Internet Appendix

for "Learning in the Limit: Income Inference from Credit Extensions" by Xiao Yin

I. Proofs

A. Derivation of Lemma 1

Let $n(L,s) \equiv C_1^*(L,s)$. Because the indicator and the positive part restrict to the repay strip $m \leq Y_1 < n$,

$$\mathbb{E}[D_1 \mathbf{1}\{Y_1 \geq m\} \mid s] = \int_m^n (n-y)\, f(y \mid s)\, dy.$$

Define $\Delta F(L,s) \equiv \Pr(\, a \leq Y_1 < b \mid s\,)$ and $\bar{Y}(L,s) \equiv \mathbb{E}[\, Y_1 \mid m \leq Y_1 < n, s\,]$, so $\int_m^n (n-y) f\, dy = (n-\bar{Y})\Delta F$ with $n-\bar{Y} \geq 0$.

Writing $\Phi_d(L,s) \equiv \Pr(\, Y_1 < m \mid s\,)$, we obtain the truncated-mean form

$$\Pi(L,s) = r(C_1^* - \bar{Y})\, \Delta F - \delta L \Phi_d$$

Denote $z_B \equiv \frac{n-s}{\sigma_\eta}$ and $z_d \equiv \frac{m-s}{\sigma_\eta} = z_B + \frac{\psi}{\sigma_\eta}$ respectively the z-statistics for borrowing and defaulting threshold. Then we have $\Delta F = \Phi(z_B) - \Phi(z_d)$, $\bar{Y} = s + \sigma_\eta \frac{\phi(z_d)-\phi(z_B)}{\Phi(z_B)-\Phi(z_d)}$, and $\Phi_d = \Phi(z_d)$. Plugging these into the profit function yields the familiar

$$\Pi(L,s) = r\big[(C_1^* - s)\big(\Phi(z_B) - \Phi(z_d)\big) + \sigma_\eta\big(\phi(z_d) - \phi(z_B)\big)\big] - \delta\, L\, \Phi(z_d), \qquad (A.1)$$

In the highest-L wins equilibrium, the posted limit is the largest L with non-negative profit:

$$f(s) \equiv \sup\{L \geq 0 \colon \Pi(L,s) \geq 0\}$$

Note that at $L = 0$, bank profit is zero. Given $\psi < 0$, increasing L by an ε amount increases profit, so $\Pi_L(0,s) > 0$. As $L \to \infty$, $\Pi(L,s) \to -\infty$. There exists at least one $L^*(s) > 0$ such that and, by maximality, $\Pi(L(s),s) = 0$, and $\Pi_L(L(s),s) < 0$. At such interior points, the implicit-function theorem on $\Pi(f(s),s) = 0$ gives $f'(s) = -\Pi_s/\Pi_L\, |_{L=f(s)}$.

Write $C_{1,L}^* \equiv \partial C_1^* / \partial L$, $C_{1,s}^* \equiv \partial C_1^* / \partial s$, and $f(a) \equiv \phi(z_d)/\sigma_\eta$. We get

$$\Pi_s = r[\big(1 + C_{1,s}^*\big)\, \Delta F + \big(C_{1,s}^* - 1\big)\, \psi f(a) - \delta L f(a)\, (C_{1,s}^* - 1)$$

On the frontier $\Pi = 0$, we can use (A.1) to eliminate δL and get

$$\delta L = \frac{r[(C_1^* - s)\,(\Phi(z_B) - \Phi(z_d)) + \sigma_\eta(\phi(z_d) - \phi(z_B))]}{\Phi(z_d)}$$

Consequently, the two partial derivatives can be represented by

$$\Pi_s\,|_{\Pi=0} = \left(C_{1,s}^* - 1\right) r\left(\Phi(z_B) - \Phi(z_d)\right) z_B\left(\lambda(z_B) - \lambda(z_d)\right),$$

where $\lambda(z) \equiv \frac{\phi(z)}{\Phi(z)}$ is the inverse mills ratio. Because $\lambda(\cdot)$ is strictly decreasing and $z_d = z_B + \psi/\sigma_\eta$, $\text{sign}(\lambda(z_B) - \lambda(z_d)) = \text{sign}\ (\psi)$. With $\Pi_L < 0$,

$$\text{sign}\left(f'(s)\right) = \text{sign}\left(\left(C_{1,s}^* - 1\right)(C_1^* - s)\psi\right)$$

