Daily Consumption Smoothing? New Evidence from a Payment Diary

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Introduction and Overview

1. **Motivation**: *Payments* $\approx$ *bank transactions* $+$ *advantages*
2. **Data validation**: *Unexpectedly high coverage of U.S.* C, Y *in real-time*
3. **PIH model estimation:** *Using daily time-series data for 1st time*
4. **Implications**: *For data and research; also payday policies?*

Related Literature

- **Payments data**: Representative diaries (Bagnall *et al* 2016, Schuh 2018, Brown et al. 2023)
- **Transactions data**: Literature review (Baker and Kueng (2022)
- **Measuring consumption**: C vs. X (Aguiar and Hurst 2005); CE data (Carroll et al. 2015)
- **Consumption theory**: Textbook (Jappelli and Pistaferri 2017)
- **Consumption estimation**: Reviews of excess sensitivity (Havranek and Sokolova, 2020), income shocks (Crawley and Theloudis, 2024)
- **Daily expenditures**: Paydays (Gelman et al. 2014, Olafsson and Pagel 2018, Gelman 2021, 2022), unanticipated income (Baker and Yannelis 2017, Baker 2018, Olafsson and Pagel 2018), Pay-cycle borrowing (Baugh and Correia 2022).
- **Expenditure shocks**: Miranda-Pinto *et al* (2025), Fulford and Low (2024)

Data Validation

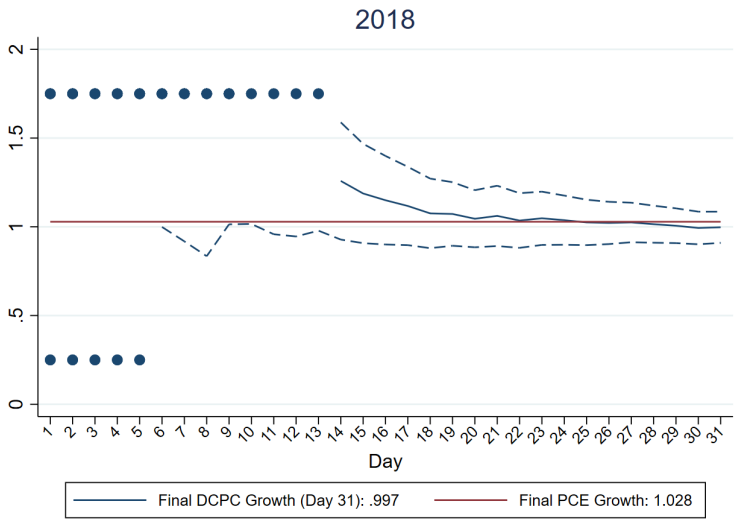
S/D Consumer Payment Choice...

- Annual Survey (SCPC)
- Daily Diary (DCPC), Oct 1 - 31
- *More representative, publicly available, data interviews, continuous improvement*

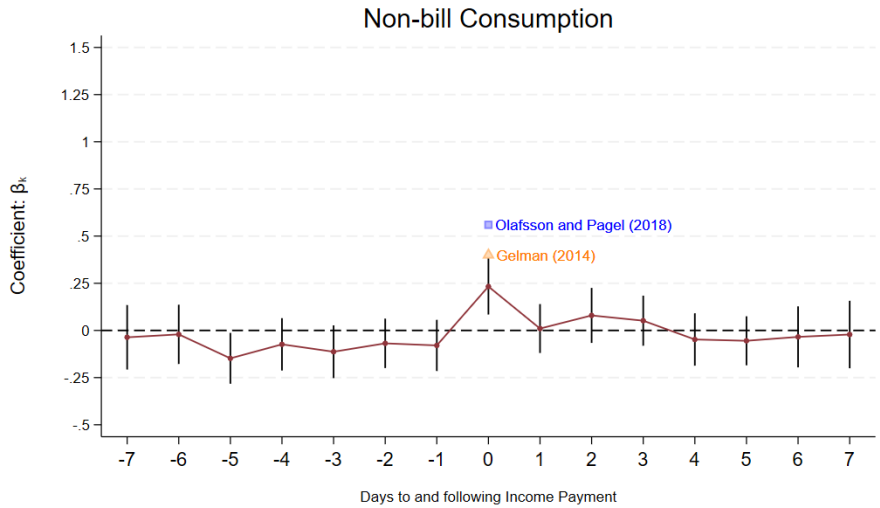
... matches adjusted US data,

	DCPC	Other
C (PCE)	72%	52% (CE)
Y^r (BEA)	76%	75% (IRS)
C/Y^r	94%	-

... forecasts PCE growth in real-time,



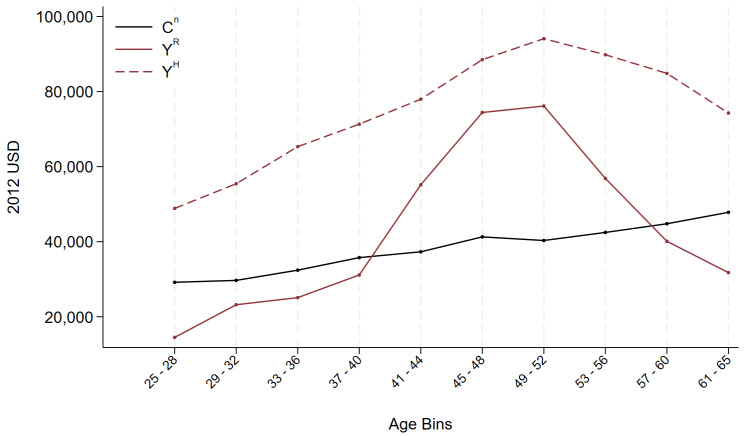
... and shows lower payday response



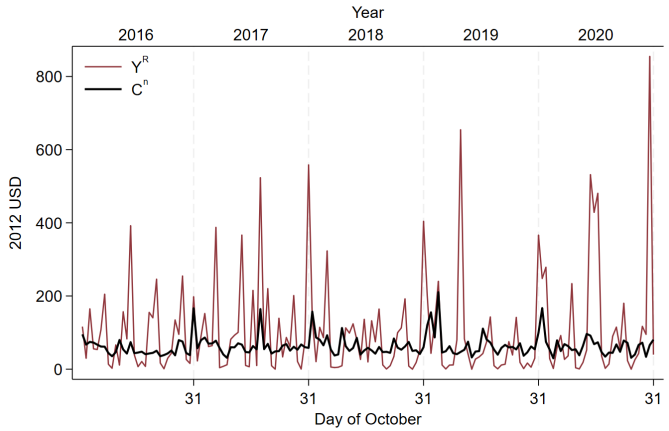
Data Info | ID Payments | Forecasting Details | PCE/BEA Details | Payday/Pay-cycle

New Data

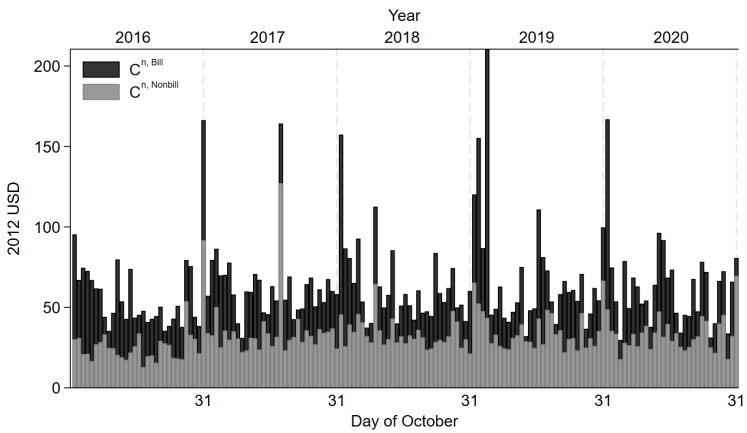
Standard Life-Cycle



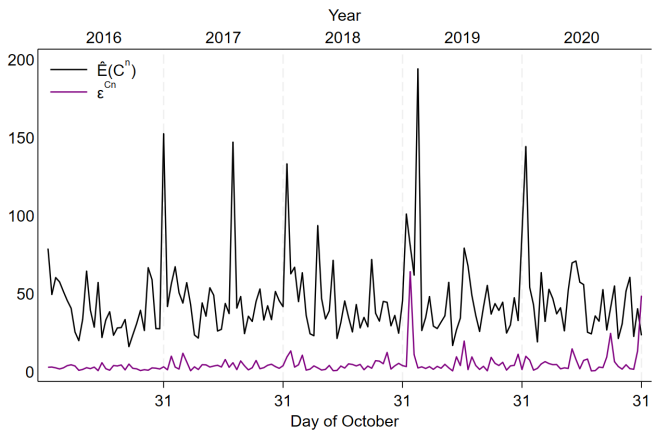
C smoother than Y



Lumpy bill payments



Expenditure shocks small, stable



Benchmark Model Estimates

C = consumption, $\widehat{Y}$ = model-predicted income, $\widehat{u}$ = unexpected income. $\widehat{Y}, \widehat{u}$ estimated by AR(1) Results. k = synthetic cohort A(7)G(2). ϵ_{kt} = expenditure shock (self-reported data).

$$\Delta C_{k\tau} = \beta_0 + \beta_1 \widehat{\Delta Y_{k\tau}} + \beta_2 \widehat{u}_{k\tau} + \beta_3 \Delta \epsilon_{k\tau} + \varepsilon_{k\tau}$$

H0: $\beta_1 = 0, \beta_2 > 0$ by PIH. $\beta_3 : C_{k\tau} = \mathbb{E}(C_{k\tau}) + \epsilon_{k\tau}$

	Lit.	Annual (t)		Daily (d)			
		ΔC_{kt}	$\Delta\mathbb{E}(C_{kt})$	ΔC_{kd}			$\Delta\mathbb{E}(C_{kd})$
Dep. Var:				*Total*	*Nonbill*	*Bill*	
Panel A: MPCs							
$\beta_1\left(\Delta\widehat{Y}_{kt}\right)$	0.200†	0.191	0.226	0.009	0.004	0.005	0.016
		(0.150)	(0.150)	(0.012)	(0.009)	(0.007)	(0.011)
$\beta_2\left(\widehat{u}_{k\tau}\right)$		0.062	0.031	0.003	0.013*	-0.009	0.001
		(0.209)	(0.197)	(0.011)	(0.007)	(0.012)	(0.012)
$\beta_3\left(\Delta\epsilon_{k\tau}\right)$			0.812				0.190***
			(0.700)				(0.048)
Panel B: Elasticities							
$\beta_1\left(\Delta\widehat{Y}_{k\tau}\right)$	0.197†	0.474	0.731	0.019***	0.052	0.670***	0.032**
		(0.406)	(0.558)	(0.005)	(0.442)	(0.193)	(0.012)
$\beta_2\left(\widehat{u}_{k\tau}\right)$		0.341	0.268	0.019***	0.855***	0.783***	0.033**
		(0.550)	(0.711)	(0.006)	(0.329)	(0.365)	(0.014)
$\beta_3\left(\Delta\epsilon_{k\tau}\right)$			0.052				0.030**
			(0.070)				(0.014)

[1] * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors are bootstrapped (1000 replications). † Havranek and Sokolva, 2020

- Results for 3 alternative income models similar, less precise (M0-M2).
- Extensions generally match literature (constrained/unconstrained, precautionary savings, nonseparable utility, full/partial insurance Results)

Daily Model Estimates by Income Frequency

Consumers paid weekly more likely to smooth consumption

Data Frequency:	Annual	Weekly		Daily				
	Full Sample		Sub Sample	Subsample by Income Frequency				
	K=A(7)G(2)	K=A(7)G(2)	Weekly Income	Weekly	Bi-Weekly	Semi-Monthly	Monthly	Misc.
MPCs								
β_1	0.191	0.079*	0.311	0.029	-0.006	0.061	0.011	0.003
	(0.150)	(0.046)	(0.400)	(0.065)	(0.025)	(0.062)	(0.018)	(0.016)
β_2	0.062	0.077	-1.338	-0.021	0.037	0.060	0.023	-0.010
	(0.209)	(0.058)	(3.949)	(0.067)	(0.033)	(0.100)	(0.039)	(0.017)
Elasticities								
β_1	0.474	0.062	0.571	0.016	0.009	0.060*	0.048**	0.016**
	(0.406)	(0.047)	(0.790)	(0.067)	(0.032)	(0.036)	(0.020)	(0.008)
β_2	0.341	0.144***	-2.620	-0.009	0.040	0.052	0.046	0.009
	(0.550)	(0.054)	(8.024)	(0.053)	(0.033)	(0.038)	(0.036)	(0.008)

[1] Each column is a separate regression. The first two columns estimate regressions when C and Y are aggregated to the same data frequency: annual and weekly respectively, where the "Weekly" Sub Sample is estimated for only those consumers who have weekly paycheck frequencies. We refer to these and Synchronous C,Y as consumption and income realizations are measured at the same frequency. The remaining columns estimate regressions for C and Y at the daily data frequency where C occurs daily, while income is measured daily but is in reality discrete dependent on paycheck frequency. We refer to these results as Asynchronous C,Y to denote the misalignment between consumption and income. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors or bootstrapped (1000 replications).

