U.S. Consumers' Demand for Cash in the Era of Electronic Payments and Low Interest Rates

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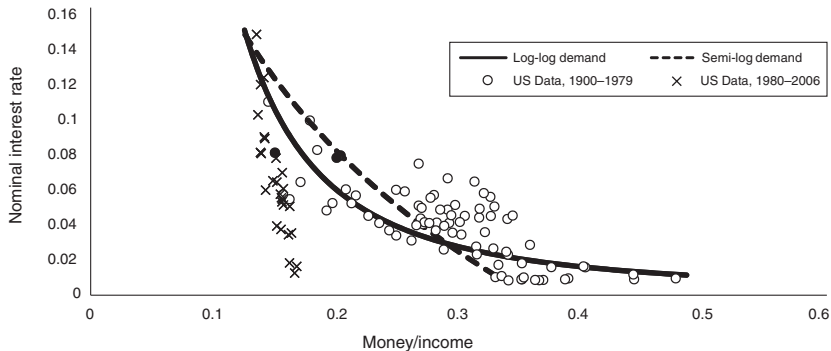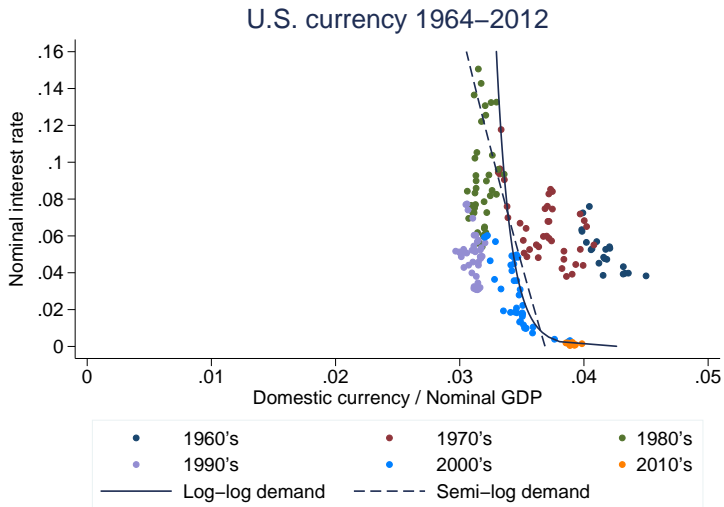
U.S. money demand—broad measure

FIGURE 2. US MONEY DEMAND, 1900–2006

Source: Peter N. Ireland, 2009, "On the Welfare Cost of Inflation and the Recent Behavior of Money Demand", *American Economic Review*, 99(3), pp. 1040-1052.

U.S. cash demand only

U.S. currency 1964–2012

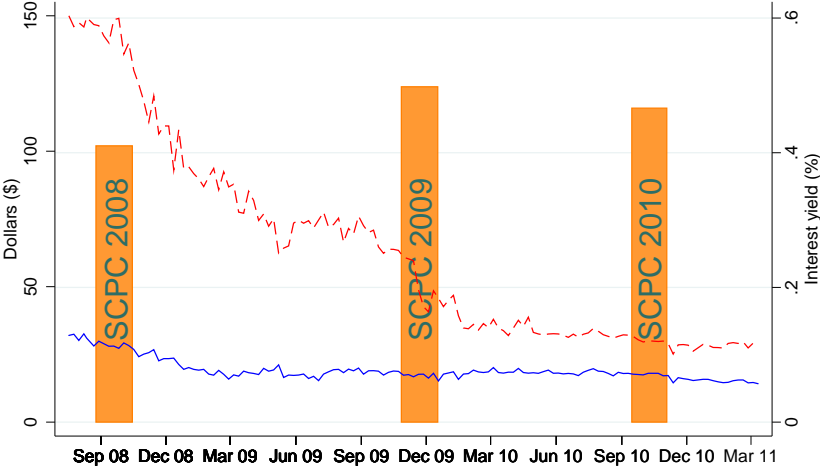Nominal interest rate (vertical axis): .16, .14, .12, .1, .08, .06, .04, .02, 0

