Appendix for "Payment Choice and Currency Use: Insights from Two Billion Retail Transactions"

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I. Forecast Details

We forecast the zip-code-level variables as follows. For racial composition and age composition, the United States Census Department's projections are used, adjusted for the level differences between the means of our sample and the national averages. Age/cohort effects are interpreted as primarily representing cohort. That is, for cohorts that were 15 or above in 2011, we assume that they carry with them their estimated marginal effect through 2020. The exception is the group age 14 and below; the regression estimates for this group are assumed to represent an age and not a cohort effect. Median nominal household income is forecasted to grow at a 2.5 percent annual rate, which is approximately equal to the 20-year national average. Educational attainment has been rising, and we forecast that it will continue to increase but at a slowing rate: The mean percentage of college graduates in our sample zip codes was 26.24 percent in 2011, and it is forecasted to reach 29.04 percent in 2015 and 32.04 percent in 2020. Bank branches per capita are forecasted to increase at 1 percent per year based on a trend identified from the FDIC's Summary of Deposits. The housing vacancy rate is forecasted to decline from 13.16 percent in 2011 to 12.25 percent in 2015 and 11.75 percent in 2020. All other zip-code-level explanatory variables are projected to remain constant at their zip-code-level means.

To evaluate the contributions of zip-code-level variables to the changes in forecasted cash fractions, we insert the forecasted values of zip-code-level variables into the estimated transaction-size regression models, and hold the day-of-week and day-of-month dummies fixed at their means. Holding fixed the month-of-sample dummies at March 2011, this procedure gives us forecasts for the payment mix based solely on changes in the zip-code-level variables. Note that there is a separate forecast associated with each of the payment size regressions.

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II. Tables and Figures

Table A1. Summary statistics of zip-code variables
(Entire U.S.)