Sample Selection Effects

Simulated Convenience Samples

	SCPC Selected Subsample				
	PFM	Visa	M.P.	Checking Account	
				Commercial	Brokerage
Panel A: Fraction of CPS					
Age	-	-	-	-	-
Male	-	-	-	-	-
White	-	-	-	-	-
Employed	-	-	-	-	X
High-School	-	-	-	-	-
Bachelor's	-	-	-	-	X
$Y^H < 25k$	X	-	X	-	X
$Y^H \geq 100k$	X	-	X	-	X
Panel B: Fraction of SCPC					
PFM	NA	-	-	-	-
Visa	-	NA	-	-	-
M.P.	X	-	NA	-	-
Checking Account					
Commercial	-	-	-	NA	NA
Brokerage	-	-	-	NA	NA
Cash User	X	X	X	-	X
Shop Resp: All	-	-	-	-	-
Sav/Inv. Resp: All	-	-	-	-	-
Panel C: Fraction of DCPC (2016)					
$2000 Emergency: Savings Account	X	-	-	-	-

Daily Model Estimates

	Used Mobile Payment		Cash User	
	(1) No	(2) Yes	(3) No	(4) Yes
MPC				
β_1	0.079*	-0.012	0.053**	0.023
	(0.042)	(0.017)	(0.026)	(0.043)
β_2	0.073	-0.010	-0.016	-0.035
	(0.050)	(0.029)	(0.029)	(0.074)
Elasticities				
β_1	0.026	-0.014	0.005	-0.003
	(0.021)	(0.017)	(0.010)	(0.013)
β_2	0.023	0.025	0.030**	0.002
	(0.023)	(0.022)	(0.013)	(0.018)

[1] Table presents daily consumption equations across subsamples. K = Age(2)Subsample(2). Column groupings denote subsamples. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

- PFM, brokerage, and cash users consistently not representative (X) Numbers
- Mobile payment and cash users smooth consumption more than counterparts

Implications

1. **More and better data**
   - Improve measurement instruments
   - Expand data collection
   - Add tailored real-time respondent interviews
   - Increase support services (Atlanta Fed)

2. **Future research opportunities**
   - Expand textbook model for daily frequency and PFM
   - Target implementation to special topics (e.g., randomized tax rebates)
   - Merge with other data sources (e.g., credit bureau data)

3. **Policy questions**
   - Find alternate provider (Census, BLS, Fed Board)?
   - Employers should pay more frequently? (Gelman **et al** 2024)
   - PFM apps for depository institutions?

US Payments Data Structure

Return

- Annual *Survey/Diary of Consumer Payment Choice* Evolution of Payments
  - SCPC (2008-present): Sep, 30-minute online, recall
  - DCPC (2012, 2015-present): Oct 1-31, 3-days paper/online, recorded
  - Samples = 1,500-3,000; Frames = *ALP, UAS* (RAND, USC)

Figure: Survey/Diary Instruments

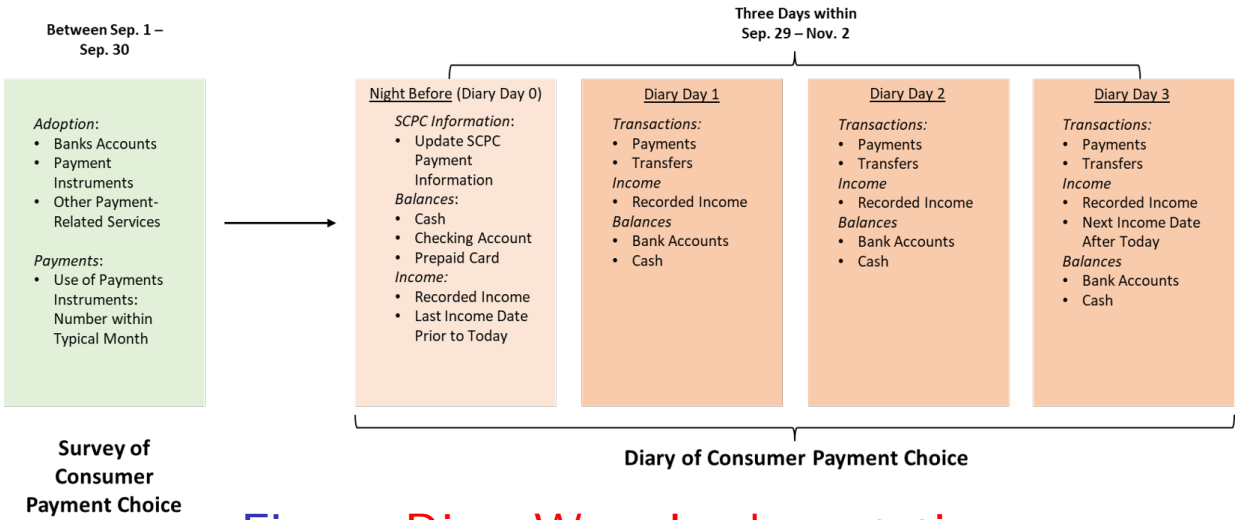


Figure: Diary Wave Implementation

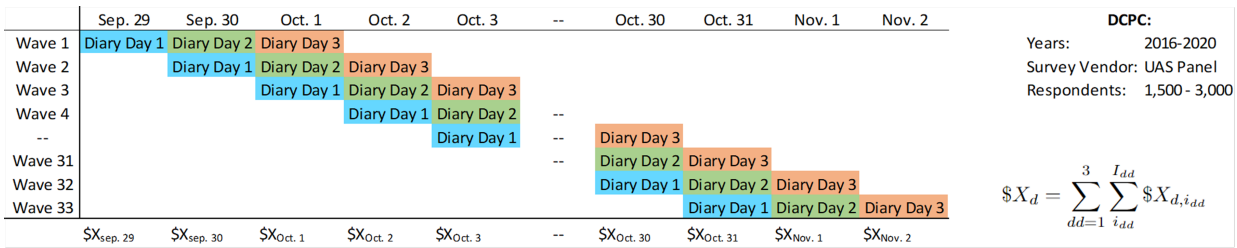
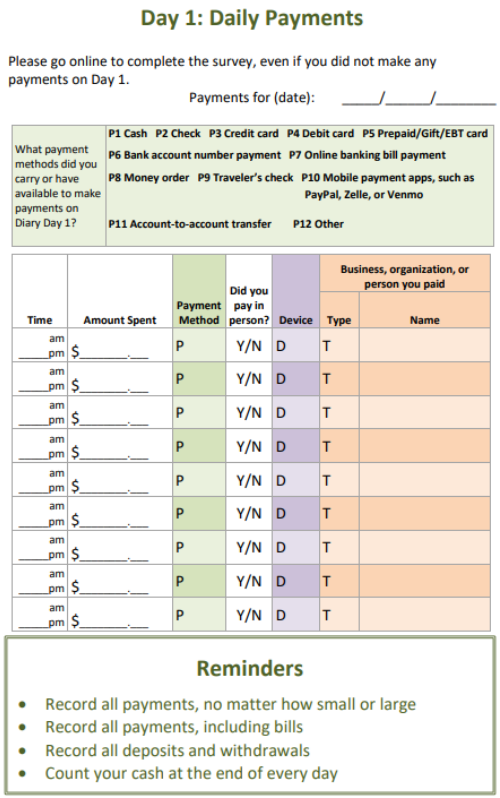


Figure: 2019 Paper Memory Aid (1 of 8 pages)



Motivation: Transformation of Payments

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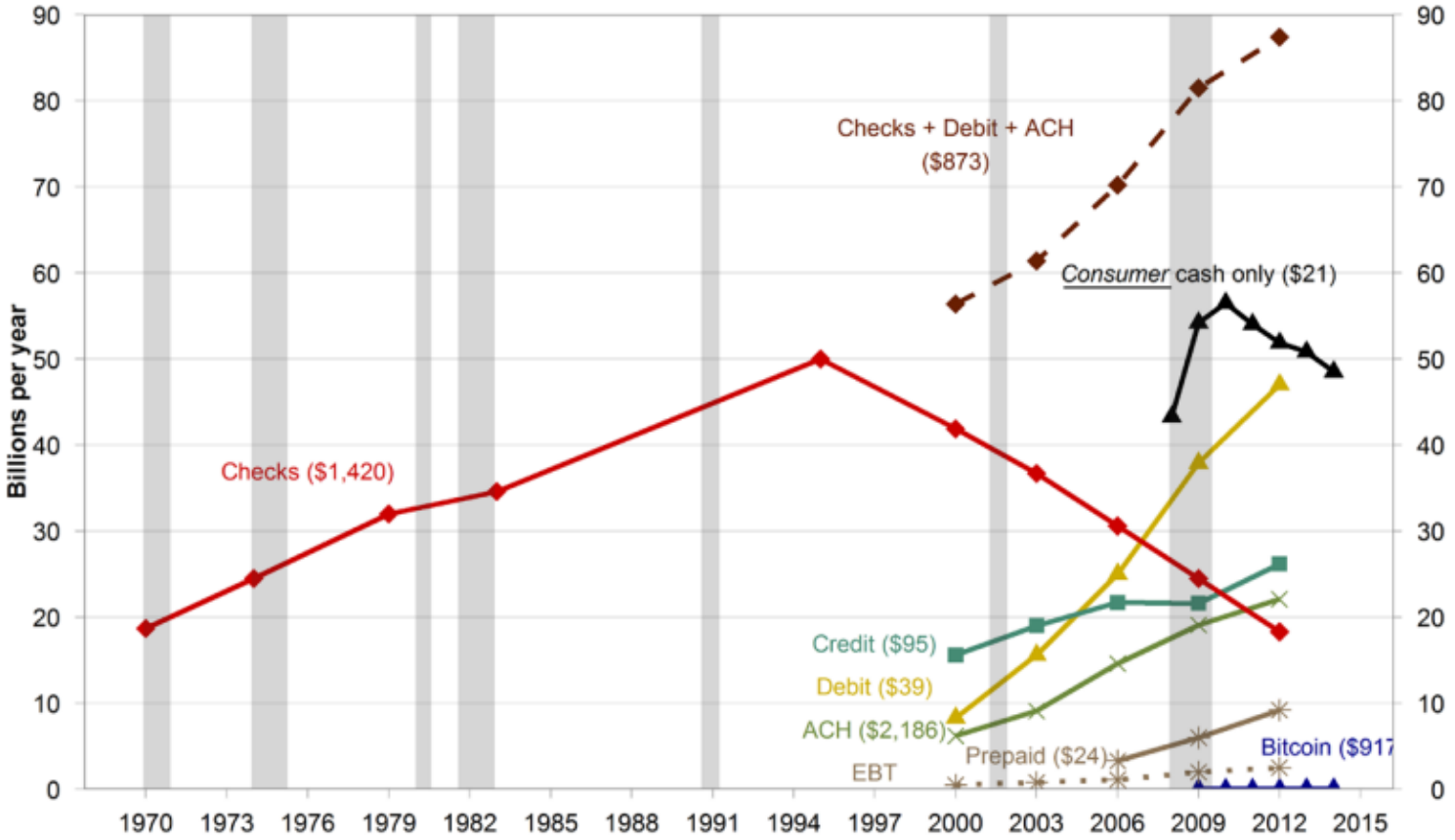
Figure: U.S. Number of Payments per Instrument



***Source**: Federal Reserve Payment Study (FRPS), Survey of Consumer Payment Choice (SCPC). Cash numbers are consumer only, and Bitcoin numbers are worldwide based on blockchain.info.