Suppose, toward a contradiction, that $C_1^* - s \leq 0$ so that $z_B < 0$. With $\psi < 0$, we have $z_d = z_B + \psi/\sigma_\eta < 0$. From equation (A.1), because Φ is increasing and $z_d < z_B$, $\Phi(z_B) - \Phi(z_d) > 0$; since $C_1^* - s < 0$, the product $(C_1^* - s)\left(\Phi(z_B) - \Phi(z_d)\right) < 0$. Also, with $z_d < z_B < 0$, we have $\phi(z_d) - \phi(z_B) < 0$. Therefore, the revenue bracket in square brackets is strictly negative. As $L > 0$ and $\Phi(z_d) > 0$, it follows that $\Pi(L, s) < 0$, contradicting the zero-profit condition at the maximal interior L. Hence $C_1^* > s$.

At non-binding liquidity constraint, differentiating the period 1 Euler equation w.r.t. s gives $C_{1,s}^* = \mathbb{E}_1\left[C_{2,s}\right]$. Meanwhile, differentiating the budget constraint yields $C_{2,s} = R\left(\mathbb{E}_1[Y_2|s] - C_{1,s}^*\right)$. Substituting these into the Euler derivative gives $C_{1,s}^* = \frac{R}{1+R}K(1+\theta)$. In contrast, when defaults or when limit binds in t_2, $C_1^* = Y_1 + L$, so $C_{1,s}^* = K(1+\theta)$. Therefore, $C_{1,s}^* \in \left(\frac{R}{1+R}K(1+\theta), K(1+\theta)\right)$. Under Bayesian learning, $\theta = 0$ and $K < 1$. This gives $C_{1,s}^* < 1$, and $f'(s) > 0$. In contrast, there exist $\bar{\theta} \in \left(\frac{1-K}{K}, \frac{1+R(1-K)}{RK}\right)$ such that for all $\theta > \bar{\theta}$, $C_{1,s}^* > 1$, and $f' < 0$.

B. Derivation of Equation (8)

After receiving the signal, posterior expectation of X_1 is captured by equation (2) in the main text, which is

$$\hat{X}_1 = X^0 + K[g(L) - X^0].$$

Then in period 1, the consumers' expectation about income over the next two periods are respectively

$$\mathbb{E}_1[Y_2] = 2\alpha + \rho\,\hat{X}_1$$

$$\mathbb{E}_1[Y_3] = 3\alpha + \rho^2\,\hat{X}_1.$$

For an average consumer that are not borrowing constrained at t_1. Optimal consumption is given by

$$C_1^* = \Phi_d(Y_1 + L) + (1 - \Phi_d)\mathbb{E}_1[C_2^*], \tag{$A.2$}$$

$$\mathbb{E}_1[C_2^*] = \Phi_L\left(\frac{RA_1 + \mathbb{E}_1[Y_2] + \mathbb{E}_1[Y_3]}{2}\right) + (1 - \Phi_L)(RA_1 + \mathbb{E}_1[Y_2] + L), \tag{$A.3$}$$

where Φ_L is the probability that borrowing is not binding in t_2, which is

$$\Phi_L \equiv P\left(\frac{RA_1 + Y_2 + Y_3}{2} < RA_1 + Y_2 + L\right) = \Phi\left(\frac{2L + RA_1 - \alpha + \hat{X}_1}{\rho(1-\rho)\hat{\sigma}}\right),$$

where $\Phi(\cdot)$ is the standard normal CDF. Then $E_1[C_2^*]$ can be written as

$$\mathbb{E}_1[C_2^*] = C_2^{NC} - (1 - \Phi_L)(C_2^{NC} - C_2^C),$$

where $C_2^{NC} = (RA_1 + \mathbb{E}_1[Y_2] + \mathbb{E}_1[Y_3])/2$ and $C_2^C = RA_1 + \mathbb{E}_1[Y_2] + L$.

