Is Cash Here to Stay?

An Exploration of the Factors that Drive Individual Cash Use

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Abstract

Technology has rapidly transformed almost every aspect of our lives - including the way we carry out payments. Within recent years, the development of PayPal, Ripple, Venmo among other mobile payment systems has accelerated the presence of cashless technologies across the US. Yet, despite this growth in technology, cash continues to make up a substantial portion of everyday transactions. Why has cash usage persisted in spite of the revolution of technology in the last decade? Using survey data from the Federal Reserve's 2015, 2016 and 2017 Diaries of Consumer Payment Choice – this project attempts to draw more conclusive insights on this question. The analysis is twofold. Firstly, the web application provides an opportunity to visualize the factors driving individual cash usage, focusing on three main questions: Who uses cash? What is cash used for? And, when is cash used? Secondly, a regression model is presented that predicts cash usage based on a series of demographic, transaction and time specific factors. Ultimately, the project concludes that a large portion of cash usage is driven by a very specific sub-set of the population – namely low income and education groups and older populations – that seem to be less responsive to changes in technology. Further, there are specific transaction types, mainly food and convenience, that lend themselves to cash usage across all populations. These factors seem to explain a considerable part of the puzzle of the persistence of cash.

Background and Significance

In the last two decades technology has dramatically altered many aspects of our lives, including the way we make payments. With the rapid expansion of mobile technologies like Venmo and PayPal many are suggesting that a cashless future is near.[1] But, as shown in Figure A.1 in Appendix A, cash remains a substantial portion of everyday transactions in the U.S. What has caused the persistence of cash despite tremendous growth in technology? In additional to impacting our everyday lives, this question has important societal implications. It is widely argued that cash usage is linked to crime, tax evasion and corruption.[2] Reducing cash usage, could therefore, have significant positive effects on society. In the opposite way, however, many are fearful of loss of privacy and security in a completely cashless society. Thus, there are many important reasons to be invested in what the future of cash will look like in the United States.

Methods

Data for this project was collected from the 2015, 2016 and 2017 Diaries of Consumer Payment Choice (DCPC). The DCPC is a survey of consumer payment behavior run by the Federal Reserve along with USC's Understanding America Study (UAS). The survey respondents were randomly assigned a three-day period and asked to track all of their payments using an online questionnaire. To the largest extent possible, each sample is representative of the US population. The 2017 survey data includes 2,793 individuals with 11,380 expenditures, data from 2016 includes 2,848 individuals with 12,407 expenditures and data from 2015 includes 1,392 individuals with 8,959 expenditures. Each of these data sets was merged together to form a large data set of 32,746 transactions. It's important to note one modification made in merging the data sets. The merchandise variable categories, each representing a different transaction type, were coded differently each year, therefore 2015/2016 categories were aligned with those in 2017.

As previously mentioned the analysis of this project is divided into two main parts. The first part of the project, presents a series of visualizations that can be used to understand trends in individual cash usage. The analysis focuses on three main questions: Who uses cash? What is cash used for? And, when is cash used?

The "who uses cash" section analyzes three categories of demographic variables that affect cash usage – highest education level, household income level and age. Since the variables highest_education and hh_income variable were collected as categorical variables a select box was used in shiny to allow each category of education and income to be selected. Age, on the other hand, was available as a continuous variable so a slider was utilized in Shiny to allow any age value to be selected. These changing demographic variables were imputed into a bar graph that presented the amount of each payment type used by the selected group. The raw totals were presented (instead of percentages) because it allowed for both relative transaction use (between payment types) and total transactions to be compared between different demographic groups.