Identifying C, Y from Payments

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Payment expenditures (more precise measurement after 2012!)

$$X_t = X_t^c + X_t^o = [C_t^n + C_t^d] + [X_t^u + \Delta A_t + \Delta L_t]$$

- X^c, X^o = consumption, non-consumption expenditures;
- C^n = nondurable investment, C^d = durable investment
- X^u = undocumented expenditures; A_t = assets; L_t = debt.

Net Worth l=liquid, n=illiquid

$$NW_t = A_t - L_t = \left[A_t^l + A_t^n\right] - L_t$$

Cash flow D=deposits; W=withdrawals

$$\Delta A_t^l = D_t - W_t = [Y_t + D_t^o] - [X_t^c + X_t^n + W_t^o]$$

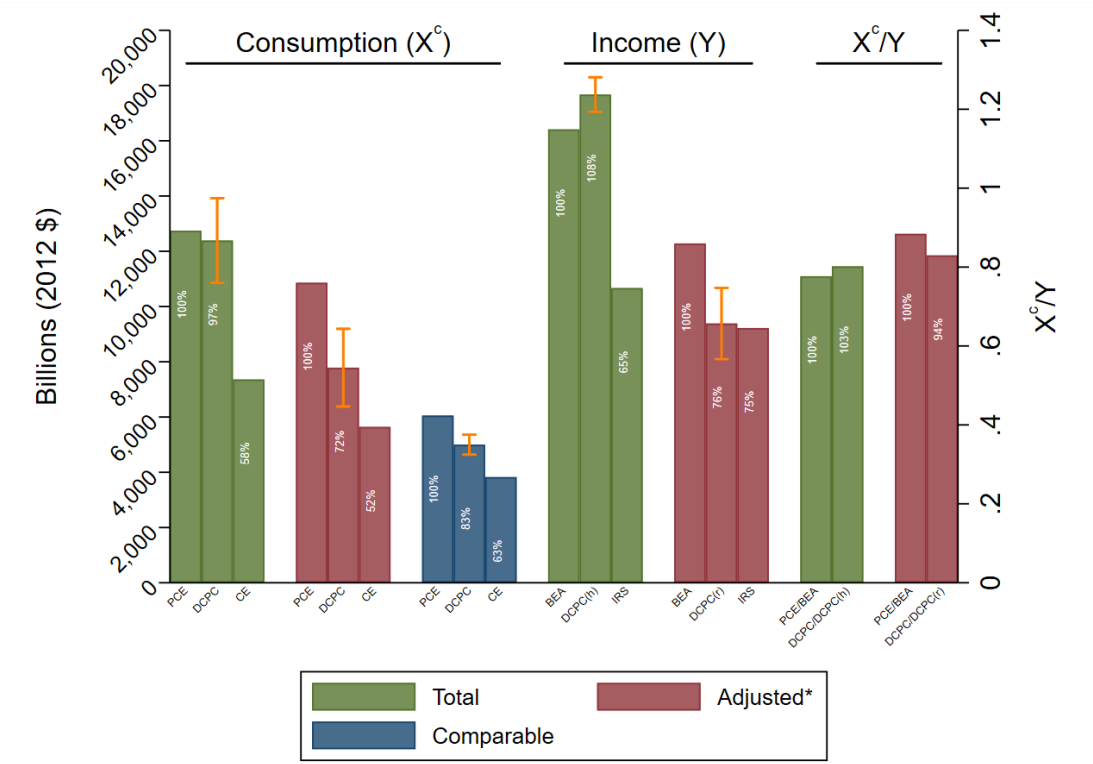
Income H=household (annual, recall); R=respondent (daily, recorded)

$$Y_t^H = Y_t^R + Y_t^O$$

Exercise #1: Coverage of U.S. Data

Return

Figure: 5-year Consumption and Income Averages



*Analogous BEA and IRS income categories are pre-tax while DCPC analogous income is post-tax.

$$C_t = \overline{C}_{10,t} \cdot P_t \cdot (365.25) \text{ (Analogous for Income)}$$

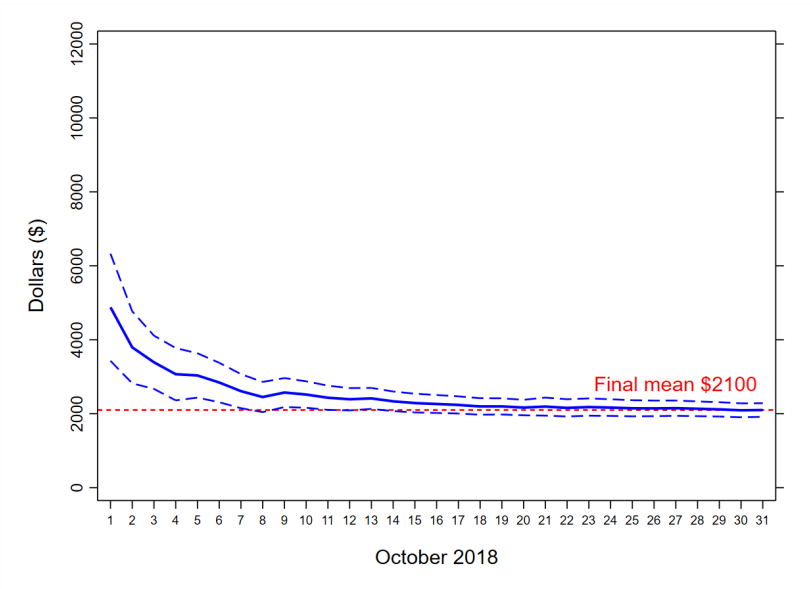
Consumption Table | BEA Income Table | IRS Income Table | Annual Consumption | Annual Income | Income Types/Frequencies | X^c/Y by Household Income

Exercise #2: Real-Time Forecasts

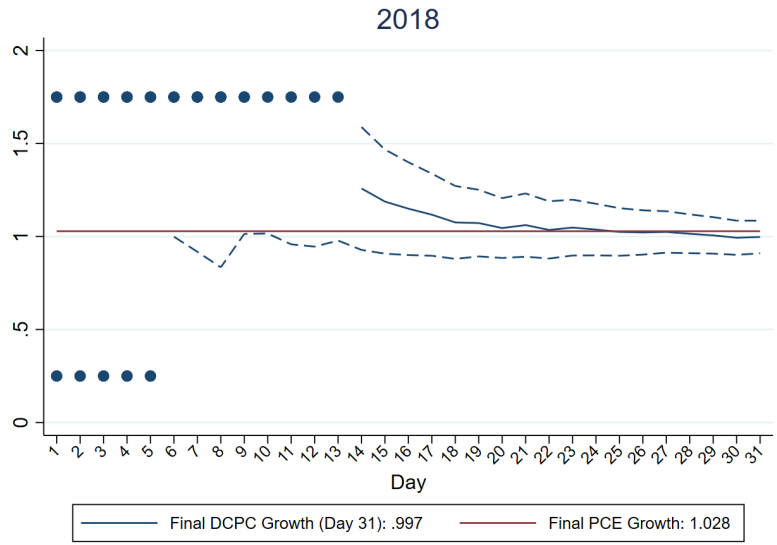
Return

Figure: 2018 Real-Time Projections of October Consumption

(a) DCPC Level



(b) PCE Growth Rate (gross)



(a) $\widehat{\overline{X^c}}_{d,10,t}$: Daily projections of DCPC *monthly* level

(b) $\widehat{G}_{d,10,t}$: Daily projections of PCE 12-month growth (using DCPC growth)

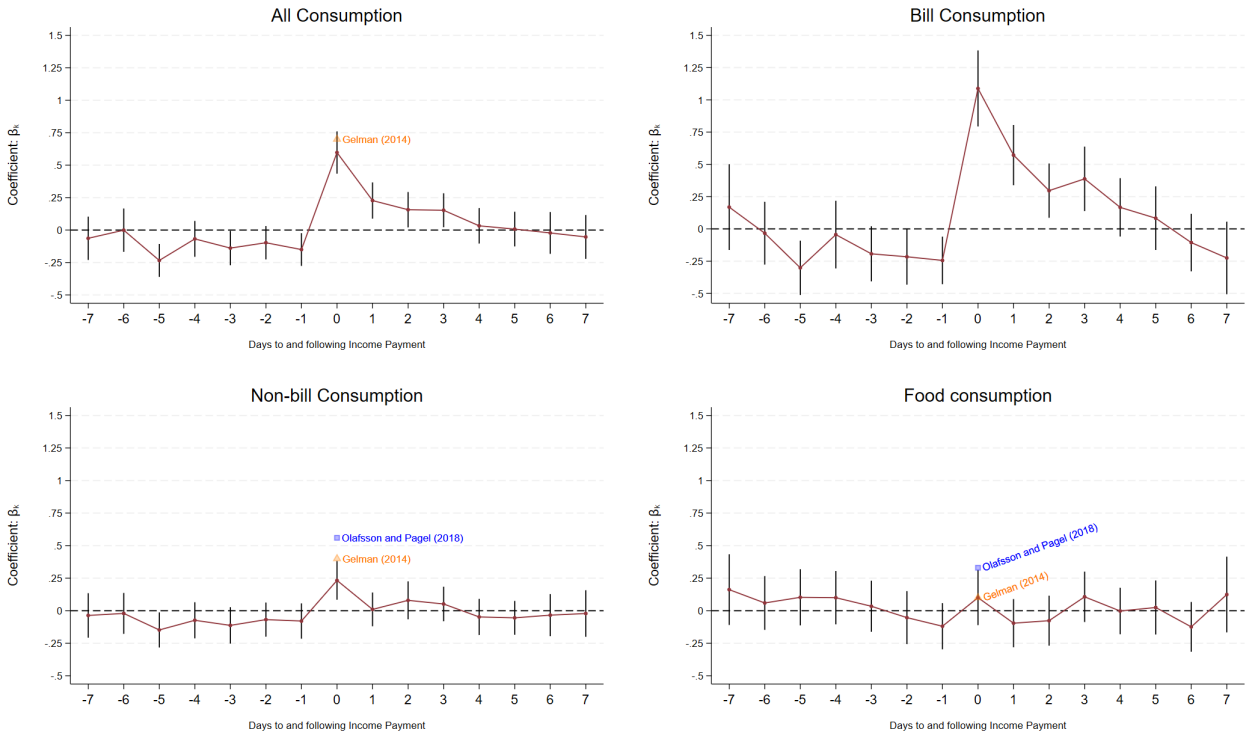
Equations | Levels: All years | Growth: All years