Domestic currency / Nominal GDP (horizontal axis): 0, .01, .02, .03, .04, .05

Legend:
- 1960's
- 1970's
- 1980's
- 1990's
- 2000's
- 2010's
- Log–log demand
- Semi–log demand

U.S. consumer cash usage 1980s–2010

	1984/86 Average	2008-10 Average	Change
All values are in 2010 dollars			
Cash in pocket, purse or wallet			
average amount ($)	112	79	-33
share of monthly median income (%)	2.9	1.9	1.0
Cash withdrawals			
withdrawals per month (#)	4.3	5.6	1.3
usual amount per withdrawal ($)	261	132	-129
estimated monthly amount* ($)	817	488	-329
share of monthly median income (%)	21.0	12.0	-9.0
Cash payments			
per month (#)	na	19.2	na
share of monthly payments (%)	na	27.0	na

Sources: Survey of Currency and Transaction Account Usage for 1984-86, Survey of Consumer Payment Choice for 2008-10, median incomes from Census Bureau.

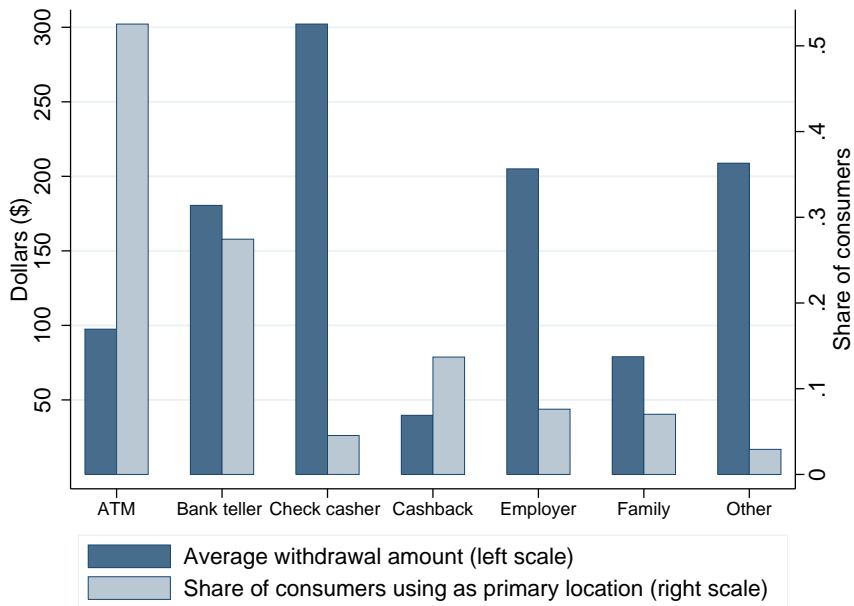* Derived from respondents' typical number and amount of withdrawal, may not equal actual totals.

Consumer cash withdrawals and interest rates

Consumer cash withdrawal locations

Figure: Bar chart comparing "Average withdrawal amount (left scale)" in Dollars ($) and "Share of consumers using as primary location (right scale)" across locations: ATM, Bank teller, Check casher, Cashback, Employer, Family, Other.

Consumers have more payment options
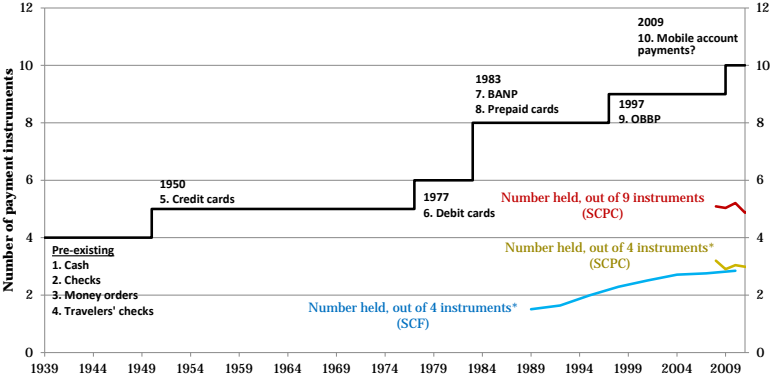
*The four instruments are checks, debit cards, credit cards, and some BANP.
Sources: 2008-2012 Survey of Consumer Payment Choice, 2011-2012 results unofficial and preliminary;
Survey of Consumer Finance; CPRC research