Variable (unit)	Mean	Std. dev.	1%	99%
Cash holding and payment choice				
Banking HHI Metro	0.167	0.118	0.057	0.735
Banking HHI Rural	0.367	0.218	0.111	1.000
Branches per capita $(1/10^3)$	0.98	10.84	0.05	7.20
Robbery rate $(1/10^5)$	14.12	29.96	0.00	179.15
Adoption of non-cash payments				
Median household income ($)	50,011	21,475	20,001	128,961
Deposits per capita ($)	16,153	1,205,581	27.85	55,296
Population density (per mile^2)	1782	5815	1.80	21,159
Demographics (%)				
Family households	67.22	9.93	28.24	85.73
Housing: Renter-occupied	26.47	14.38	6.21	77.63
Owner-occupied	60.29	15.68	9.86	87.28
Vacant	13.24	10.77	2.81	60.23
Female	50.21	2.89	37.61	54.94
Age < 15	18.90	4.15	6.0	29.7
15-34	24.98	7.52	13.08	55.3
35-54	27.06	3.70	15.47	34.94
55-69	18.42	4.47	7.88	31.94
≥ 70	10.64	4.36	2.27	23.93
Race white	80.91	20.27	11.93	99.02
black	9.09	16.25	0.00	79.82
Hispanic	10.18	15.64	0.30	78.69
Native	1.08	4.39	0.00	16.11
Asian	2.73	5.89	0.00	31.41
Pac-Islr	0.11	0.69	0.00	1.15
other	3.76	6.32	0.00	31.87
multiple	2.32	1.97	0.27	7.82
Educ below high school	15.20	11.38	0.00	54.0
high school	34.60	13.18	0.00	70.6
some college	20.91	8.89	0.00	49.6
college	29.30	16.71	0.00	80.4
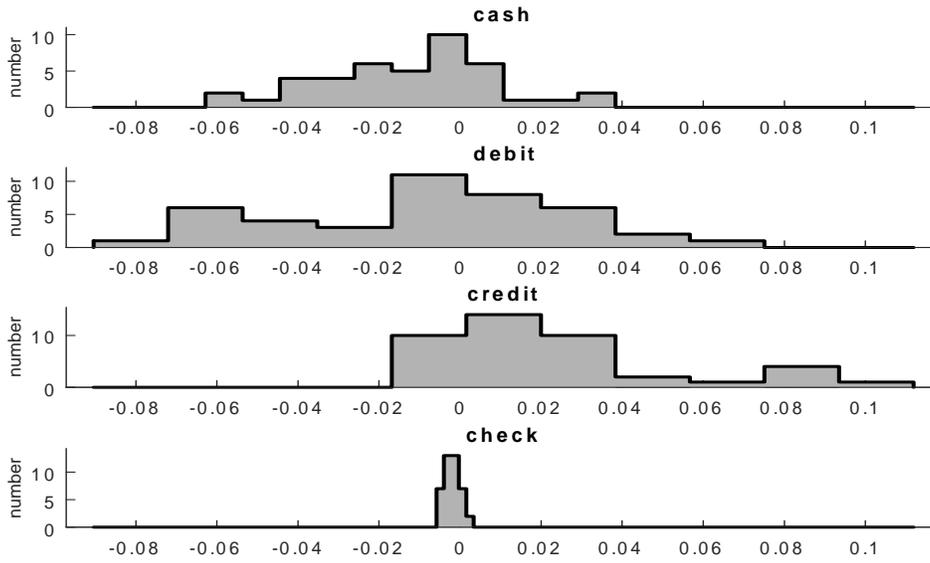
Figure A1. Histogram of State Dummies from the Overall Regression.
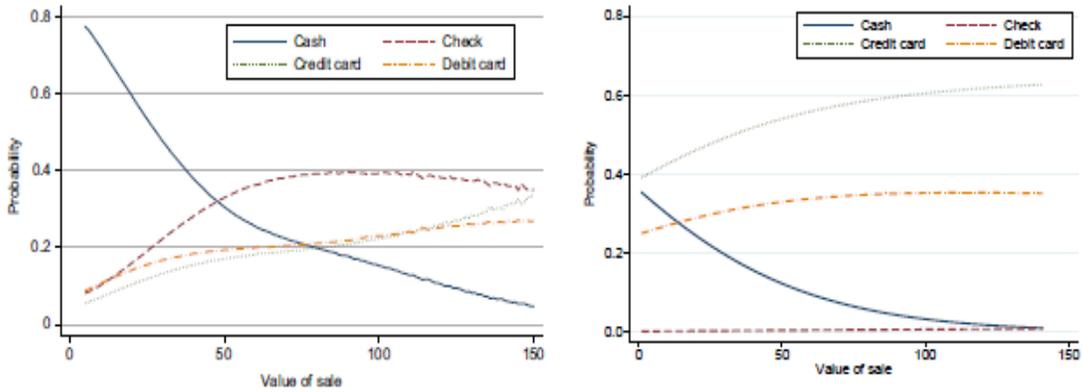
Figure A2. Payment Probabilities at Grocery Stores in 2001 (left, from Klee, 2008) and in 2012 (right, from Briglevics and Schuh, 2014).

Table A2. Cash: marginal effects by transaction size

Variable	$1-$2	$10-$11	$25-$30	over $50
Cash holding and payment choice				
Banking HHI	0.018*	0.031*	0.028*	0.023*
Banking HHI*Metro	-0.026*	-0.056*	-0.048*	-0.039*
Branches per capita	0.003*	0.010*	0.013*	0.015*
Robbery rate	-0.012*	-0.087*	-0.120*	-0.128*
Adoption of non-cash payments				
Median household income	-0.011*	-0.044*	-0.082*	-0.148*
Deposits per capita	-0.001	-0.024*	-0.006	-0.032*
Population density	-0.051*	-0.087*	-0.056*	-0.028*
Demographics				
Family households	-0.008*	-0.149*	-0.228*	-0.250*
Housing Owner-occupied	0.005*	-0.024*	-0.067*	-0.087*
Vacant	-0.002	-0.052*	-0.106*	-0.146*
Female	-0.046*	-0.064*	-0.045*	0.011
Age 15-34	-0.037*	-0.250*	-0.371*	-0.421*
35-54	0.008*	-0.244*	-0.423*	-0.515*
55-69	0.079*	0.005	-0.151*	-0.240*
≥ 70	0.050*	-0.054*	-0.189*	-0.263*
Race black	0.003*	0.078*	0.105*	0.120*
Hispanic	0.000	0.028*	0.062*	0.091*
Native	0.031*	0.148*	0.209*	0.250*
Asian	-0.023*	-0.021*	0.038*	0.071*
Pac-Islr	-0.090*	-0.399*	-0.512*	-0.899*
other	0.030*	0.121*	0.128*	0.030*
multiple	-0.106*	-0.014	0.154*	0.406*
Edu high school	-0.019*	-0.269*	-0.382*	-0.387*
some college	-0.079*	-0.416*	-0.535*	-0.530*
college	-0.046*	-0.290*	-0.369*	-0.350*
Time & state dummies	included	included	included	included
Pseudo R-squared	0.11	0.11	0.11	0.10
Zip code-days (1,000)	4,505	4,498	4,483	4,405
Transactions (1,000)	198,700	67,465	50,800	37,905