Exercise #3: Income Timing and Consumption

Return

$$\frac{X^c_{idmt}}{\bar{X}^c{}_i} = \sum_{s=-7}^{7} \beta_s I_i(Paid_{d+s,mt}) + \eta_i + \lambda_t + \lambda_{DOW} + \lambda_{WEEK} + \varepsilon_{idmt}$$

Figure: Payday Consumption Responses ($\hat{\beta}_s$)



Within Pay Cycle Borrowing

Consumption 5-Year Averages Table

Return

Table: 5 Year Averages of Consumption

5 Year Averages (2012 Billions USD)	CE (1)	PCE (2)		DCPC (3)	CE/PCE (4)	DCPC/PCE (5)
Total Expenditures	**7,360**	**12,749**		**12,391**	**.58**	**.97**
	(138)	(151)		(781)		
-Imputed Rent	1,719	1,479				
	(66)	(23)				
-Non-Profit Goods and Services		409				
		(10)				
-Mortgage Payments, Expenses for Owned Dwellings				1,245		
				(103)		
-Taxes, Payments to Persons, Non-Classifiable				463		
				(75)		
-Loan Repayments				2,897		
				(191)		
Adjusted Consumption	**5,641**	**10,861**		**7,786**	**.52**	**.72**
	(96)	(129)		(717)		
Mostly Comparable	**3,825**	**6,089**	**6,054**	**4,999**	**.63**	**.83**
	(70)	(70)	(70)	(30)		
Food and Food Services	981	1,688	1,688	1,172	.58	.69
	(24)	(19)	(19)	(30)		
General Merchandise	447	1,087	1,087	1,228	.41	1.13
	(16)	(9)	(9)	(137)		
Housing and Utilities	1,274	1,520	1,520	1,683	.84	1.11
	(5)	(28)	(28)	(77)		
Transportation	788	915	915	389	.86	.43
	(16)	(12)	(12)	(26)		
Entertainment and Recreation	174	367	367	295	.48	.8
	(4)	(3)	(3)	(54)		
Pharmaceuticals	140	477	477	17	.29	.03
	(39)	(13)	(13)	(2)		
Other*	20	36		215	.57	NA
	(2)	(1)		(23)		
Mostly Noncomparable	**1,816**	**4,772**	**4,807**	**2,788**	**.38**	**.58**
	(117)	(79)	(79)	(689)		
2012 Estimates (Schuh 2018)						
Adjusted Consumption	4,943	9,492		8,729	.52	.92
Mostly Comparable	3,659	5,486	5,093	6,014	.67	1.18
Mostly Noncomparable	1,284	4,006	4,399	2,715	.32	.62

BEA Income 5-Year Averages Table

Return

Table: BEA and DCPC Income Estimates

5 Year Income Averages of DCPC and BEA Income (2012 Billions USD)	**BEA** (1)	**DCPC(r)** (2)	**DCPC(r)/BEA** (3)	**DCPC(h)** (4)
Total Income	**16,413**	**9,615**	**.59**	**17,675**
	(313)	(659)		(320)
Wages and Salaries	8,233	4,923	.6	
	(135)	(478)		
Proprietor's Income	1,472	409	.28	
	(51.40)	(107)		
Retirement, Interest, and Dividends	2,585	786	.3	
	(43)	(158)		
Rental Income	623	160	.26	
	(6)	(41)		
Social Security	912	1,158	1.27	
	(18)	(329)		
Government Assistance	655	126	.19	
	(96)	(22)		
Other Income	1,932	2,054	1.06	
	(21)	(177)		
Adjustments				
Employee Contributions to Retirement	298			
	(6)			
Supplements to Wages and Salaries	1,882			
	(22)			
Alimony and Child Support	-	26		
		(5)		
Taxes	1,949	204		
	(19)	(49)		
Adjusted Income (Disposable)	**12,284**	**9,386**	**.76**	
	(277)	(658)		

IRS Income 5-Year Averages Table

Return

Table: IRS and DCPC Income Estimates

5 Year Income Averages of DCPC and BEA Income (2012 Billions USD)	**IRS** (1)	**DCPC(r)** (2)	**DCPC(r)/IRS** (3)	**DCPC(h)** (4)
Total Income	**10,668**	**9,615**	**.9**	**17,675**
	(228)	(659)		(320)
Wages and Salaries	7,225	4,923	.68	
	(105)	(478)		
Propreitors' Income	935	409	.44	
	(8)	(107)		
Interest and Dividends	390	81	.21	
	(18)	(52)		
Retirement Income	967	704	.73	
	(17)	(148)		
Rental Income	53	160	3.02	
	(2)	(41)		
Social Security	305	1,158	3.79	
	(11)	(329)		
Government Assistance	66	126	1.91	
	(44)	(22)		
Alimony	10	1	.12	
	(0)	(1)		
Other Income	717	2,053	**2.86**	
	(64)	(177)		
Adjustments				
Taxes	1,446	204		
	(27)	(49)		
Child Support	-	24		
		(5)		
Adjusted Income (Disposable)	**9,222**	**9,387**	**1.02**	
	(214)	(658)		

Annual Comparable Consumption

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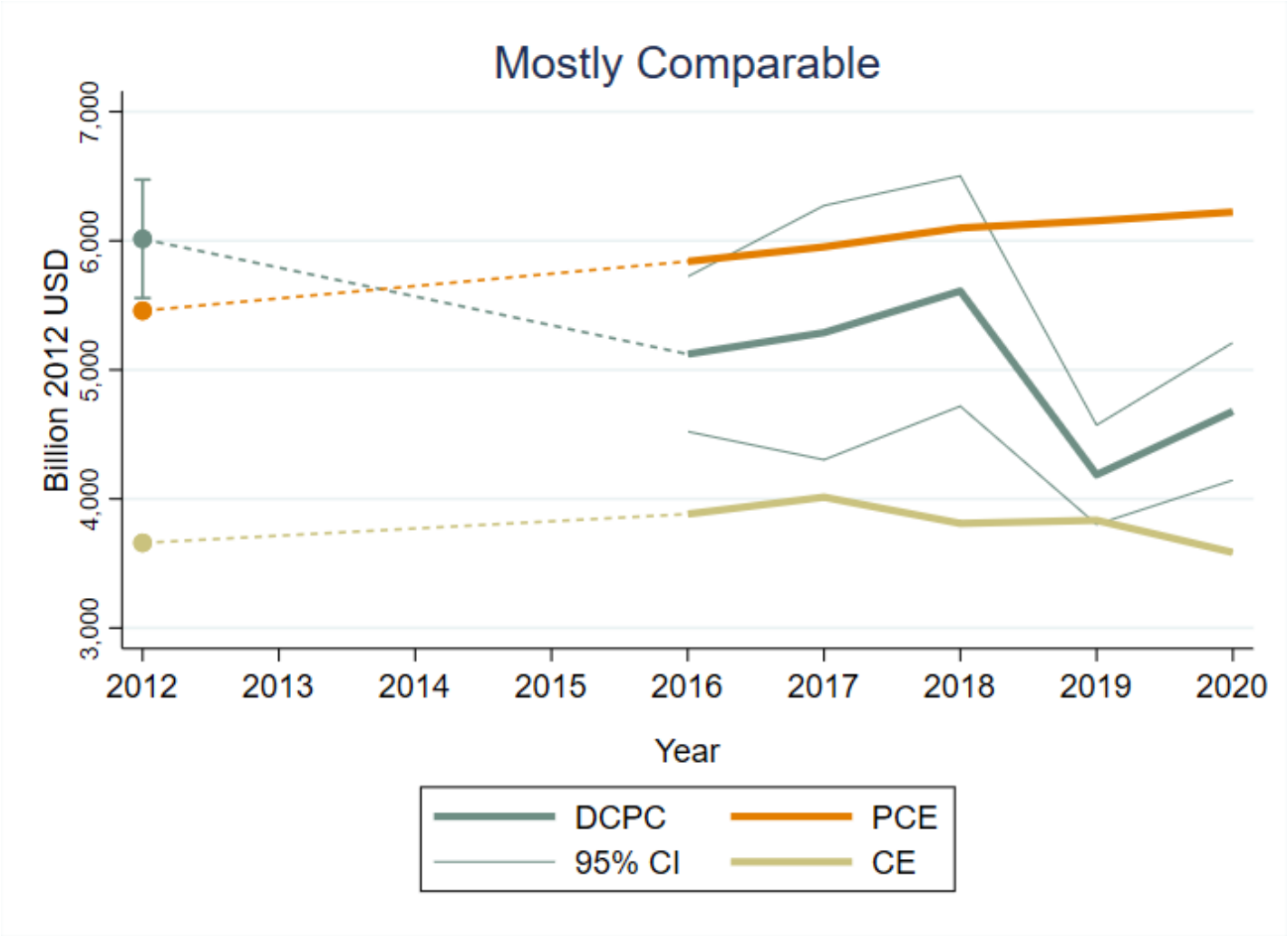
Figure: Annual Comparable Expenditures