Overview of paper

- ► Motivation: Unusual time period
    - ► Near-zero interest rates for most bank accounts that provide checking services
    - ► Consumers have more payment instruments than ever before
- ► Research strategy:
    - ► New panel microdata on payment instrument use (SCPC)
    - ► Estimate econometric model similar to Mulligan and Sala-i-Martin (2000), Lippi and Secchi (2009)
- ► Key results:
    - ► Small interest elasticity of cash demand at low interest rates
    - ► Credit card debt appears to have a significant effect on the interest elasticity of cash demand
    - ► Withdrawal location (heterogeneity in transactions cost) has highly significant (level) effects (Lippi and Secchi (2009))

Selected literature

- ▶ Basic money demand model
  - ▶ Baumol(1952, QJE)-Tobin (1956, REStat); extended for credit card use: Sastry (1970, JoF) and Lewis(1974, JoF)
- ▶ Other extensions of BT model:
  - ▶ Alvarez and Lippi (2009, Econometrica), Miller and Orr (1966, QJE)
- ▶ *Microeconometric* studies of cash demand:
  - ▶ Mulligan and Sala-i-Martin (2000, JPE), Attanasio et. al. (2002, JPE), **Lippi and Secchi (2009, JME)**, Stix (2004, Empirica), Daniels and Murphy (1994, JMCB), Duca and Whitesell (1995,JMCB), Reynard (2004, JME)
- ▶ *Time-series* estimation of money demand:
  - ▶ Lucas (2000, Econometrica), Ireland (2009, AER), many others
- ▶ Welfare cost of costly credit:
  - ▶ Gillman (1993, JME), Lacker and Schreft (1996, JME), Ireland and Dotsey (1995, JME), Khan, King and Wolman (2003, REStud)
- ▶ Search theoretic models of cash and credit use:
  - ▶ Telyukova and Wright (2008, REStud), Telyukova and Visschers (forthcoming, JME)

BT model with credit cards (Sastry 1970)
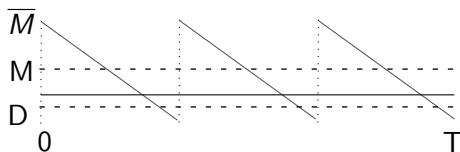
$$min_{W,\overline{M}} \quad RM + b \cdot \frac{C}{W} + R^{cc}D,$$

$$\text{s.t.} \quad M = \frac{\overline{M}^2}{2W}, \quad D = \frac{(W - \overline{M})^2}{2W}, \quad R^{cc} > R$$

$$W = \left(\frac{2bC}{R}\right)^{\frac{1}{2}} \left(\frac{R^{cc}}{R + R^{cc}}\right)^{\frac{1}{2}},$$

$$M = \frac{W}{2} = \left(\frac{bC}{2R}\right)^{\frac{1}{2}} \left(\frac{R^{cc}}{R + R^{cc}}\right)^{\frac{1}{2}}$$

$$\log(M_i) = \frac{1}{2}\log\left(\frac{b}{2}\right) + \frac{1}{2}\log(C_i) - \frac{1}{2}\log(R_i) + \frac{1}{2}\log\left(\frac{R_i^{cc}}{R_i + R_i^{cc}}\right) + \epsilon_i$$

Interest elasticities in the model with credit cards

$$M = \left(\frac{bC}{2R}\right)^{\frac{1}{2}} \left(\frac{R^{cc}}{R + R^{cc}}\right)^{\frac{1}{2}}$$

$$\frac{\partial \log(M)}{\partial \log(R)} = -0.5 \left[1 + \frac{R}{R + R^{cc}}\right]$$