Note: *1% significance level based on robust standard errors. The dependent variables are the fractions of each of the four general payment instruments used in transactions at stores in a zip code on a day between April 1, 2010, and March 31, 2013. The independent variables take their values in 2011. Banking HHI index is calculated by squaring each bank's share of deposits in a market (an MSA or a rural county) and then summing these squared shares. Metro is a dummy variable taking the value one when the banking market is an MSA, otherwise equal to zero. Branches per capita is measured as the number of bank branches per 100 residents in a zip code. Robbery rate is defined as the number of robberies per 100 residents in a county. Median household income is measured in units of $100,000 per household in a zip code. Deposits per capita is measured in units of $10,000 deposits per resident in a zip code. Population density is measured in units of 100,000 residents per square mile in a zip code. All the demographic variables are expressed as fractions.

Table A3. Debit: marginal effects by transaction size

Variable	$1-$2	$10-$11	$25-$30	over $50
Cash holding and payment choice				
Banking HHI	-0.014*	-0.022*	-0.023*	-0.026*
Banking HHI*Metro	0.019*	0.032*	0.031*	0.033*
Branches per capita	-0.002*	-0.006*	-0.009*	-0.009*
Robbery rate	0.014*	0.089*	0.144*	0.176*
Adoption of non-cash payments				
Median household income	-0.001*	0.007*	0.026*	0.066*
Deposits per capita	0.003*	0.027*	0.032*	0.062*
Population density	0.036*	0.086*	0.263*	0.464*
Demographics				
Family households	0.009*	0.128*	0.195*	0.200*
Housing Owner-occupied	-0.005*	0.010*	0.025*	0.024*
Vacant	-0.002	0.015*	0.035*	0.046*
Female	0.039*	0.096*	0.133*	0.117*
Age 15-34	0.033*	0.218*	0.324*	0.340*
35-54	-0.010*	0.189*	0.319*	0.364*
55-69	-0.057*	0.025*	0.156*	0.183*
≥ 70	-0.050*	-0.026*	0.021*	0.056*
Race black	0.004*	-0.042*	-0.042*	-0.028*
Hispanic	-0.001*	-0.024*	-0.046*	-0.067*
Native	-0.021*	-0.083*	-0.105*	-0.116*
Asian	0.011*	0	-0.020*	0.002
Pac-Islr	0.089*	0.678*	1.096*	1.384*
other	-0.019*	-0.056*	-0.031*	0.053*
multiple	0.098*	0.061*	0.046*	0.103*
Edu high school	0.009*	0.190*	0.243*	0.234*
some college	0.057*	0.301*	0.372*	0.371*
college	0.031*	0.185*	0.207*	0.170*
Time & state dummies	included	included	included	included
Pseudo R-squared	0.08	0.12	0.12	0.10
Zip code-days (1,000)	4,505	4,498	4,483	4,405
Transactions (1,000)	198,700	67,465	50,800	37,905

Note: *1% significance level based on robust standard errors. The dependent variables are the fractions of each of the four general payment instruments used in transactions at stores in a zip code on a day between April 1, 2010, and March 31, 2013. The independent variables take their values in 2011. Banking HHI index is calculated by squaring each bank's share of deposits in a market (an MSA or a rural county) and then summing these squared shares. Metro is a dummy variable taking the value one when the banking market is an MSA, otherwise equal to zero. Branches per capita is measured as the number of bank branches per 100 residents in a zip code. Robbery rate is defined as the number of robberies per 100 residents in a county. Median household income is measured in units of $100,000 per household in a zip code. Deposits per capita is measured in units of $10,000 deposits per resident in a zip code. Population density is measured in units of 100,000 residents per square mile in a zip code. All the demographic variables are expressed as fractions.