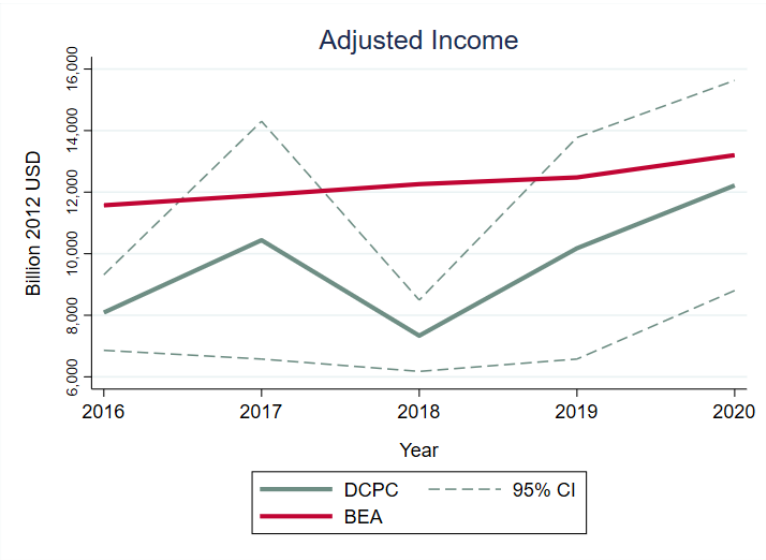


Annual Adjusted Income

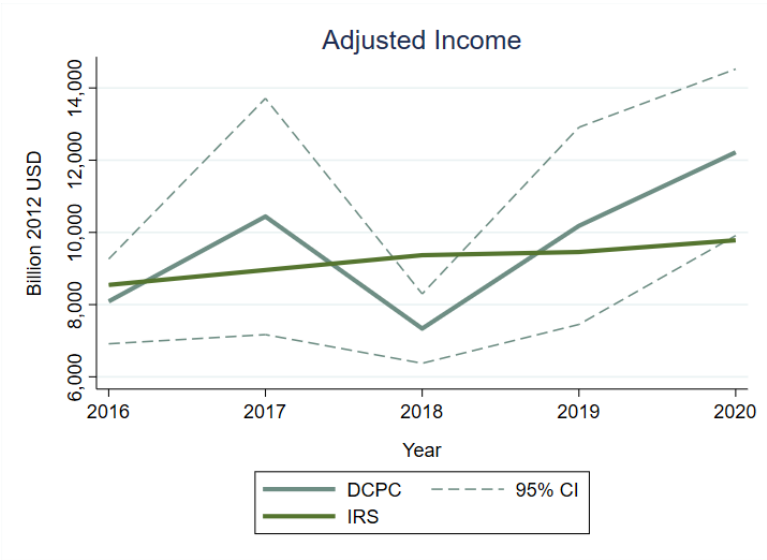
Return

Figure: Annual Adjusted Income

(a) DCPC and BEA Income



(b) DCPC and IRS Income



Income Types and Frequency in Data

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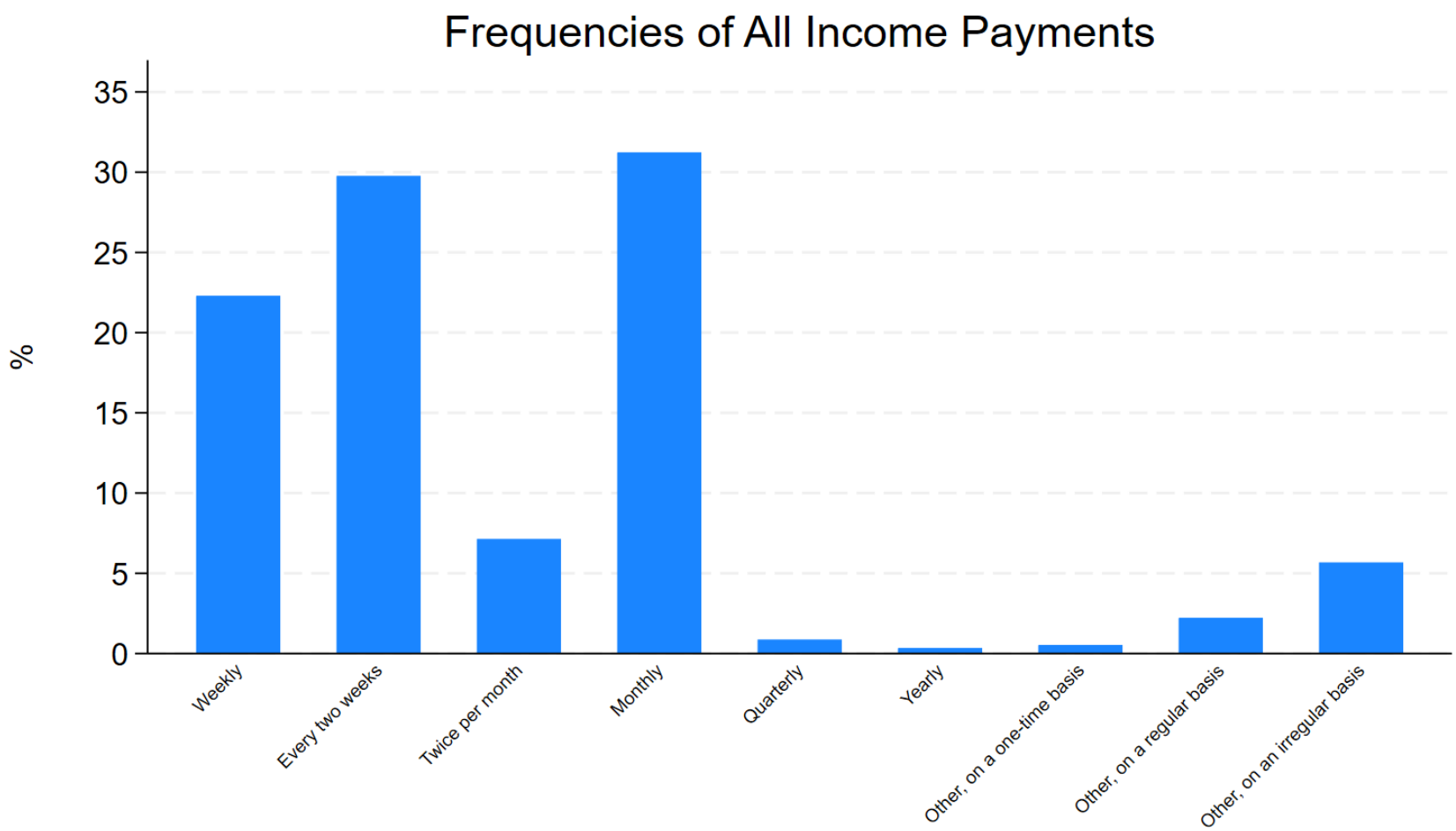
Table: Recorded Income Identifications: 5 Year Average

	%
Respondents with Recorded Income	23.0%
Recorded Income Unidentified	21.1%
Recorded Income Identified	78.9%
Identified Income by Type:	
Employment	54.5%
Employer paid retirement	5.0%
Self-employment income	12.3%
Social Security	11.7%
Interest and dividends	3.3%
Rental income	2.9%
Government assistance	5.3%
Alimony	.2%
Child Support	2.7%
IRA, Roth IRA, 401K or other retirement fund or other retirement fund	1.9%

Income Payments are Discrete

Return

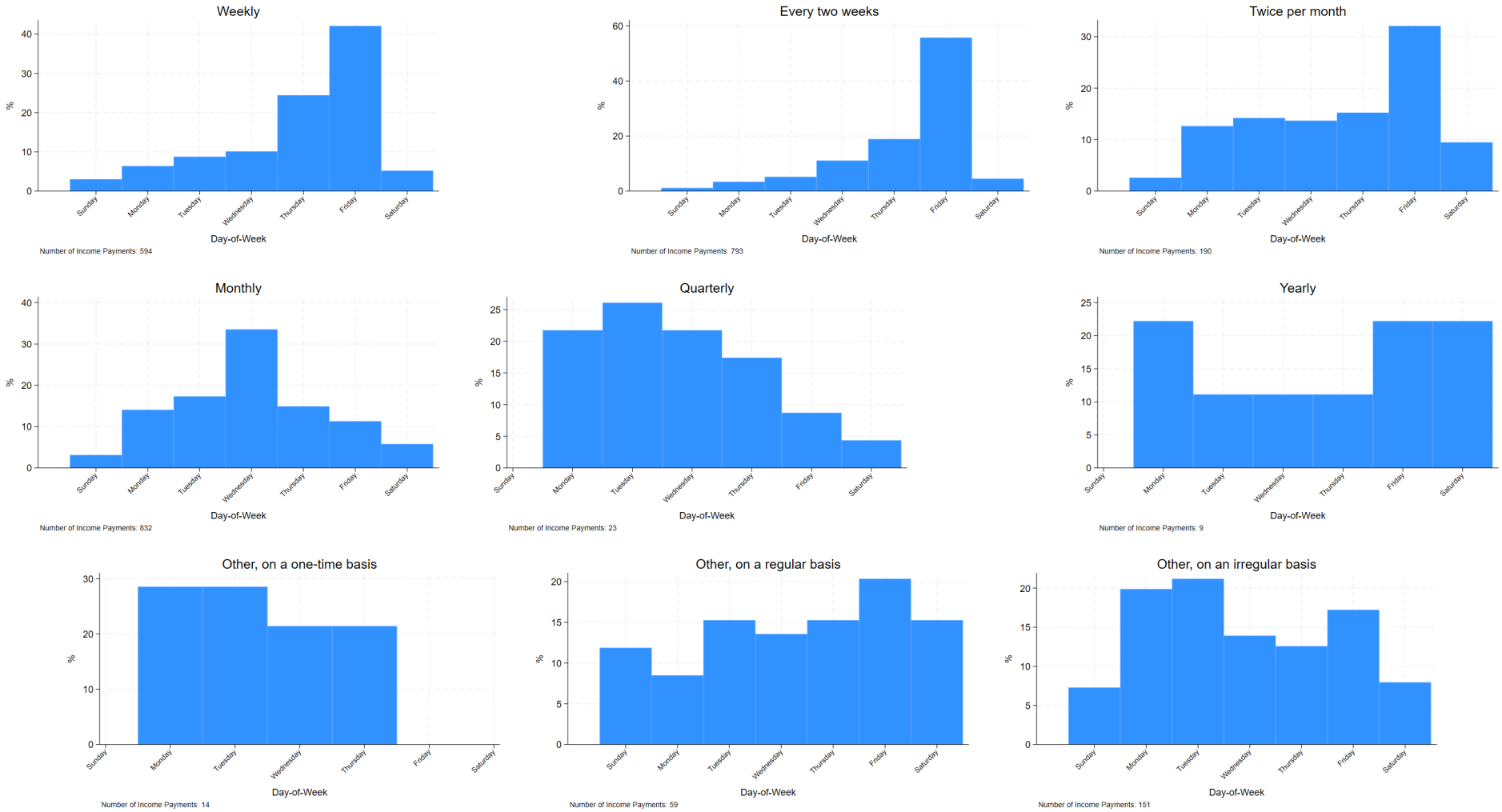
Figure: Frequencies of Income (Y^R) Receipts by Pay Period



Income Frequency by Day-of-Week

Return

Figure: Reported Frequencies by Income Type: By Day-of-Week



X^c/Y^H by household income

Return

Figure: X^c/Y by Household Income Categories

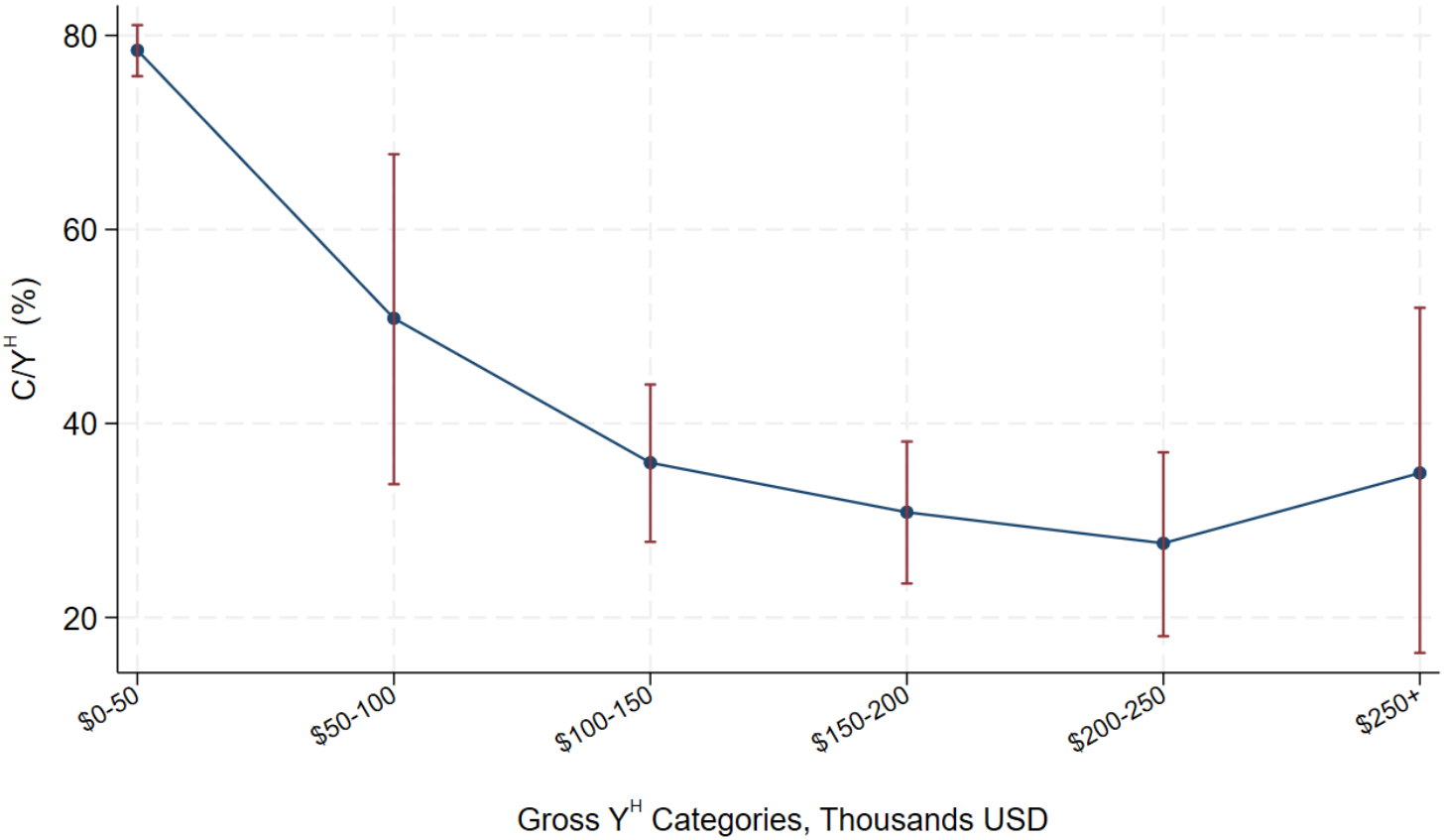


Figure reports consumption expenditures divided by income in the 2016 - 2020 DCPC. Consumption is estimated by using the average adjusted consumption categories (annualized) divided by average household income within each household income category.