The "what is cash used for" section analyzes differences in the relative cash usage among different transaction types (i.e. grocery and convenience, fast food, services). To best display this

1 "Rich Countries Must Start Planning for a Cashless Future," The Economist, n.d)

2 Vishal Marria, "What A Cashless Society Could Mean For The Future," Forbes, December 21, 2018)

information a stacked bar chart was used showing the breakdown of cash, debit card and credit card use for the top seven transaction type categories. Again a raw total was used to show differences in total expenditures in each transaction category in addition to differences in relative payment types used. And, a year selection button was incorporated into the Shiny app to allow for the breakdown of these relationships by year.

The "when is cash used" section analyzes changes in cash and total payment usage over the course of a 24-hour period. The first graph displays total transaction frequency over the course of the day relative to the transaction frequency for each payment type over the same 24-hour period. Since there was no significant differences between the frequency of payment types (other than the relatively low sample sizes for checks, prepaid and online payments) over the course of the day, trends in total payment usage for each transaction type were displayed in the second graph.

Lastly, the second part of the project presents a regression model with the following specification: $Cash_t = B_0 + B_1 demographics + B_2 transaction\text{-}level + B_3 time\text{-}specific + \varepsilon_t$. Where cash is a dummy variable equal to one if the transaction was carried out with cash, demographics is a vector of demographic variables including age, education, income, dummy variables for race, and preferences, transaction-level is a vector of transaction variables including the amount of the transaction and dummy variables for different transaction types and time-specific factors including the year. Since the dependent variable of the regression is a binary variable, a logistic model was used, where the coefficients are interpreted as a relative increase/decrease in the log of the probability of a cash transaction.

Results

The results of the project, in all, were very interesting. As shown in Appendix B there are significant differences in cash usage by education level. US residents with some high school education but no degree use a very high percentage of cash relative to other payment methods. Debit cards are the second highest payment method used, with checks, credit cards and prepaid methods at very low frequencies. This is substantially different than those with high school degrees who use more credit cards, debit cards and checks but still maintain the highest levels of cash usage. Those with bachelor's degrees seem to use equal parts cash, credit cards and debit cards and have higher levels of online payments. In each education category beyond a bachelor's degree (Masters, Professional and Doctorate) cash usage and debit card usage falls. The trends in income levels are very similar (see figures Appendix C). For incomes lower than $100,000 cash is universally the most used payment type with credit card and debit card usage increasing with increasing income. At the $100,000 income level, cash, credit card and debit card usage is about equal parts. And, in each successive income bracket above $100,000 cash and debit card sustainably decrease. With age, as shown in Appendix D, the trend is slightly different. Overall cash usage increases with age – those over 50 years old have consistent and high cash usage relative to other payment types. Interestingly and not surprisingly, check usage is highest among those eighty years and older and debit card usage is highest for those thirty-five and younger.

For the transaction-level analysis, the results were mixed. While there did not seem to be significant differences in cash usage for different transactions types over the three year period, there was significant differences in cash usage for particular types of transactions. Specifically,

cash made up a majority of convenience and grocery, fast-food and cafes and services payments. Thus, among all populations it seems like cash continues to be prevalent for food and convenience related payments.

There was also interesting results in the time-specific analysis. Overall, there were not significant differences in cash usage versus total payment usage over the course of a 24-hour period. In fact, across all payment types, total expenditures follows an almost normal curve – peaking at midday and falling consistently throughout the afternoon/evening. The most interesting results in this section, was looking at how transaction frequency changes for each merchandise type. Fast food for example peaked at 12am, 8am, 1pm and 7pm (all meal times in addition to a midnight snack). This was significantly different from sit-down restaurant transactions that peaked at lunch and dinner only. It's especially interesting that these trends were identified in the data.