Table A4. Credit: marginal effects by transaction size

Variable	$1-$2	$10-$11	$25-$30	over $50
Cash holding and payment choice				
Banking HHI	-0.003*	-0.012*	-0.016*	-0.015*
Banking HHI*Metro	0.007*	0.028*	0.034*	0.034*
Branches per capita	-0.001*	-0.004*	-0.007*	-0.010*
Robbery rate	-0.002*	0.009*	0.008*	0.009*
Adoption of non-cash payments				
Median household income	0.011*	0.045*	0.082*	0.115*
Deposits per capita	-0.002	0.004	0.005	0.019*
Population density	0.017*	0.120*	0.232*	0.322*
Demographics				
Family households	-0.002*	0.026*	0.051*	0.084*
Housing Owner-occupied	-0.001*	0.008*	0.013*	0.011*
Vacant	0.004*	0.034*	0.057*	0.075*
Female	0.007*	-0.011*	-0.022*	-0.01
Age 15-34	0.005*	0.045*	0.084*	0.145*
35-54	0.003*	0.070*	0.149*	0.249*
55-69	-0.021*	-0.011*	0.046*	0.125*
≥ 70	0	0.073*	0.145*	0.194*
Race black	-0.007*	-0.026*	-0.033*	-0.043*
Hispanic	0.001*	0.003*	0.009*	0.021*
Native	-0.010*	-0.058*	-0.083*	-0.102*
Asian	0.013*	0.038*	0.051*	0.057*
Pac-Islr	0.002	-0.251*	-0.480*	-0.332*
other	-0.011*	-0.063*	-0.092*	-0.091*
multiple	0.009*	-0.018*	-0.078*	-0.235*
Edu high school	0.010*	0.072*	0.113*	0.123*
some college	0.021*	0.113*	0.161*	0.171*
college	0.015*	0.099*	0.141*	0.159*
Time & state dummies	included	included	included	included
Pseudo R-squared	0.12	0.14	0.15	0.12
Zip code-days (1,000)	4,505	4,498	4,483	4,405
Transactions (1,000)	198,700	67,465	50,800	37,905

Note: *1% significance level based on robust standard errors. The dependent variables are the fractions of each of the four general payment instruments used in transactions at stores in a zip code on a day between April 1, 2010, and March 31, 2013. The independent variables take their values in 2011. Banking HHI index is calculated by squaring each bank's share of deposits in a market (an MSA or a rural county) and then summing these squared shares. Metro is a dummy variable taking the value one when the banking market is an MSA, otherwise equal to zero. Branches per capita is measured as the number of bank branches per 100 residents in a zip code. Robbery rate is defined as the number of robberies per 100 residents in a county. Median household income is measured in units of $100,000 per household in a zip code. Deposits per capita is measured in units of $10,000 deposits per resident in a zip code. Population density is measured in units of 100,000 residents per square mile in a zip code. All the demographic variables are expressed as fractions.

Table A5. Check: marginal effects by transaction size

Variable	$1-$2	$10-$11	$25-$30	over $50
Cash holding and payment choice				
Banking HHI	0.000	0.003*	0.011*	0.018*
Banking HHI*Metro	0.000	-0.005*	-0.017*	-0.028*
Branches per capita	0.000	0.001*	0.002*	0.004*
Robbery rate	0.000	-0.011*	-0.032*	-0.057*
Adoption of non-cash payments				
Median household income	0.000	-0.008*	-0.026*	-0.033*
Deposits per capita	0.000	-0.007*	-0.031*	-0.049*
Population density	-0.002*	-0.120*	-0.440*	-0.758*
Demographics				
Family households	0.000	-0.005*	-0.018*	-0.033*
Housing Owner-occupied	0.000	0.007*	0.028*	0.052*
Vacant	0.000	0.003*	0.014*	0.026*
Female	0.000	-0.021*	-0.067*	-0.117*
Age 15-34	0.000	-0.013*	-0.037*	-0.064*
35-54	0.000	-0.015*	-0.046*	-0.097*
55-69	0.000	-0.018*	-0.051*	-0.069*
≥ 70	0.000	0.007*	0.024*	0.014*
Race black	0.000	-0.010*	-0.030*	-0.049*
Hispanic	0.000	-0.007*	-0.024*	-0.046*
Native	0.000	-0.007*	-0.021*	-0.031*
Asian	0.000	-0.017*	-0.068*	-0.130*
Pac-Islr	-0.001*	-0.028*	-0.104*	-0.154*
other	0.000	-0.002*	-0.005*	0.009*
multiple	-0.001*	-0.030*	-0.121*	-0.274*
Edu high school	0.000	0.007*	0.026*	0.030*
some college	0.000	0.002*	0.002	-0.011*
college	0.000	0.007*	0.020*	0.022*
Time & state dummies	included	included	included	included
Pseudo R-squared	0.003	0.06	0.11	0.11
Zip code-days (1,000)	4,505	4,498	4,483	4,405
Transactions (1,000)	198,700	67,465	50,800	37,905