Convenience users   **Revolvers**

R_0

Total spending   Total spending

Cash   Credit   Cash   Credit

$R_1 > R_0$

Total spending   Total spending

Cash   Credit   Cash   Credit
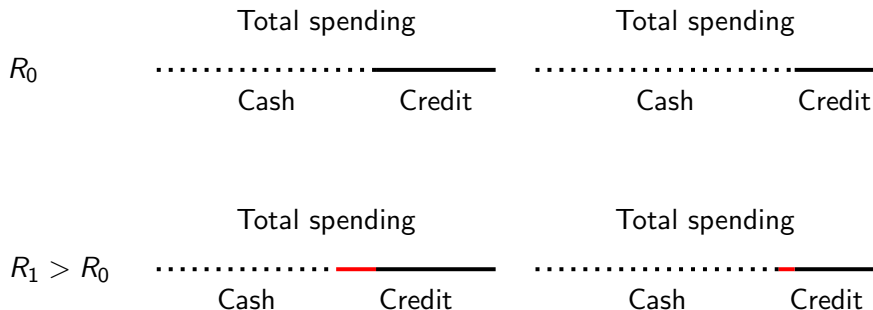
Survey of Consumer Payment Choice

- ▶ Annual internet survey of U.S. adults
- ▶ Representative sample from the *American Life Panel*
- ▶ Consumer choices of common payment instruments
    - ▶ Adoption of instruments
    - ▶ Use of instruments (number of payments)
    - ▶ Limited tracking of bank accounts
    - ▶ No data on credit card interest rates
        - ▶ But outstanding balance on credit cards is recorded!
- ▶ Part of the surveys asks about cash management:
    - ▶ Typical (modal) amount of cash withdrawn
    - ▶ Typical (modal) frequency of withdrawals
    - ▶ Location most frequently used (mode) for withdrawals
    - ▶ Actual amount of cash they have in their cash, wallet and purse
- ▶ Unbalanced longitudinal panel 2008-2010 (data for 2011-2013 to be released soon)
- ▶ Interest rates from the Bank Rate Monitor data set

Estimation sample composition

- Unbalanced panel, respondents appearing in 1, 2 or 3 years
- Estimation: Cash demand with control for self-selection
  - First-stage: Random-effects probit for adoption of interest-bearing checking account and credit card
  - Second-stage: OLS with bootstrapped standard errors (1,000 replications, bootstrapping individuals instead of observations).

	# of *observations* by year			
	2008	2009	2010	Total
Full SCPC sample	1,010	2,173	2,102	5,285
Estimation sample	561	788	1,091	2,440
	# of *respondents*			
# of *respondents* in 2008 only	166			
# of *respondents* in 2009 only	190			
# of *respondents* in 2010 only	421			
# of panel *respondents* 2008 and 2009	72			
# of panel *respondents* 2008 and 2010	144			
# of panel *respondents* 2009 and 2010	347			
# of panel *respondents* 2008-10	179			

Bank account and payment card adoption

	Full sample			Estimation sample		
Variable	2008	2009	2010	2008	2009	2010
Account adoption (%)						
Checking account	91.3	91.8	93.5	99.5	98.9	99.6
	(28.3)	(27.4)	(24.7)	(7.0)	(10.4)	(6.0)
Savings account	78.0	71.3	70.1	91.7	91.8	87.9
	(41.4)	(45.3)	(45.8)	(27.6)	(27.5)	(32.6)
Money market account	.	28.8	23.3	.	39.2	35.7
	(.)	(45.3)	(42.3)	(.)	(48.8)	(47.9)
Any interest bearing account	84.6	80.8	82.0	100.0	100.0	100.0
	(36.1)	(39.4)	(38.4)	(0.0)	(0.0)	(0.0)
Payment method adoption (%)						
Debit or ATM card	84.9	84.0	85.3	89.4	90.5	88.6
	(35.8)	(36.7)	(35.4)	(30.8)	(29.4)	(31.8)
Credit card	78.3	72.2	71.2	100.0	100.0	100.0
	(41.3)	(44.8)	(45.3)	(0.0)	(0.0)	(0.0)
Revolver	35.9	29.1	29.5	47.3	45.5	42.2
	(48.0)	(45.4)	(45.6)	(50.0)	(49.8)	(49.4)