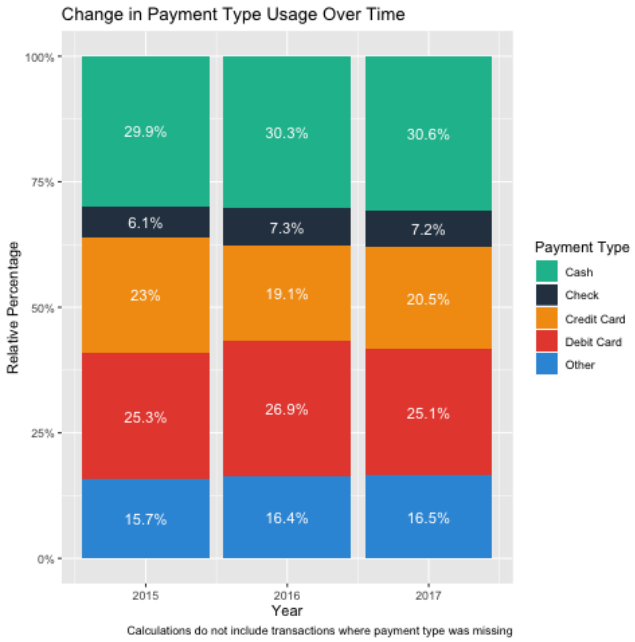
Finally, the regression findings confirm many of the preliminary visual trends. In the model, age, income and education level are strong predictors of cash usage, with higher age associated with higher probability of cash use and higher education/income level associated with lower probabilities of cash use. Additionally, the coefficients on the race dummy variables for Whites and Asians are significant and negative at the 10% level - meaning that white and Asian people have a lower probability of transacting with cash. The coefficient on transaction is negative - suggesting that cash is more likely to be used on lower value transactions. The coefficient on services, fast food and restaurants are also significant and positive - confirming trends shown in the transaction graphs that cash is more likely to be used with those transaction types. Interestingly, the preference variables indicate that those who prefer cash for transactions lower than $50 have an overall lower probability of transacting with cash, while those who prefer cash for transactions between $50 and $100 are more likely to transact with cash. This trend is especially interesting given the earlier finding that cash is more likely to be used for lower value transactions. It suggests that preference for higher values of cash is more indicative of an individual's overall affinity for cash use.

Conclusion

Overall, the findings of this project are extremely interesting. They point to very specific determinants of cash usage – demographic characteristics including age, education, income, race and preferences and transaction-level characteristics including transaction type and amount. Thus, it appears as if cash usage is driven by specific segments of the population with less access to technology. It's also driven by its ease and convenience for certain transactions like fast-food and cafes. These findings have important implications on US aspirations towards a cashless society. Further research is necessary to understand how technological development could negatively affect specific groups reliant on cash. A limitation of this project is that it focuses on cash usage only as a means of payment. Cash, in fact, has other uses like a store of value, so it would be interesting to also explore if/how technology has affected its other uses. Additionally, a limitation of the regression model is that standard errors were calculated under the assumption that all transactions are independent. This is not the case as there are multiple expenditures per person in the data. In further analysis, atandard errors should be clustered at the individual level to calculate their true value. Though the initial findings provide some clues, more research and data is necessary to fully understand the puzzling persistence of cash!