Note: *1% significance level based on robust standard errors. The dependent variables are the fractions of each of the four general payment instruments used in transactions at stores in a zip code on a day between April 1, 2010, and March 31, 2013. The independent variables take their values in 2011. Banking HHI index is calculated by squaring each bank's share of deposits in a market (an MSA or a rural county) and then summing these squared shares. Metro is a dummy variable taking the value one when the banking market is an MSA, otherwise equal to zero. Branches per capita is measured as the number of bank branches per 100 residents in a zip code. Robbery rate is defined as the number of robberies per 100 residents in a county. Median household income is measured in units of $100,000 per household in a zip code. Deposits per capita is measured in units of $10,000 deposits per resident in a zip code. Population density is measured in units of 100,000 residents per square mile in a zip code. All the demographic variables are expressed as fractions.

Figure A3. Debit marginal effects by transaction size.
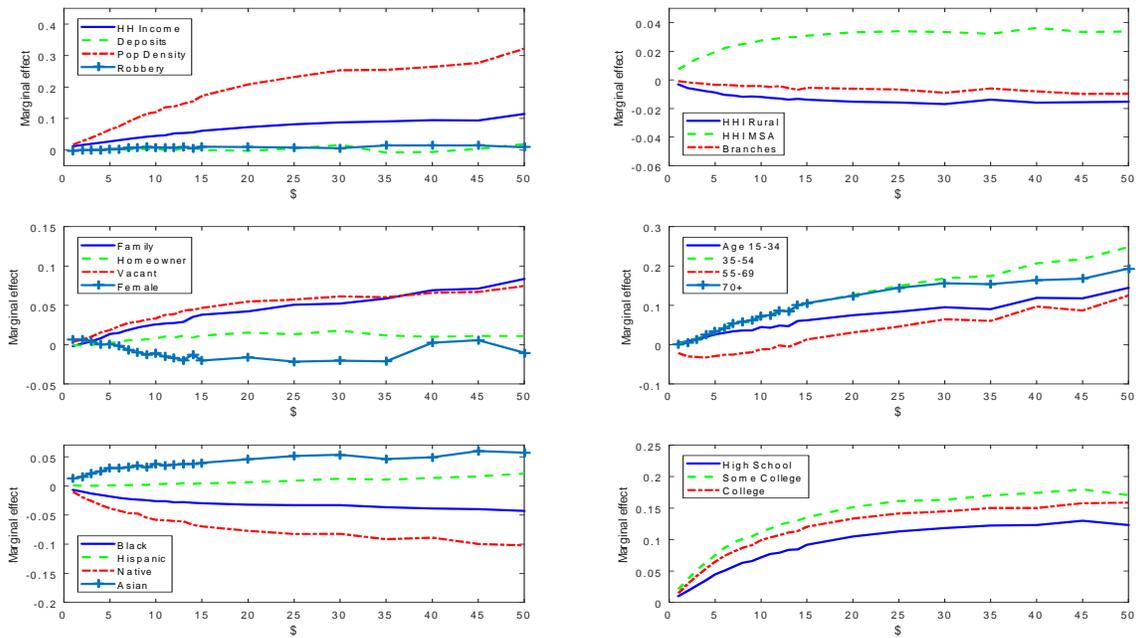
Figure A4. Credit marginal effects by transaction size.