Real-Time Analysis Equations

Return

Daily Estimates of Monthly Consumption per capita

$$\widehat{\overline{X^c}}_{mt}(d) = \sum_{s=1}^{d} \left(\frac{31}{d}\right) \overline{X^c}_{smt}$$

Daily projection of annual DCPC growth

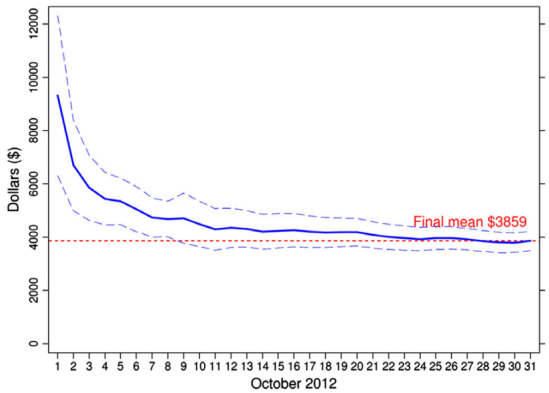
$$\widehat{G}_{d,10,t} = \left[\frac{\sum_{s=1}^{d} \left(\frac{31}{d}\right) \overline{X^c}_{s,10,t}}{\overline{X^c}_{10,t-1}}\right]^{\frac{31}{d}}$$

Forecasting DCPC Levels

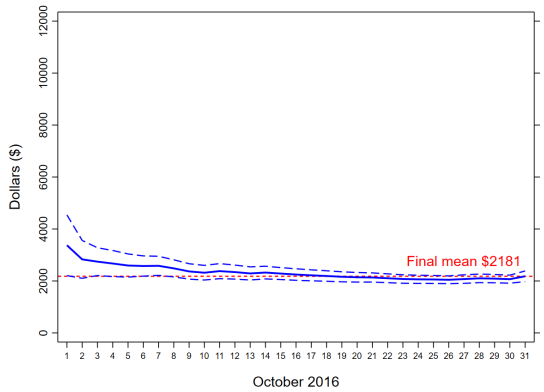
Return

Figure: Daily Estimate of Monthly Payments per U.S. Consumer

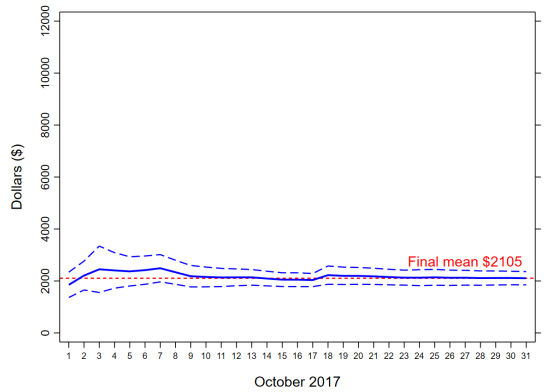
(a) 2012



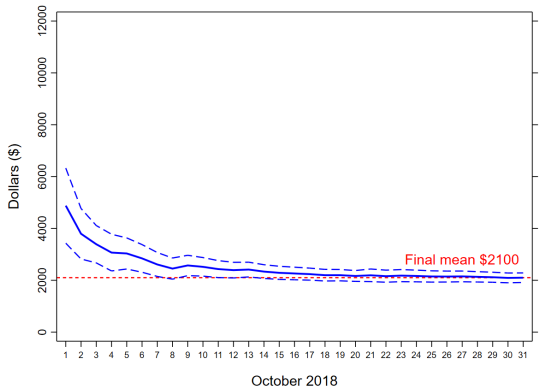
(b) 2016



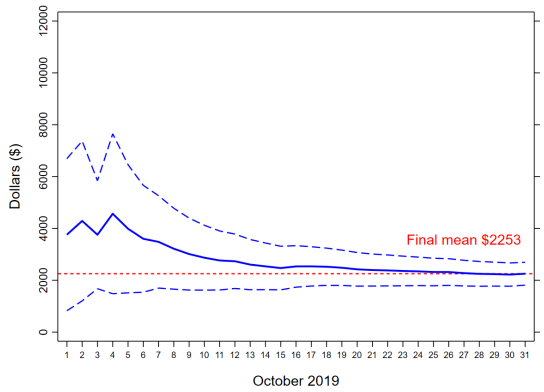
(c) 2017



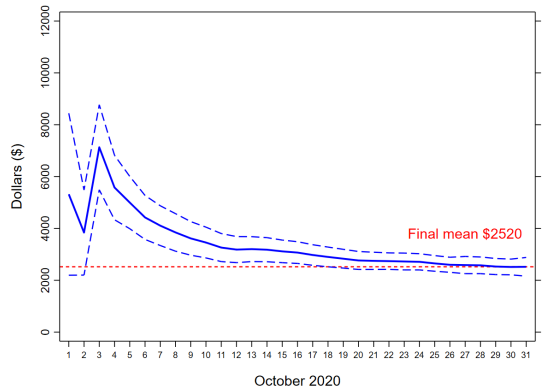
(d) 2018



(e) 2019



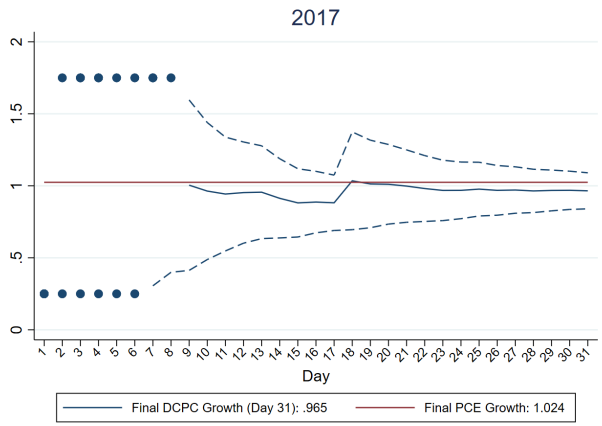
(f) 2020

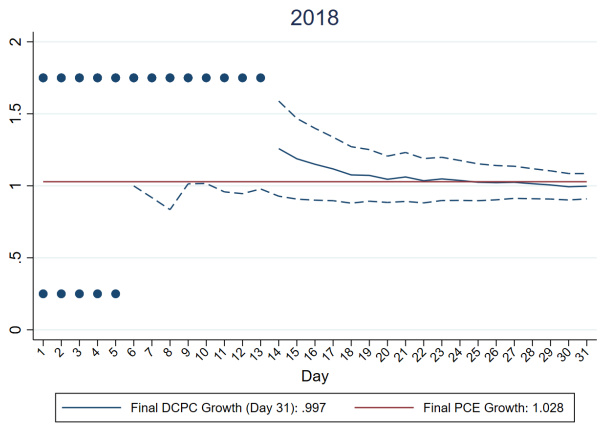


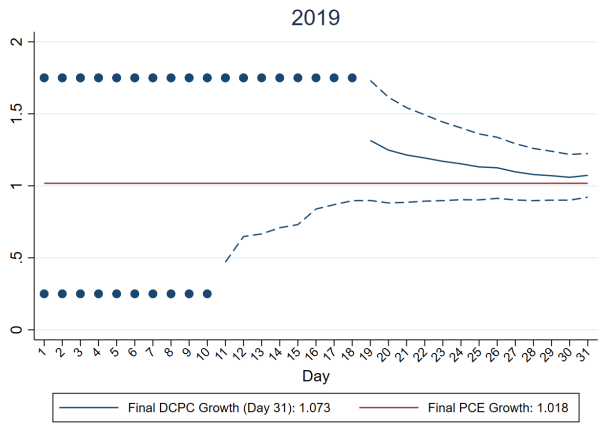
Forecasting DCPC Growth

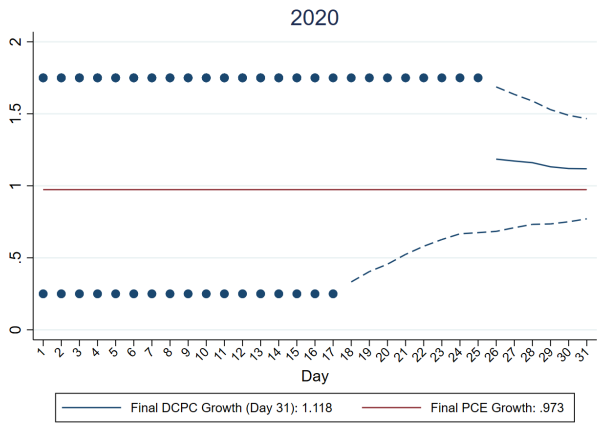
Return

Figure: Forecasting Annual DCPC Growth





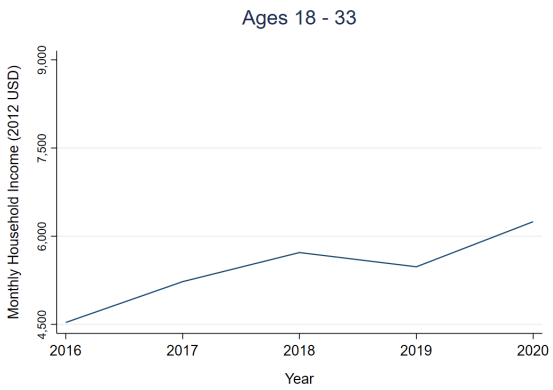




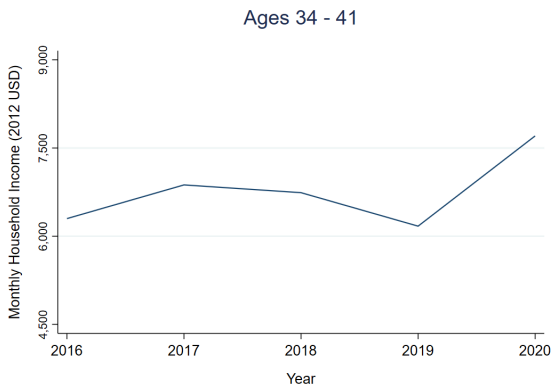
Household Income: Age Cohorts

Return

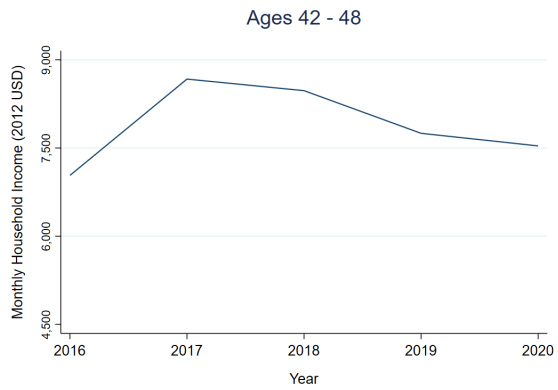
Figure: Income Profiles by Age Cohorts



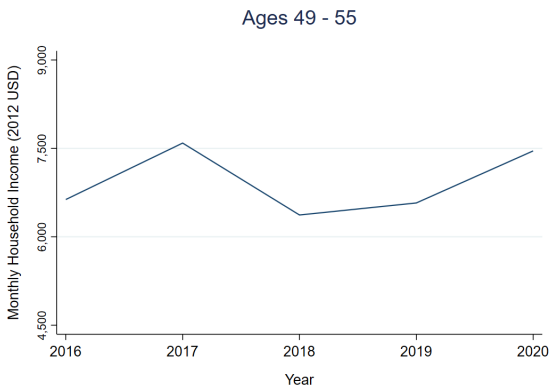
(a)