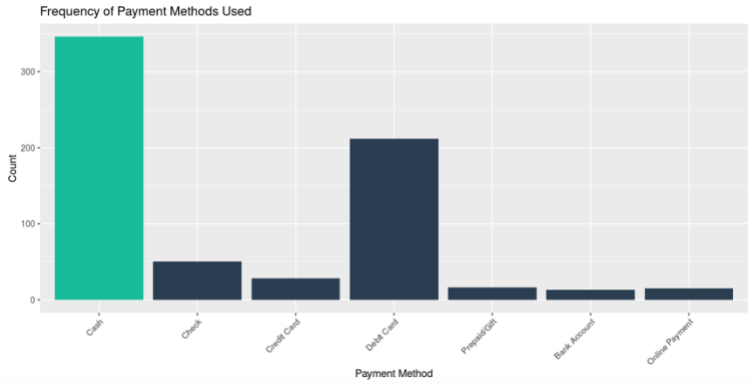
Appendix A

A.1 – Change in Payment Usage over Time

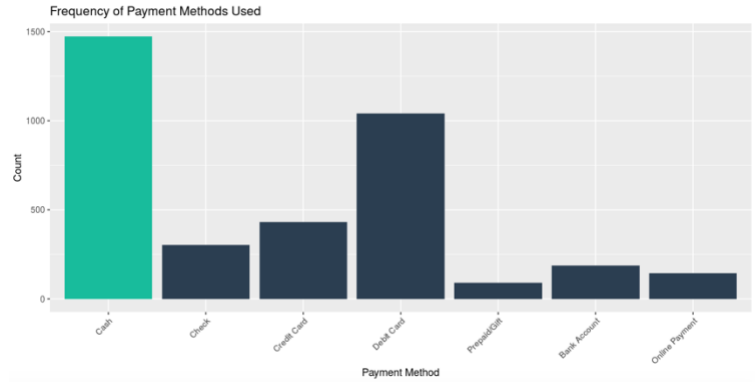


Appendix B – Cash Usage by Education Level

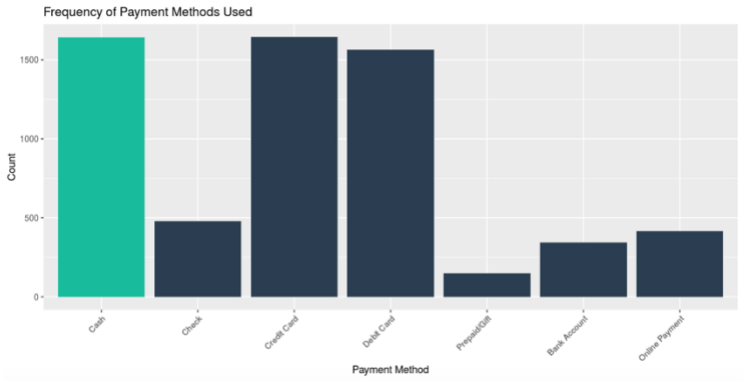
B.1 – Some High School, No Degree



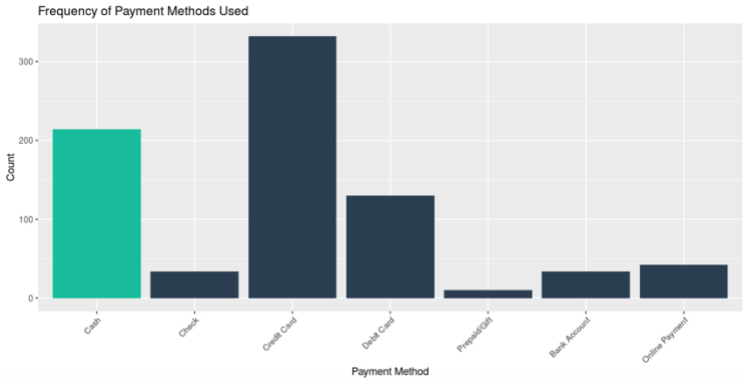
B.2 – High School Degree



B.3 – Bachelor's Degree

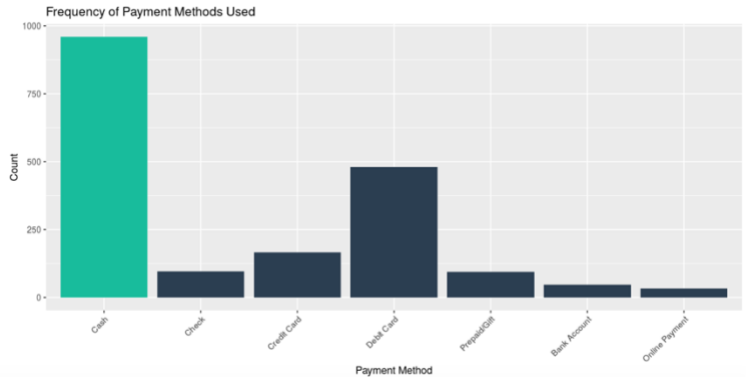


B.4 – Doctorate Degree

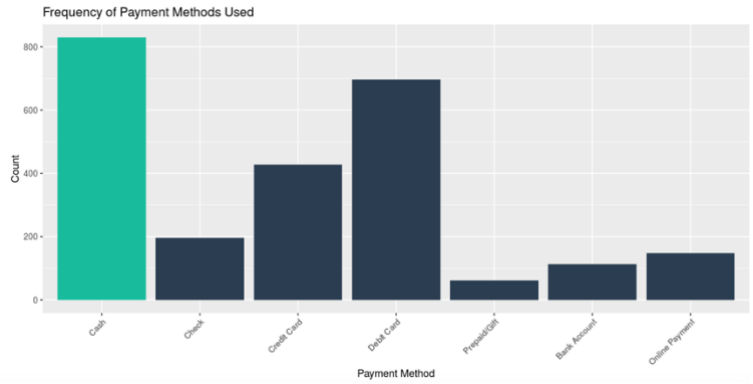


Appendix C – Cash Usage by Income Level