When consumers do not default, $A_1 = Y_1 - C_1^* + RA_0$ in $(A.3)$. Total differentiating equation $(A.2)$ with respect to L gives

$$\frac{dC_1^*}{dL} = \Phi_d - (\mathbb{E}_1[C_2^*] - Y_1 - L)\frac{d\Phi_d}{dL} + (1 - \Phi_d)\frac{d\mathbb{E}_1[C_2^*]}{dL},$$

where

$$\frac{d\Phi_d}{dL} = \frac{\phi_d}{\sigma_\eta}\frac{dC_1^*}{dL}$$

and

$$\frac{d\mathbb{E}_1[C_2^*]}{dL} = -\frac{R}{2}\frac{dC_1^*}{dL} + \frac{\rho(1-\rho)}{2}\frac{d\hat{X}_1}{dL} + \frac{(C_2^{NC} - C_2^C)\phi_L}{\rho(1-\rho)\hat{\sigma}}\left(2 + \frac{d\hat{X}_1}{dL} - R\frac{dC_1^*}{dL}\right)$$
$$- (1 - \Phi_L)\left(\frac{R}{2}\frac{dC_1^*}{dL} - 1 - \frac{\rho(1-\rho)}{2}\frac{d\hat{X}_1}{dL}\right).$$

This gives

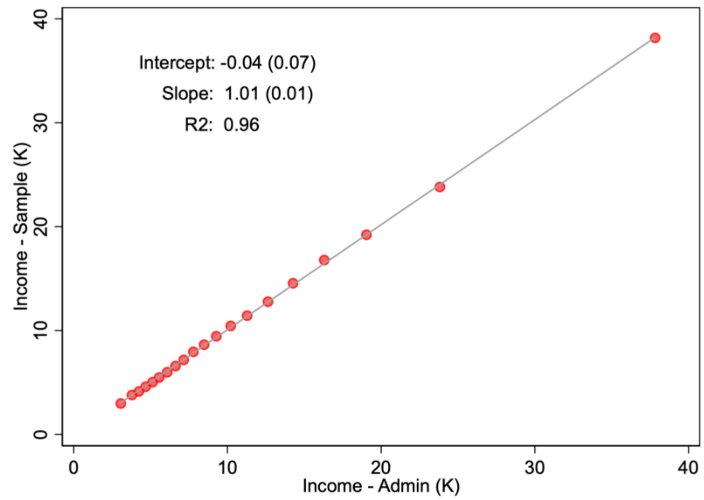
$$\begin{aligned}\frac{dC_1^*}{dL} = \Phi_d - (C_2^{NC} - C_2^C)\frac{\phi_d}{\sigma_\eta}\frac{dC_1^*}{dL}\\ &+ (1 - \Phi_d)\Bigg(-\frac{R}{2}\frac{dC_1^*}{dL} + \frac{\rho(1-\rho)}{2}\frac{d\hat{X}_1}{dL}\\ &+ \frac{(C_2^{NC} - C_2^C)\phi_L}{\rho(1-\rho)\hat{\sigma}}\left(2 + \frac{d\hat{X}_1}{dL} - R\frac{dC_1^*}{dL}\right)\\ &- (1 - \Phi_L)\left(\frac{R}{2}\frac{dC_1^*}{dL} - 1 - \frac{\rho(1-\rho)}{2}\frac{d\hat{X}_1}{dL}\right)\Bigg).\end{aligned}$$

Let $\omega = \left(\frac{1}{1-\Phi_d} + (C_2^{NC} - C_2^{C})\left(\frac{\phi_d}{(1-\Phi_d)\sigma_\eta} + \frac{\phi_L R}{\rho(1-\rho)\hat{\sigma}}\right) + R\left(1 - \frac{\Phi_L}{2}\right)\right)$ and $\chi = \left(1 - \frac{\Phi_L}{2}\right)\rho(1-\rho) + \frac{(C_2^{NC}-C_2^{C})\phi_L}{\rho(1-\rho)\hat{\sigma}}$, then

$$\frac{dC_1^*}{dL} = \frac{1}{\omega}\frac{\Phi_d}{1-\Phi_d} + \frac{1}{\omega}\left(\frac{2(C_2^{NC} - C_2^{C})\phi_L}{\rho(1-\rho)\hat{\sigma}} + (1-\Phi_L)\right) + \frac{\chi}{\omega}K(1+\theta)g'$$

