	38.3	34.4	25.4	23.5	13.5	9.5	6.7	3.0	2.4	15.1
No debit (%)	13.4	7.2	13.5	12.1	14.7	13.5	14.9	14.7	15.0	13.6
None banked (%)	2.5	2.7	1.2	0.7	0.2	0.0	0.1	0.0	0.0	0.6
None unbanked (%)	13.9	10.4	6.2	3.3	2.6	2.0	0.3	1.2	0.0	3.4
Num respondents	201	221	260	306	468	400	669	334	127	2986
Percentage (%)	6.7	7.4	8.7	10.2	15.7	13.4	22.4	11.2	4.3	100.0
Percentage (%)(w)	7.6	6.0	8.5	9.4	15.3	13.6	22.9	11.5	5.3	100.0

Table 1: Possession (adoption) of credit and debit cards by household income and payments statistics.

Source: Author's computations from the 2017 and 2018 Survey and Diary of Consumer Payment Choice.
Notes: The table displays information on 2986 respondents. The top five rows display percentage of respondents within each income group who have both credit and debit cards, no credit cards, no debit cards, and no credit or debit cards (banked and unbanked).

	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Median	Average
Cash cost assessment	58.3	8.3	31.7	0.8	0.8	1.0	1.8
Prepaid cost assessment	18.2	31.4	34.7	12.4	3.3	3.0	2.5
Debit cost assessment	27.3	33.1	27.3	12.4	0.0	2.0	2.2
Credit cost assessment	12.4	12.4	21.5	32.2	21.5	4.0	3.4
Cash security assessment	25.6	12.4	16.5	14.9	30.6	3.0	3.1
Prepaid security assessment	17.4	28.1	26.4	15.7	12.4	3.0	2.8
Debit security assessment	16.5	30.6	15.7	24.8	12.4	3.0	2.9
Credit security assessment	22.3	28.9	14.0	22.3	12.4	2.0	2.7
Cash convenience assessment	3.3	3.3	12.4	19.8	61.2	5.0	4.3
Prepaid convenience assessment	3.3	10.7	24.0	33.9	28.1	4.0	3.7
Debit convenience assessment	5.0	5.0	9.9	38.8	41.3	4.0	4.1
Credit convenience assessment	6.6	7.4	24.0	31.4	30.6	4.0	3.7

Table 2: Unbanked respondents' assessments of cost, security, and convenience of cash, prepaid cards, debit cards, and credit cards.

Source: Author's computations from the 2017 and 2018 Survey and Diary of Consumer Payment Choice.
Notes: Table displays information on 121 unbanked respondents who do not have credit or debit cards. Cost is rated 1 (lowest cost) to 5 (highest cost, hence less desirable). Security and convenience are rated 1 (least desirable) to 5 (most desirable).

Variables	Coefficients	Std.error	P-value	Sig.
Cost	-0.330	0.101	0.001	**
Security	0.048	0.067	0.471	
Convenience	0.454	0.119	0.000	***
Cost	-0.408	0.239	0.087	.
Security	0.060	0.089	0.500	
Convenience	0.595	0.343	0.082	.
Std.dev Cost	0.897	1.203	0.455	
Std.dev Security	0.100	2.791	0.971	
Std.dev Convenience	1.122	1.308	0.391	

Table 3: Estimated coefficients using random utility models.

Source: Author's computations from the 2017 and 2018 Survey and Diary of Consumer Payment Choice.
Note: The estimation is based on 352 payments made by 120 unbanked respondents who do not have credit or debit cards. *Top*: Logistic regression with fixed effects. *Bottom*: Mixed effects.
(***), (**), (*), and (·) correspond to the 0.1, 1, 5, and 10 percent significance levels, respectively.

		Change in consumer surplus (%)				
Counterfactual scenario	Method	25%	Med	Avg	75%	Std.
Provide debit card	FE	13.3	18.9	21.4	23.4	14.3
Subsidize debit card	FE	16.5	20.7	29.3	34.2	22.5
Provide debit card	ME	9.3	14.5	17.7	19.7	14.7
Subsidize debit card	ME	13.0	17.4	26.1	28.7	24.5

Table 4: Estimated percentage change in consumer surplus generated by providing access and subsidizing debit cards to unbanked consumers.

Source: Author's computations from the 2017 and 2018 Survey and Diary of Consumer Payment Choice.
Note: Table displays utility computations for 120 unbanked respondents who do not have credit and debit cards. FE refers to logistic regression with fixed effects. ME refers to mixed effects.

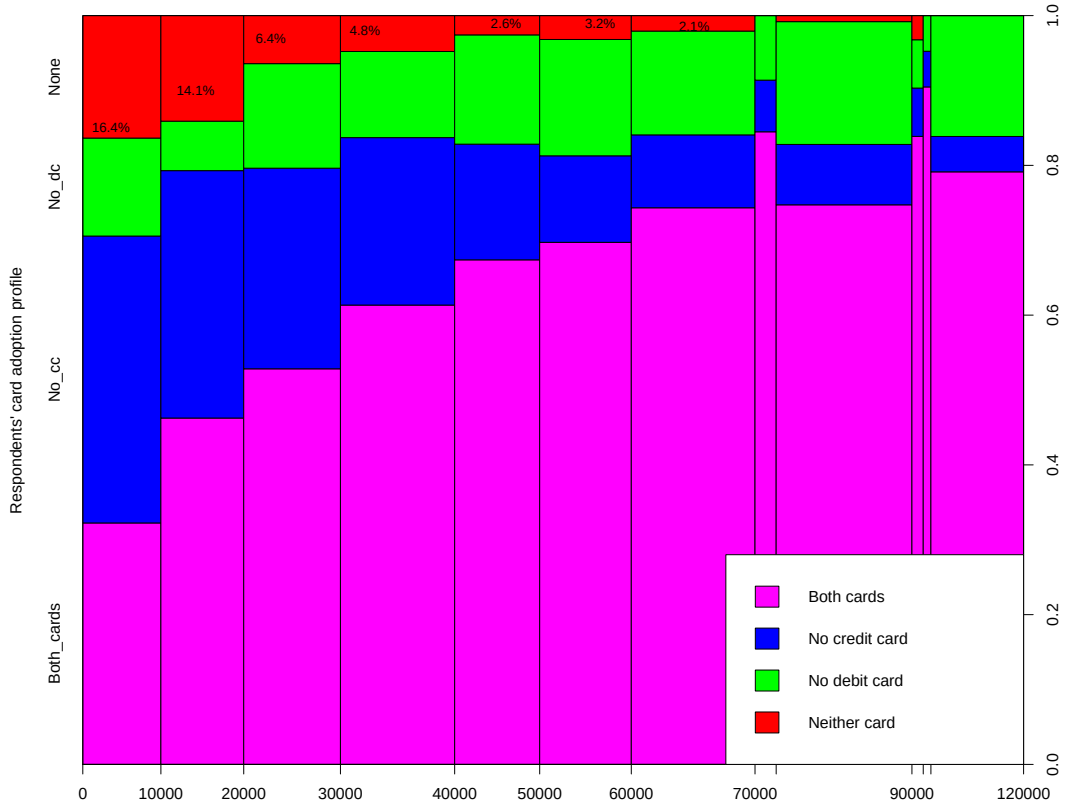

Figure 1: Respondents' possession of credit and debit cards by household income.

Source: Author's computations from the 2017 and 2018 Survey and Diary of Consumer Payment Choice.
Note: Based on 3026 respondents with household income not exceeding $120,000.