Alternative cost of holding cash

	Commercial banks		Thrifts		Opportunity
	checking	mmkt.	checking	mmkt.	cost
	$R^{ch,cb}$	$R^{mm,cb}$	$R^{ch,th}$	$R^{mm,th}$	$\tilde{R}$
2008	0.118	0.342	0.641	0.729	0.418
	(0.050)	(0.196)	(0.180)	(0.481)	(0.336)
2009	0.064	0.155	0.222	0.413	0.179
	(0.026)	(0.087)	(0.109)	(0.199)	(0.161)
2010	0.065	0.144	0.127	0.281	0.124
	(0.026)	(0.073)	(0.038)	(0.122)	(0.099)

▶ BRM dataset reports the average interest yields of various account types at the state level (R_{it}) ▶ Graph

  ▶ Daniels and Murphy (1994) aside, microeconometric studies of U.S. money demand do not have/use interest rate data

▶ SCPC contains information on the adoption of these accounts ($\mathcal{I}_{it} = 1$ if adopted, 0 otherwise) and on the state of residence of respondents

▶ The *lowest* interest rate available to the respondent is taken as the alternative cost ($\tilde{R}$)

$$\tilde{R}_{it} = \min\left(R_{it}^{ch,cb}\mathcal{I}_{it}^{ch,cb}, R_{it}^{mm,cb}\mathcal{I}_{it}^{mm,cb}, R_{it}^{ch,th}\mathcal{I}_{it}^{ch,th}, R_{it}^{mm,th}\mathcal{I}_{it}^{mm,th} \right)$$

Econometric model: Adoption equations

$$z_{it}^* = \theta_0 + \theta_1 \cdot Y_{it} + \theta_2 \cdot wealth_{it} + \theta_3 R_{it} + \theta_4{}'\mathbf{X_{it}} +$$
$$\theta_5{}'\mathbf{assessments_{it}} + c_i + \varepsilon_{it}$$

$$z_{it} = \left\{ \begin{array}{ll} 1 & z_{it}^* > 0 \\ 0 & z_{it}^* \leq 0 \end{array} \right.$$

▶ We estimate the adoption equations for interest-bearing bank account, credit card separately
▶ Both equations are estimated as RE probit models; the unobserved effect accounts for a large part of the variance of the composite error.
▶ **assessments_{it}** and a dummy for homeownership are the omitted variables from the second-stage regression
  ▶ **assessments_{it}** are self-reported ratings (1(worst)-5(best) likert scale) of cost and acceptance of payment instruments
  ▶ Average log differences are used in the regressions (to eliminate level differences across respondents)

Adoption results

	Interest–bearing account		Credit card	
log(Income)	0.018***	(0.005)	0.047***	(0.006)
log(Wealth)	0.003**	(0.002)	0.006***	(0.002)
Age	-0.000	(0.000)	0.002***	(0.000)
Black	0.005	(0.012)	-0.055***	(0.013)
Less than HS educated	-0.040**	(0.021)	-0.076***	(0.024)
High-school educated	-0.020**	(0.009)	-0.044***	(0.009)
# of household members	-0.003	(0.002)	-0.012***	(0.003)
Disabled	-0.010	(0.015)	-0.077***	(0.017)
Income rank: 1st	0.011	(0.011)	0.039***	(0.012)
Income rank: 2nd	0.011	(0.013)	0.034**	(0.014)
Homeowner	0.025***	(0.009)	0.025***	(0.008)
Born abroad	-0.022*	(0.012)	0.049***	(0.019)
Year 2010	-0.014*	(0.008)	-0.024***	(0.008)
log(interest)	0.004	(0.007)	-0.007	(0.008)
Rating of credit card				
Cost			0.019***	(0.006)
Acceptance			0.059***	(0.015)
Pseudo R^2	0.051		0.193	
Observations	3,728		3,738	

Econometric model: Cash demand

$$\log(M_{it}) = \beta_1 \log(Y_{it}) + \beta_2 \log(\text{Cash share}_{it}) + \beta_3 \log(R_{it}) +$$
$$\beta_4 \left[\log(R_{it}) \times revoler_{it}\right] + \beta_5 \left[\log(R_{it}) \times branches_{it}\right] +$$
$$\mathbf{X_{it}}'\gamma + \rho'\lambda_{\mathbf{it}} + \epsilon_{it},$$