II. Additional Results

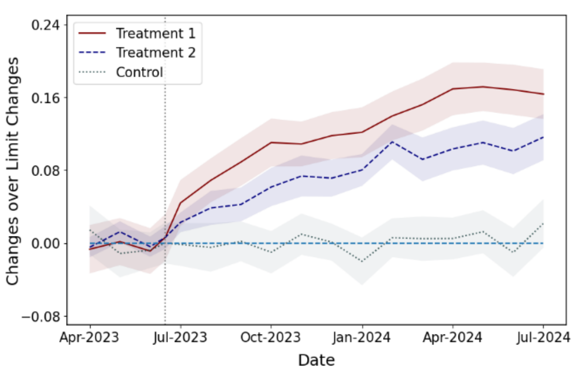
Figure A.1. Income Verification



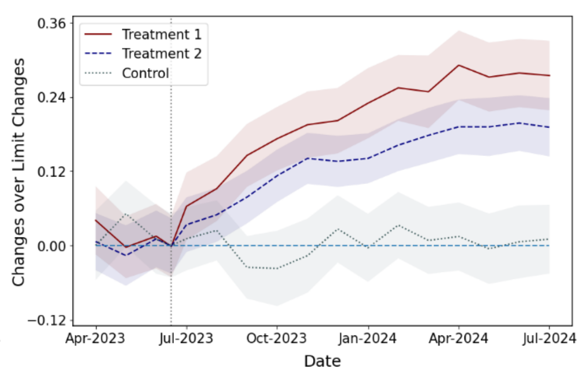
Note: The *x*-axis is the total income over the past 12 months from the social security administrative department, and the *y*-axis is total income calculated based on transacton histories. Units are in thousand CNY. The parentheses give the standard errors.