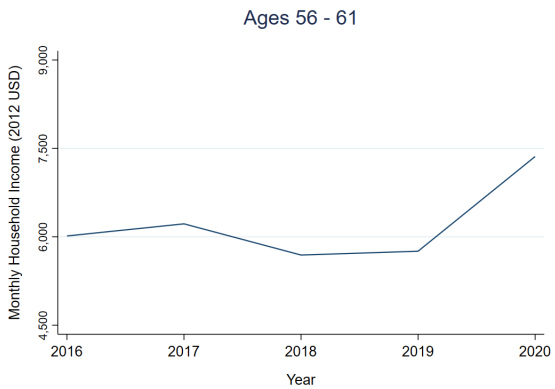
(b)



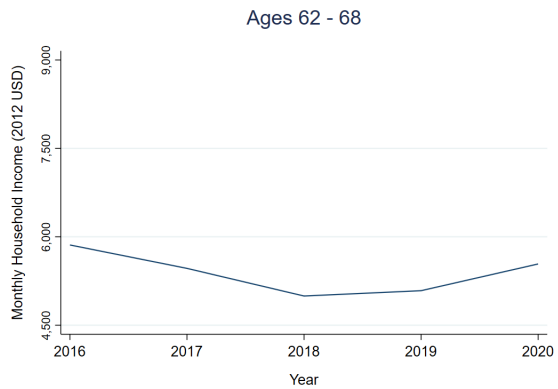
(c)



(d)



(e)



(f)

Econometric Model: *Synthetic Cohorts*

Return

Diarists: three days in a diary year. Short longitudinal component (annual and daily): unbalanced

- **Synthetic Cohorts** (Age, Gender: $k = \{1, 2, \ldots, K \leq 14\}$; Deaton (1985))

$$\overline{C}_{kdmt} = \frac{\sum_{i \in k} w^D_{idt} \cdot C_{idmt}}{\sum_{i \in k} w^D_{idt}}$$

- **Liquidity constrained cohorts**: Age (2), Gender (2), Constrained (2). Follow similar definitions to Aguiar (2024)
  - Zeldes (1989): Net-worth Cohort (less than 2 months of household income)
  - Kaplan et al. (2014): net-liquidity (short-term assets minus credit card debt) negative or $<$ one-week of household income
- **Differencing Measurement**
  - Daily change for variable Z_k

$$\Delta^{\tau}_{d} = Z_{kdmt} - Z_{k,d-\tau,mt} \quad \forall \quad d > \tau$$

  - Annual change of monthly variable:

$$\Delta^{12}_{m} = Z_{kmt} - Z_{km,t-1}$$

Econometric Model: *Consumption Euler Equations*

Return

Benchmark model reduced form:

$$\Delta C_t = \beta_0 + \beta_1 \mathbb{E}_{t-1} \Delta Y_t + \beta_2 \pi_t + \beta_3 \upsilon_t + e_t$$

where PIH predicts $\beta_1 = 0$, $\beta_2, \beta_3 > 0$

Consumption and Income Dynamics (2SLS):

$$\Delta_m^{12} C_{k,10,t} = \beta_0 + \beta_1 \widehat{\Delta_m^{12} Y_{k,10,t}^H} + \beta_2 \widehat{u}_{k,10,t} + \varepsilon_{k,10,t}$$

Consumption and Income Dynamics (model implication):

$$\Delta_m^{12} C_{kt} = \left(\frac{r}{1+r} \right) \left(\frac{1+r}{1+r-\rho} \right) \cdot u_{kt} = \Omega \cdot u_{kt}$$

Benchmark PIH Model

Return

Consumption (C) Euler Equation (given real interest rate r):

$$U'(C_t) = \beta(1+r)\mathbb{E}_t U'(C_{t+1}) \tag{1}$$

Analytical Solution (certainty equivalence):

$$\Delta C_t = e_t \tag{2}$$

$$= (\mathbb{E}_t - \mathbb{E}_{t-1}) \sum_{\tau=0}^{\infty} \frac{Y_{t+\tau}}{(1+r)^\tau} = \upsilon_t + \frac{r}{1+r}\pi_t \tag{3}$$

where e_t = random error; income shocks = permanent (υ_t), transitory (π_t)

CRRA Utility (first-order approximation):

$$\Delta c_t \approx \frac{1}{\gamma}(r - \delta) + \epsilon_t \tag{4}$$

- $\therefore$ consumption *does not* respond to predicted changes in income (excess sensitivity) $\Rightarrow \Delta C_t \neq 0$ only for revisions to income expectations (shocks)
- Equation (4) forms the basis for empirical tests

Within Paycycle Borrowing

Return ϕ decreases with income frequency (Baugh and Correia 2022)

$$Z_{fdt} = \phi' Freq_f + \lambda_{DOW} + \lambda_d + \lambda_t + \varepsilon_{fdt}$$

Data from anonymous online account aggregator

Table: Paycheck Frequency Analysis

	Rolling C.C. Borrowing				Rolling C.C. Repayment			
	(1) % of Y (p.p)	(2) % of Y (p.p)	(3) $/day	(4) $/day	(5) % of Y (p.p)	(6) % of Y (p.p)	(7) $/day	(8) $/day
Panel A: Gilyard and Schuh								
Semi-Monthly	-0.012	0.003	4.103	0.938	-0.077	-0.115	2.396	-3.953
	(0.036)	(0.043)	(1.860)	(2.537)	(0.087)	(0.080)	(4.246)	(4.451)
Weekly	-0.104	-0.097	-3.244	-4.630	-0.188	-0.205	-6.708	-9.487
	(0.039)	(0.041)	(1.896)	(1.930)	(0.082)	(0.078)	(3.578)	(3.707)
Monthly Income (Y^H_{fmt})		-0.000		0.002		0.000		0.003
		(0.000)		(0.001)		(0.000)		(0.001)
Panel B: Baugh and Correia (2022)								
Semi-Monthly	-0.175	-0.172	-4.309	-3.870	-0.426	-0.455	-12.110	-12.470
	(0.007)	(0.007)	(0.267)	(0.276)	(0.020)	(0.020)	(0.877)	(0.882)
Weekly	-0.395	-0.348	-16.330	-8.921	-0.935	-1.430	-43.710	-49.740
	(0.007)	(0.023)	(0.257)	(0.832)	(0.019)	(0.045)	(0.832)	(1.701)
Monthly-Income		0.000		0.010		-0.001		-0.008
		(0.000)		(0.001)		(0.000)		(0.002)

[1] Regressions are calculated at the paycheck frequency group - day level. Rolling borrowing refers to credit card expenditures, while rolling repayment refers to credit card repayments. % of income reports dollar values divided by monthly household income, while $ / day refers to daily dollar values (2012 USD for this paper). Even columns control for household income. Results are robust to heteroskedasticity.

Econometric Model: *Income Models*

Return

$$\Delta Y_t = \mathbb{E}_{t-1}\Delta Y_t + u_t$$

Use four types of income models (subscript notation suppressed):

$$Y_t = \mathbb{E}_{t-1} Y_t \tag{M0}$$
$$Y_t = \alpha + Y_{t-1} + u_t^{M1} \tag{M1}$$
$$Y_t = \alpha + Y_{t-1} + \gamma_2(Y_{t-2} - Y_{t-3}) + u_t^{M2} \tag{M2}$$
$$Y_t = \alpha + \phi_3 t + \gamma_3 Y_{t-1} + u_t^{M3} \tag{M3}$$

From the literature: M0 = perfect foresight (a baseline); M1 = unit root (macro) M2 = IV approach (micro). Practical: M3 = best fit to DCPC data.

Estimating $\mathbb{E}_{t-1}\Delta Y_t, u_t$ in diaries. First-stage: Utilize $Y^{H,R}$ Y^H by age cohort

$$\Delta_m^{12} Y_{k,10,t}^H = \alpha + (\rho - 1) Y_{k,10,t-1}^H + \eta_{AGE} + t \cdot \eta_{k \in AGE} + u_{k,10,t}^{M3^t} \tag{M3^t}$$

$$\Delta_d^1 Y_{kd,10,t}^R = \alpha + (\rho - 1) Y_{k,d-1,10,t}^R + \lambda_t \times \lambda_d + \eta_k + \sum \gamma_j \vartheta_{kd,10,t}^j + u_{k,10,t}^{M3^d} \tag{M3^d}$$

Representative Agent: Actual and Predicted Income

Return

Income model M3

Figure: Annual and Daily Income: Observed vs. Predicted

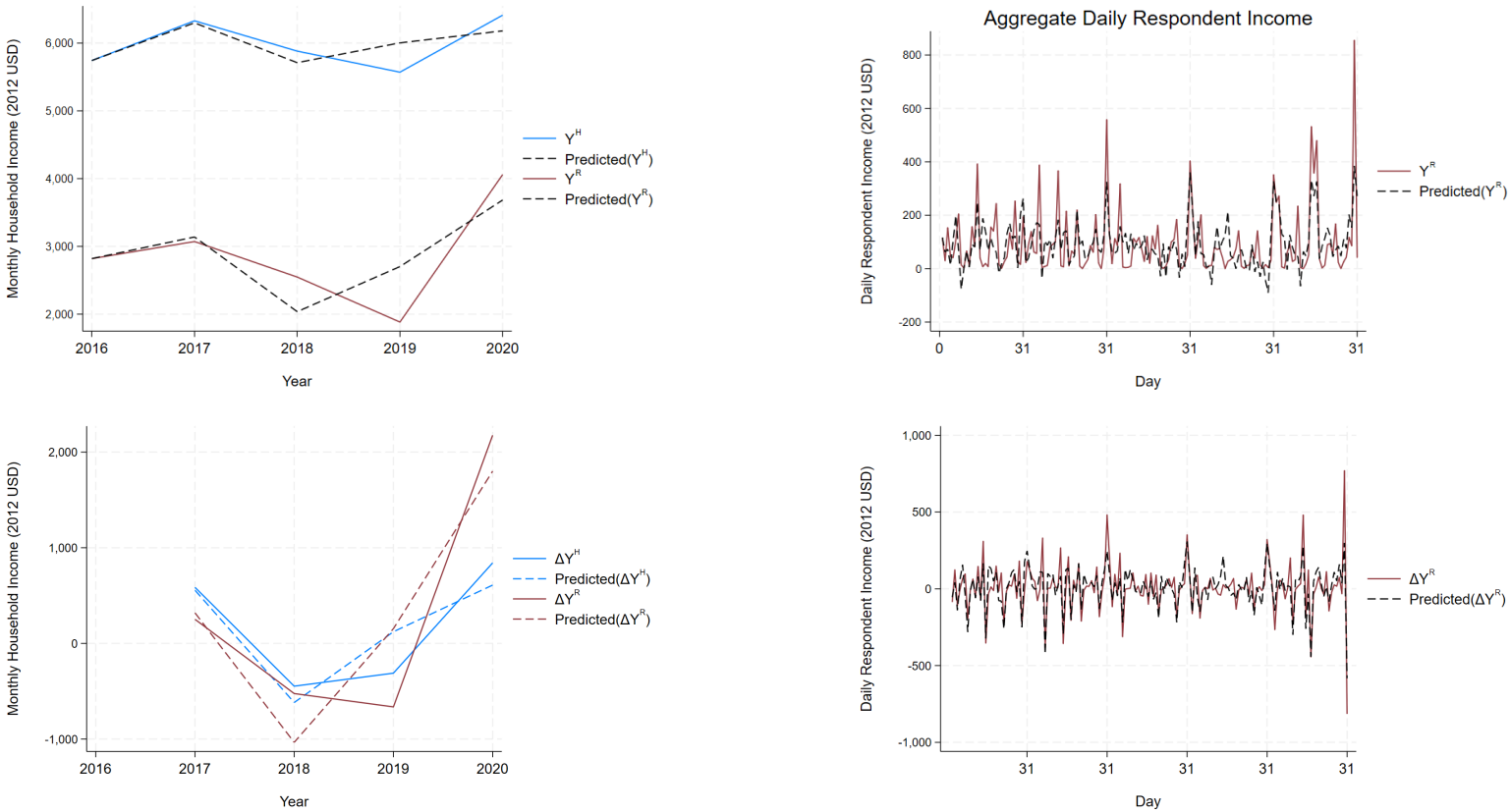


Figure 17 reports monthly income in the first panel and daily income in the second panel over all respondents. The blue line report Y^H, while the red line reports Y^r. The first row reports the levels in income, while the second reports changes in income.