▶ We let the interest elasticity for *revolvers* and *convenience users* differ, exploiting that

$$R_{it}^{cc} = \left\{ \begin{array}{ll} 0 & \text{if convenience user} \\ > 0 & \text{if revolver} \end{array} \right.$$

▶ Demographic controls: age, gender, education, labor force, status, financial wealth; withdrawal location most often visited, time fixed-effects

Model identification results—Amount withdrawn

	(1)	(2)	(3)	(4)	(5)
log(Interest)	-0.009	-0.049	-0.064*	-0.063*	-0.054*
log(Interest) × revolver		0.094**	0.104**	0.110**	0.112***
log(Cash share)			0.177***	0.173***	0.139***
log(Income)	0.151***	0.142***	0.168***	0.230***	0.263***
log(Wealth)	0.084***	0.076***	0.069***	0.076***	0.068***
Withdrawal Method:					
Bank teller					0.365***
Check casher					0.347
Cashback					-0.758***
Employer					0.510***
Family					-0.603***
Other					0.371
Mills ratios:					
Interest–bearing acnt.				1.179**	1.156**
Credit card				0.062	0.071
Time effects	Yes	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.111	0.125	0.159	0.161	0.285
Observations	2,440	2,440	2,440	2,440	2,440

Model identification results—Cash in wallet

	(1)	(2)	(3)	(4)	(5)
log(Interest)	-0.034	-0.070*	-0.085**	-0.073	-0.071*
log(Interest) × revolver		0.085	0.096*	0.103*	0.104*
log(Cash share)			0.209***	0.207***	0.189***
log(Income)	0.253***	0.241***	0.273***	0.312***	0.344***
log(Wealth)	0.091***	0.082***	0.075***	0.076***	0.072***
Withdrawal Method:					
Bank teller					0.273***
Check casher					0.455
Cashback					-0.290***
Employer					0.268
Family					0.062
Other					0.599***
Mills ratios:					
Interest–bearing acnt.				-0.007	-0.029
Credit card				0.314*	0.300*
Time effects	Yes	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.148	0.159	0.187	0.188	0.208
Observations	2,363	2,363	2,363	2,363	2,363

Cash demand results—Part I

	(1)		(2)		(3)	
	Withdrawal amnt.		Avg. cash in wallet		# of withdrawals	
log(R)	-0.054*	(0.031)	-0.071*	(0.044)	0.064*	(0.033)
log(R) × rev.	0.112***	(0.039)	0.104*	(0.054)	-0.039	(0.040)
log(R) × brnch.	0.019	(0.038)	-0.034	(0.064)	0.007	(0.047)
log(Cash share)	0.139***	(0.018)	0.189***	(0.025)	0.198***	(0.019)
log(Income)	0.263***	(0.044)	0.344***	(0.055)	0.154***	(0.041)
log(Wealth)	0.068***	(0.014)	0.072***	(0.017)	-0.016	(0.011)
Revolver	0.038	(0.089)	-0.003	(0.123)	0.213***	(0.086)
Rewards cc.	0.177***	(0.048)	0.027	(0.066)	-0.171***	(0.048)
Age	0.006***	(0.002)	0.015***	(0.003)	0.006***	(0.002)
Male	0.106***	(0.044)	0.301***	(0.055)	-0.010	(0.039)
Single	0.054	(0.080)	-0.025	(0.110)	-0.037	(0.075)
Married	-0.058	(0.054)	-0.199***	(0.073)	-0.083	(0.051)
Employed	-0.203***	(0.052)	-0.133**	(0.070)	0.176***	(0.050)
Self-employed	0.170***	(0.067)	0.298***	(0.090)	-0.096	(0.062)
Hh. mmbrs (#)	-0.072***	(0.020)	-0.111***	(0.028)	0.059***	(0.018)

...