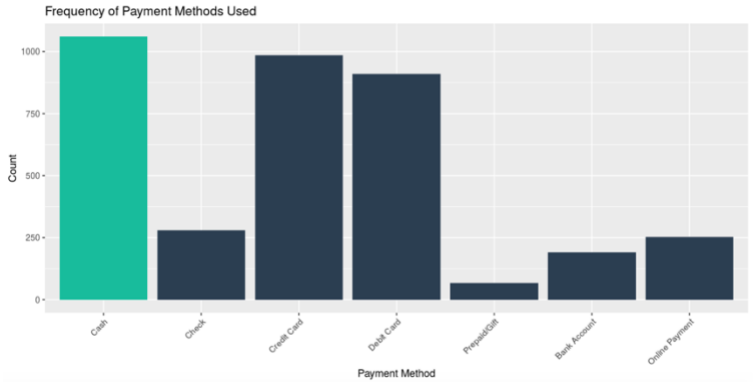
C.1 – Less than $10,000



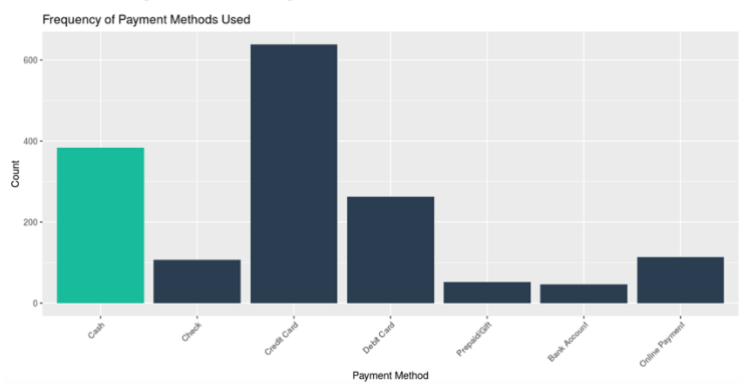
C.2 – $50,000



C.3 – $100,000

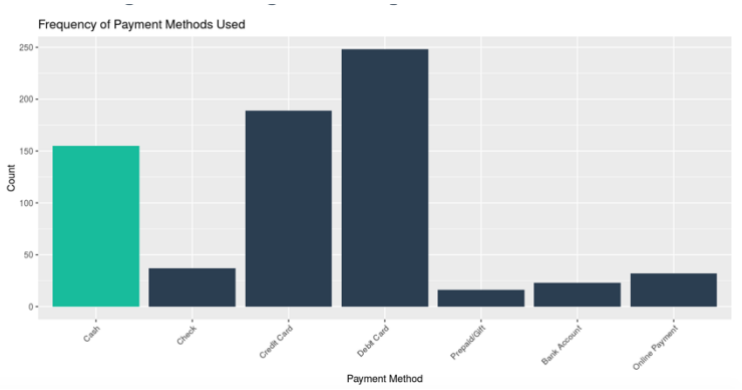


C.4 – $200,000 - $499,999

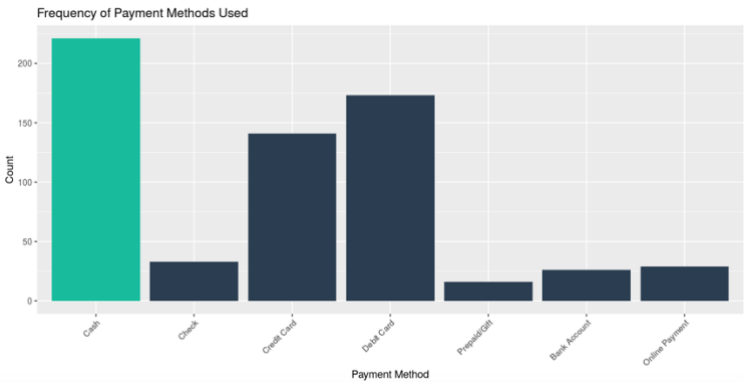


Appendix D – Cash Usage by Age

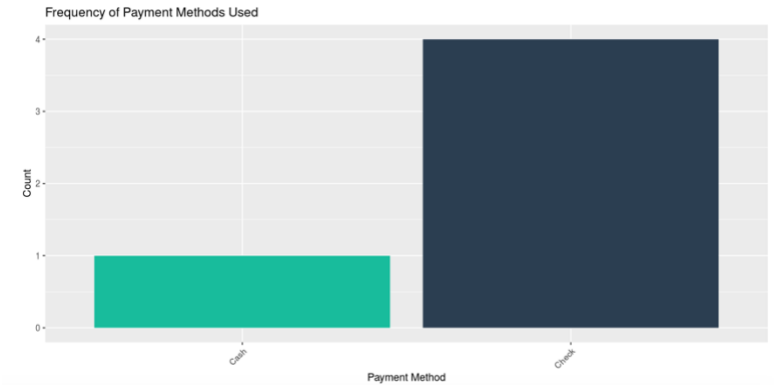
D.1 – 35 Year-olds



D.2 – 50 Year-olds

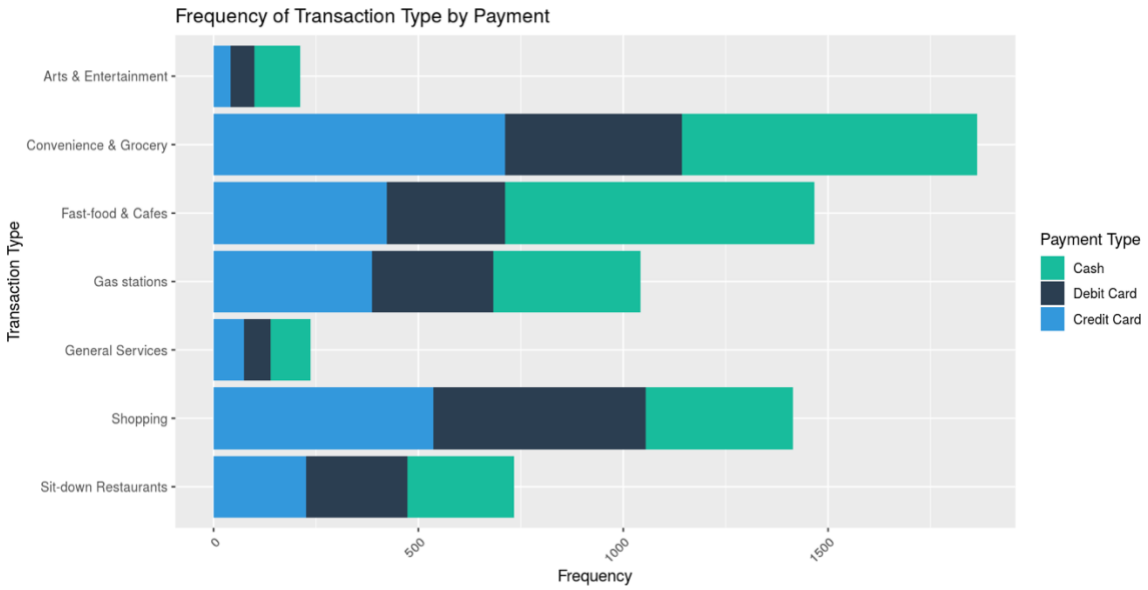


D.3 – 90 Year-olds



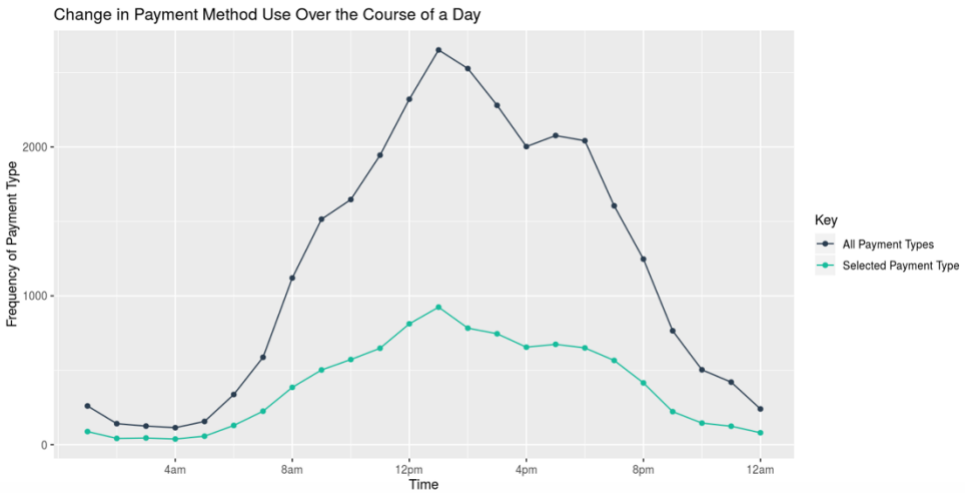
Appendix E – Cash Usage by Transaction Type