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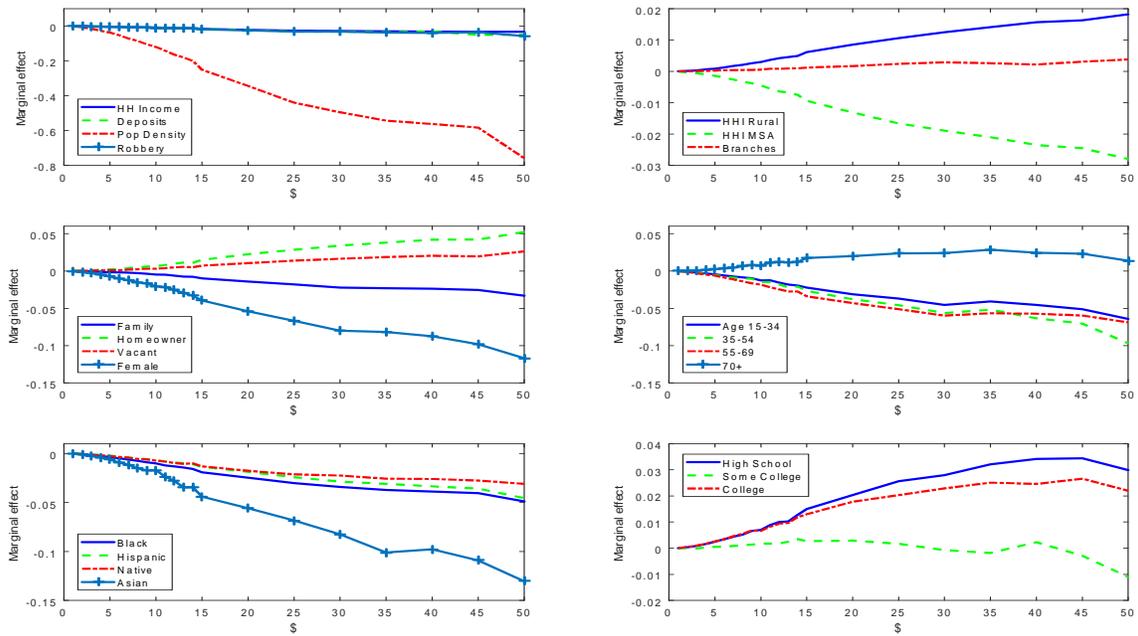
Figure A5. Check marginal effects by transaction size.
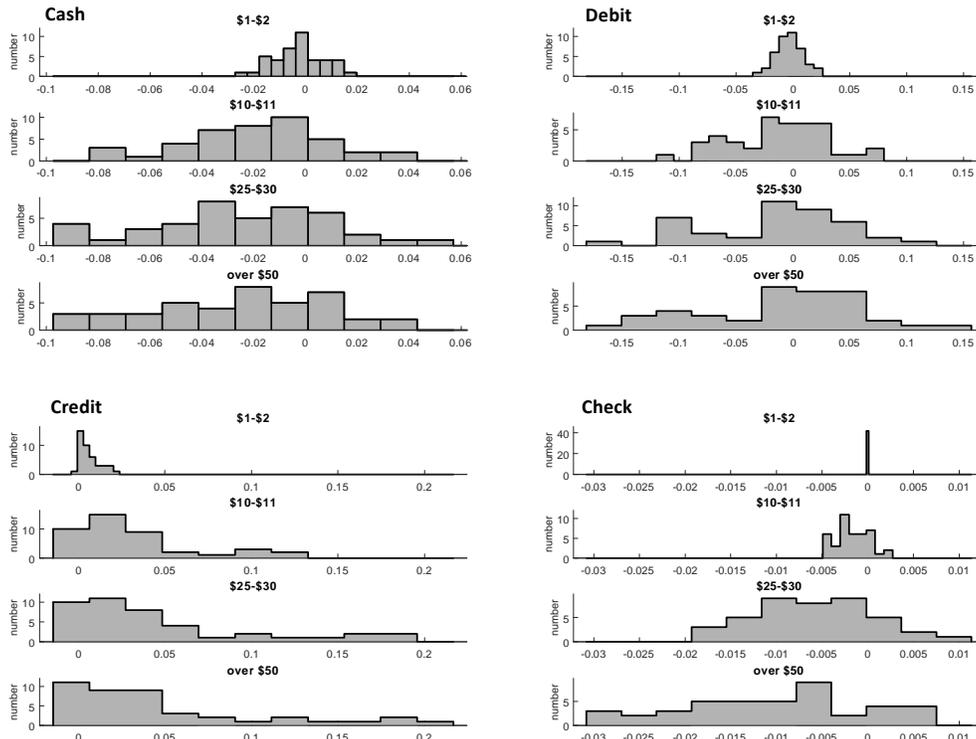
Figure A6. Histograms of state effects by transaction size.