Bootstrapped standard errors in parenthesis (1,000 replications).
* $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Cash demand results—Part II

Withd. method						
	...					
Bank teller	0.365***	(0.050)	0.273***	(0.061)	-0.299***	(0.045)
Check casher	0.347	(0.364)	0.455	(0.383)	-0.340	(0.305)
Cashback	-0.758***	(0.050)	-0.290***	(0.075)	0.214***	(0.053)
Employer	0.510***	(0.179)	0.268	(0.172)	0.495***	(0.149)
Family	-0.603***	(0.116)	0.062	(0.144)	-0.244**	(0.118)
Other	0.371	(0.263)	0.599***	(0.190)	-0.164	(0.161)
Mills ratios						
Int. acnt.	1.156**	(0.556)	-0.029	(0.768)	0.833	(0.557)
Credit card	0.071	(0.099)	0.300*	(0.182)	0.105	(0.113)
Constant	1.099**	(0.503)	-0.848*	(0.644)	-0.533	(0.473)
Time effects	Yes		Yes		Yes	
Sample effects	Yes		Yes		Yes	
Month effects	Yes		Yes		Yes	
Adjusted R^2	0.285		0.208		0.166	
Observations	2,440		2,363		2,435	

Bootstrapped standard errors in parenthesis (1,000 replications).
* $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Is log(Cash share) an endogenous regressor?
GMM distance test

|	Withdrawal amnt.		Avg. cash in wallet	
log(Interest rate)	-0.053	(0.035)	-0.051	(0.049)
log(Interest rate)×revolver	0.113***	(0.042)	0.087	(0.057)
log(Cash share)	0.153	(0.224)	-0.168	(0.361)
log(Income)	0.257***	(0.041)	0.324***	(0.061)
log(Wealth)	0.069***	(0.017)	0.086***	(0.023)
Hansen J-test	1.927		2.814	
p-value	0.381		0.245	
GMM distance	0.003		1.103	
p-value	**0.954**		**0.294**	

Robust standard errors in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
H_0 : log(Cash share) is exogenous

- ▶ Instrument for log(Cash share) with the self-reported assessment of security of and cost of cash relative to debit and credit cards
  - ▶ GMM distance test shows that the IV model is not significantly different from the original model
  - ▶ Hansen J-test validates the exclusion restriction

Welfare Cost of Inflation
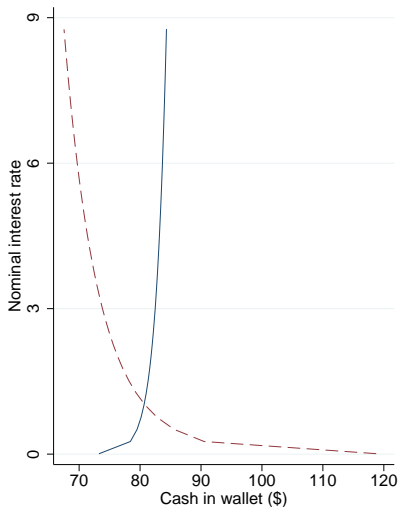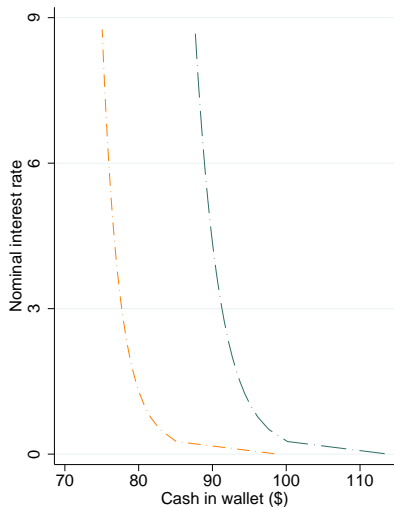
Conclusions and future research

- Conclusions:
    - Plenty of heterogeneity across consumers'
        - cash management
        - bank account management
    - Credit card debt has a significant effect on the interest elasticity of cash demand
    - With the increase of revolving debt, the welfare implications of these effects becomes more important

- Future research topics:
    - Extend estimation sample through 2013
    - Long-run money demand (1984-86 vs 2008-2010/13)
    - Money demand for unbanked
    - Modeling of joint payment-borrowing decision for credit cards
    - Generalized model of short-term liquidity management in 21st century

Interest rates by states