Income Prediction Results

Return

Table: Predicted Income Estimates

	Annual			Daily		
	M1	M2	M3	M1	M2	M3
Levels						
α_i	399.18**			-101.44**		
	(144.07)			(40.88)		
ρ_2		-0.17			-0.04	
		(0.34)			(0.02)	
ρ_3			0.50***			0.03
			(0.14)			(0.05)
R^2	0.07	0.73	0.42	0.19	0.19	0.55
% R^2 explained by TE, FE, and Controls	71	70	71	100	100	22
Logs						
α_i	0.07***			-3.75**		
	(0.02)			(1.39)		
ρ_2		-0.10			-0.04	
		(0.29)			(0.03)	
ρ_3			0.60***			0.03
			(0.13)			(0.02)
R^2	0.08	0.71	0.37	0.28	0.28	0.63
% R^2 explained by TE, FE, and Controls	63	78	73	100	96	33

[1] Table reports coefficients of income prediction models specified in M1-M3. Each model reports R^2 estimates as a goodness-of-fit measurement. Models include time-invariant fixed effects and time effects. Models are then run to exclude any fixed and time effects to calculate % of R^2 due to these controls. M1 estimates reported are the base category for fixed effects.

Predicted Income Time Series

Additional Income Model Results

Return

	M0	M1	M2	M3				
	K=A(7)G(2)			K=A(2)G(2)C(2)				
				C=Net Worth		C=Liquidity		
				U	C	U	C	
Panel A: Annual								
MPCs								
β_1	0.117	0.224	0.031	0.191	-0.001	0.081	0.153	-0.151
	(0.102)	(0.267)	(0.115)	(0.150)	(0.212)	(0.247)	(0.369)	(0.285)
β_2		0.110	-0.214	0.062	-0.120	0.268	-0.066	-0.139
		(0.109)	(0.351)	(0.209)	(0.362)	(0.335)	(0.448)	(0.259)
R^2	0.02	0.02	0.03	0.03	0.02	0.13	0.02	0.07
Elasticities								
β_1	0.391	0.583	0.175	0.474	0.076	0.328	0.751	-0.300
	(0.321)	(0.698)	(0.328)	(0.406)	(0.677)	(0.776)	(0.981)	(0.760)
β_2		0.385	-0.423	0.341	-0.181	0.859	-0.150	-0.247
		(0.322)	(0.792)	(0.550)	(1.121)	(1.016)	(1.000)	(0.761)
R^2	0.03	0.04	0.02	0.03	0.01	0.15	0.05	0.03
Panel B: Daily								
MPCs								
β_1	0.006	0.032	0.011	0.009	-0.002	0.058**	0.038*	0.010
	(0.007)	(0.025)	(0.027)	(0.012)	(0.014)	(0.023)	(0.020)	(0.021)
β_2		0.004	0.004	0.003	0.013	0.066	0.010	-0.016
		(0.008)	(0.008)	(0.011)	(0.020)	(0.040)	(0.031)	(0.041)
R^2	0.04	0.04	0.04	0.04	0.10	0.11	0.08	0.10
% R^2 explained by TE	94	82	87	92	95	65	84	82
Elasticities								
β_1	0.019***	0.046***	0.036***	0.019***	0.003	0.029***	0.002	0.007
	(0.003)	(0.012)	(0.013)	(0.005)	(0.007)	(0.010)	(0.008)	(0.008)
β_2		0.017***	0.018***	0.019***	0.017*	0.025	0.007	0.020*
		(0.004)	(0.004)	(0.006)	(0.010)	(0.016)	(0.011)	(0.012)
R^2	0.06	0.06	0.07	0.06	0.14	0.10	0.09	0.13
% R^2 explained by TE	55	42	45	53	76	54	94	57

[1] Panel A: Annual results. Panel B: Daily results. All values are reported in 2012 USD values. Sub-panel MPCs reported differences in levels, while sub-panel Elasticities report differences in logs. Grouping M0 - M3 denote income model used. C denotes the cohort constraint specification, where C is constrained and U is unconstrained.

[2] * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Each subpanel reports R^2 for each regression, and the % of R^2 explained by time effects (TE). Standard errors are bootstrapped (1000 replications).

Model Extensions

Return

		Insurance			Excess Sensitivity		
		Complete		Partial			
	(1) Benchmark	(2) DCPC $\Delta C_{d,t}$	(3) Risk Index	(4) ψ, ϕ	(5) Precautionary	(6) Nonsep. Leisure	(7) (5) + (6)
Panel A: Annual							
Elasticities							
β_1	0.474	0.552	0.643		0.483	0.227	0.233
	(0.406)	(0.425)	(0.429)		(0.397)	(0.395)	(0.370)
β_2	0.341	0.511	0.550		0.366	0.491	0.492
	(0.550)	(0.552)	(0.552)		(0.550)	(0.568)	(0.569)
β_3	[.25, 1.60]†				0.215		0.249
					(0.688)		(.668)
ξ	[.74, 1.32]†	1.033**	-0.215**				
		(0.503)	(0.100)				
Labor Controls						Y	Y
Panel B: Daily							
Elasticities							
β_1	0.019***	0.018***	0.019***		0.019***		
	(0.005)	(0.005)	(0.005)		(0.002)		
β_2	0.019***	0.019***	0.019***		0.019***		
	(0.006)	(0.006)	(0.006)		(0.006)		
$\beta_{2,\psi}$	[.05, .48]†			0.048			
				(0.117)			
$\beta_{2,\phi}$	[.64, .66]†			0.016*			
				(0.009)			
β_3					-0.013		
					(0.035)		
ξ		0.597***	-0.013**				
		(0.089)	(0.053)				

[1] Table presents several extensions of the Euler equation tests. All results are expressed as elasticities. Panel A reports annual results, while Panel B reports daily results. Column (1) reports the results from Table **??**, while estimates in brackets are ranges from the literature (see note † for specific citations). Columns (2) and (3) examine the full insurance hypothesis. Column (2) uses aggregate nondurable consumption (C_t annual, C_d daily) from DCPC data as the independent variable in the Euler equation. Column (3) introduces the Economic Policy Uncertainty Index (Baker et al., 2025, FRED code: USEPUINDXD) as a proxy for aggregate shocks. Column (4) tests for partial insurance following Blundell et al. (2008), using an instrumental variables (IV) approach to estimate the responses to permanent (ζ) and transitory (ν) components of unexpected income shocks. Due to lack of time periods, annual partial insurance estimates are excluded in column (4). Columns (5) through (7) test for potential violations of the Permanent Income Hypothesis (PIH). Column (5) incorporates consumption uncertainty, estimated via a two-stage least squares method. Column (6) includes labor controls (change in employed and unemployed share of cohort), while Column (7) adds both precautionary savings motives and labor controls. Standard errors are bootstrapped (1000 replications).

[2] * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

† Column (1) estimates in brackets report ranges of coefficient estimates from the literature. β_3 estimates from Attanasio and Weber (1995); Bertola et al. (2005); Christelis et al. (2020). ξ estimates from Mace (1991); Townsend (1994); Jappelli and Pistaferri (2017). $\beta_{2;\psi,\phi}$ estimates come from Blundell et al. (2008); Eika et al. (2020).

Sample Selection Statistics

Return

Table: Summary Statistics, 2015-2016

	Representative			SCPC Subsample				
	CPS	SCPC	DCPC	PFM	Visa	M.P.	Checking Account	
							Commercial	Brokerage
Panel A: Fraction of CPS								
Age	47.2	1.00	1.01	0.89	1.05	0.85	1.02	0.96
Male	48.2%	1.00	0.98	0.96	0.99	1.00	0.99	1.06
White	78.4%	0.95	0.95	0.86	0.99	0.91	0.99	0.87
Employed	61.3%	0.98	0.98	1.16	1.02	1.25	1.02	1.28
High-School	29.3%	1.13	1.07	0.41	0.93	0.61	1.07	0.08
Bachelor's	20.0%	0.86	0.88	1.53	1.15	1.30	0.95	2.26
$Y^H < 25k$	20.2%	1.06	1.07	0.56	0.54	0.55	0.79	0.30
$Y^H \geq 100k$	24.2%	0.98	0.98	1.68	1.35	1.60	1.06	1.74
Panel B: Fraction of SCPC								
PFM		6.48%	1.01	NA	1.23	2.68	1.10	1.13
Visa		41.99%	1.05	1.23	NA	1.21	1.09	1.10
M.P.		13.83%	1.05	2.68	1.21	NA	1.08	1.92
Checking Account								
Commercial		58.28%	1.00	1.10	1.09	1.08	NA	NA
Brokerage		1.12%	1.10	1.13	1.10	1.92	NA	NA
Cash User		24.9%	0.98	0.56	0.68	0.53	0.80	0.51
Shop Resp: All		39.3%	1.01	1.01	1.03	1.00	1.03	0.94
Sav/Inv. Resp: All		35.3%	1.01	1.23	1.04	1.05	1.07	1.27
Panel C: Fraction of DCPC (2016)								
$2000 Emergency: Savings Account			$ 411.34	1.50	1.24	1.38	1.09	1.40

[1.] Table reports selected demographics comparisons to the October Current Population Survey for 2015 and 2016. The first column shows the average age in the CPS, followed by the percent of respondents within the CPS who are male, white, employed, have a high-school diploma, bachelor's degree, income under $25,000, and income greater than or equal to $100,000. Columns two and three calculate the same statistics for the DCPC and SCPC respectively, and are converted to a fraction of the CPS. The remaining columns report demographics as a fraction of CPS statistics for the following subsamples: personal financial management, Visa credit-card adopters, mobile payment users, commercial checking account adopters, and brokerage accounts. Mobile payment users are defined as using a mobile app to make a payment within the last 12 months. Panel B reports different shares of subsamples within the datasets. As these variables are not included in the CPS, shares are reported for the SCPC, and the remaining columns report the fraction relative to the SCPC. The first rows report the cross-tabulation of subsamples within each subsample. *Cash users* are defined by those who make more than 50% of their monthly retail payments in cash. The remaining rows show the share of respondents who reported having all the household responsibilities in various categories. Panel C reports the average amount consumers could pay for a $2,000 out of their savings account. This question is only asked in the 2016 DCPC.