E.1 – Frequency of Transactions by Payment Type



Appendix F – Cash Usage Over Time

F.1 Frequency of all Payment Types vs. Cash Over the Course of a Day



Appendix G – Regression Model

	Dependent variable:
	Cash
Age	0.014***
	(0.001)
Income Level	-0.026***
	(0.006)
Gender	0.017
	(0.038)
Education Level	-0.082***
	(0.009)
Number of Credit Cards	-0.083***
	(0.019)
Race - White	-0.430*
	(0.233)
Race - Black	-0.025
	(0.233)
Race - Asian	-0.389*
	(0.230)
Race - Other	-0.244
	(0.261)
Transaction Amount	-0.019***
	(0.001)
Year2017	0.115***
	(0.037)
Fast Food	0.706***
	(0.050)
Gas	-0.180***
	(0.060)
Services	0.691***
	(0.096)
Restaurants	0.342***
	(0.065)
Pref. for Cash 100+	-0.016
	(0.023)
Pref. for Cash <10	-0.275***
	(0.017)
Pref. for Cash 10-25	-0.290***
	(0.018)
Pref. for Cash 25 - 50	-0.146***
	(0.028)
Pref. for Cash 50 - 100	0.089***
	(0.031)
Constant	2.142***
	(0.279)
Observations	18,143
Log Likelihood	-8,936.829
Akaike Inf. Crit.	17,915.660
Note:	*p**p***p<0.01

Works Cited

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