Figure A.2. Evolution of Debt and Spending – Full Sample II

A: Debt – Without Survey

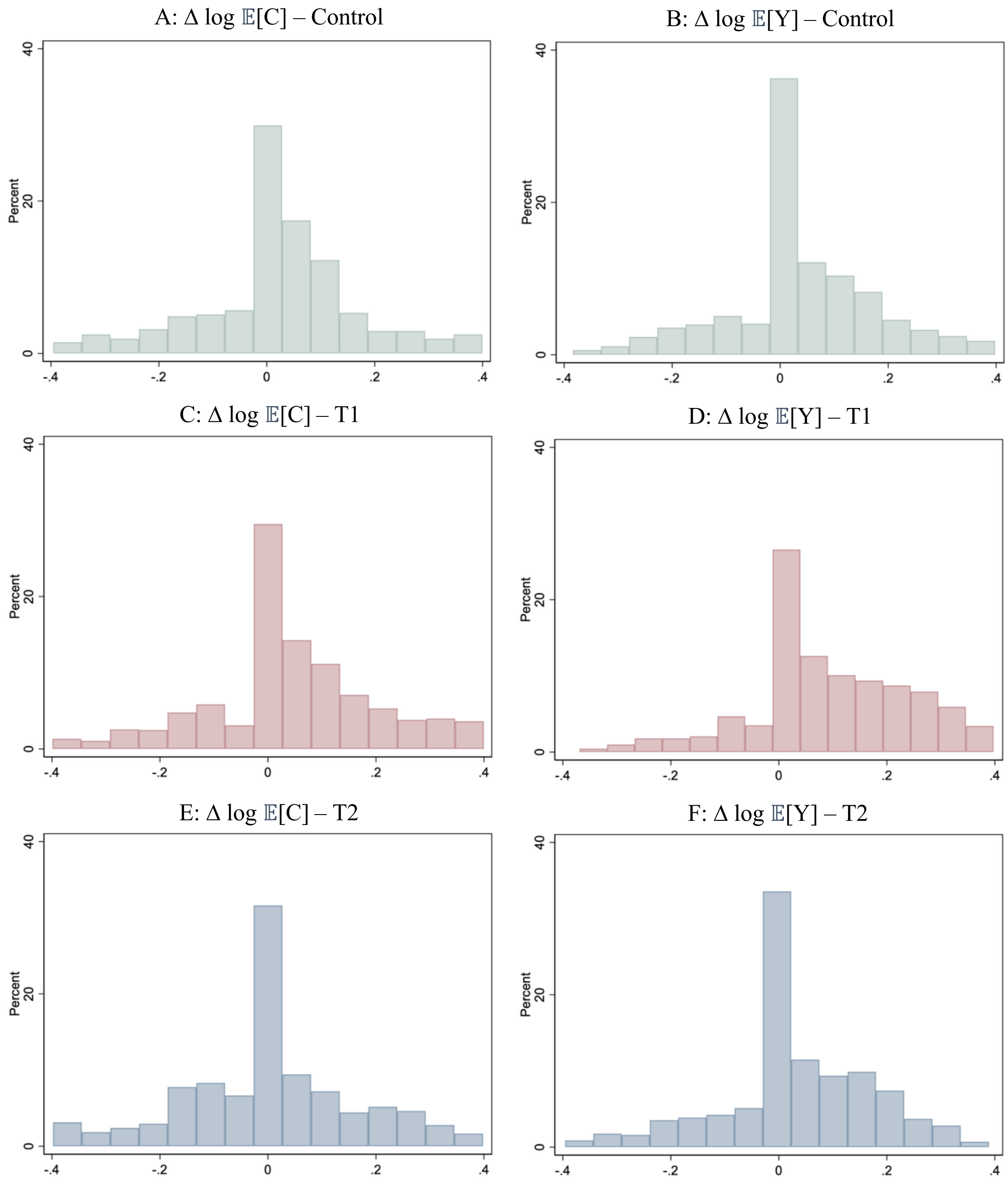


B: Spending – Without Survey



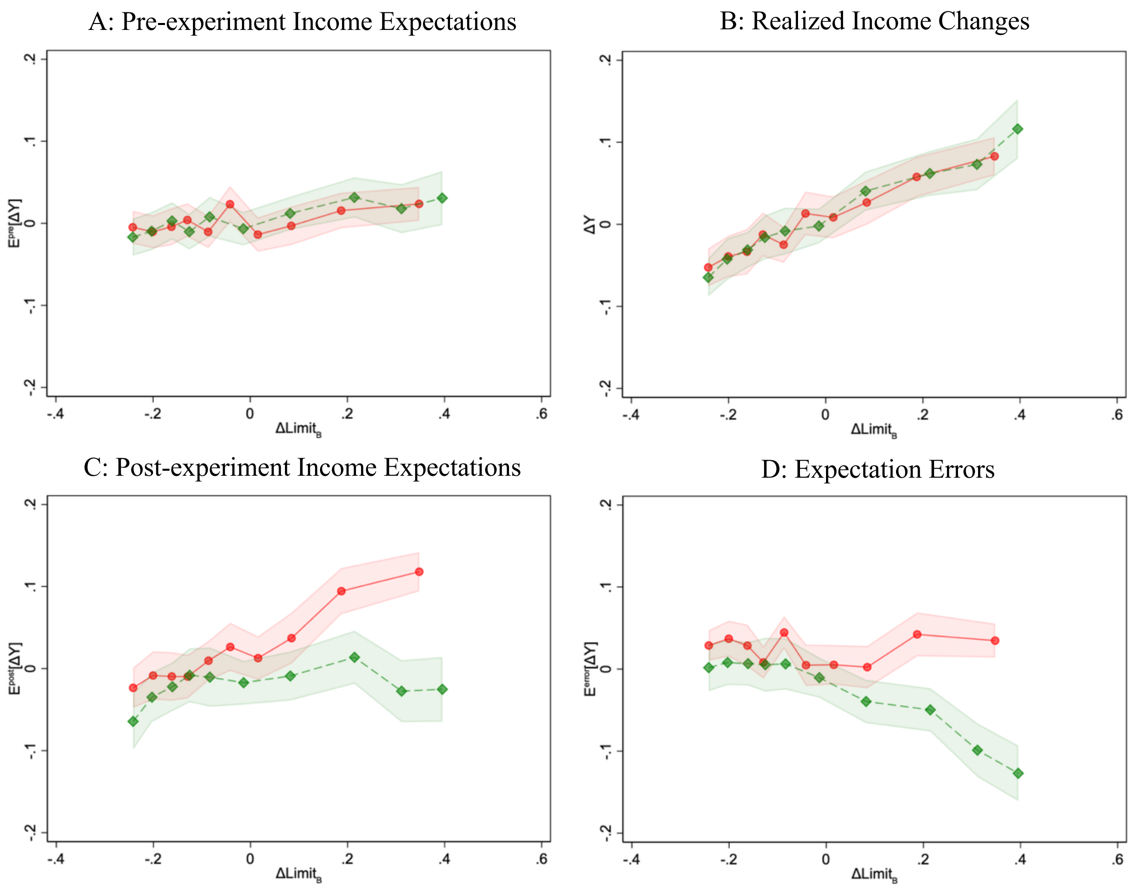
Note: This figure plots the evolution of total unsecured debt and spending on both sides of the experimental period, residualized by date fixed effects. Results are are based on everyone in Sample II. In each panel, the x-axis gives the dates. The solid red line shows the evolution of T1, the blue dashed line shows the evolution of T2, and the gray dotted line shows the evolution of the control group. The gray vertical line gives the time of the treatment. All lines are vertically shifted so that the value for the control group at the treatment time is 0.

Figure A.3. Distributions of log Belief Changes



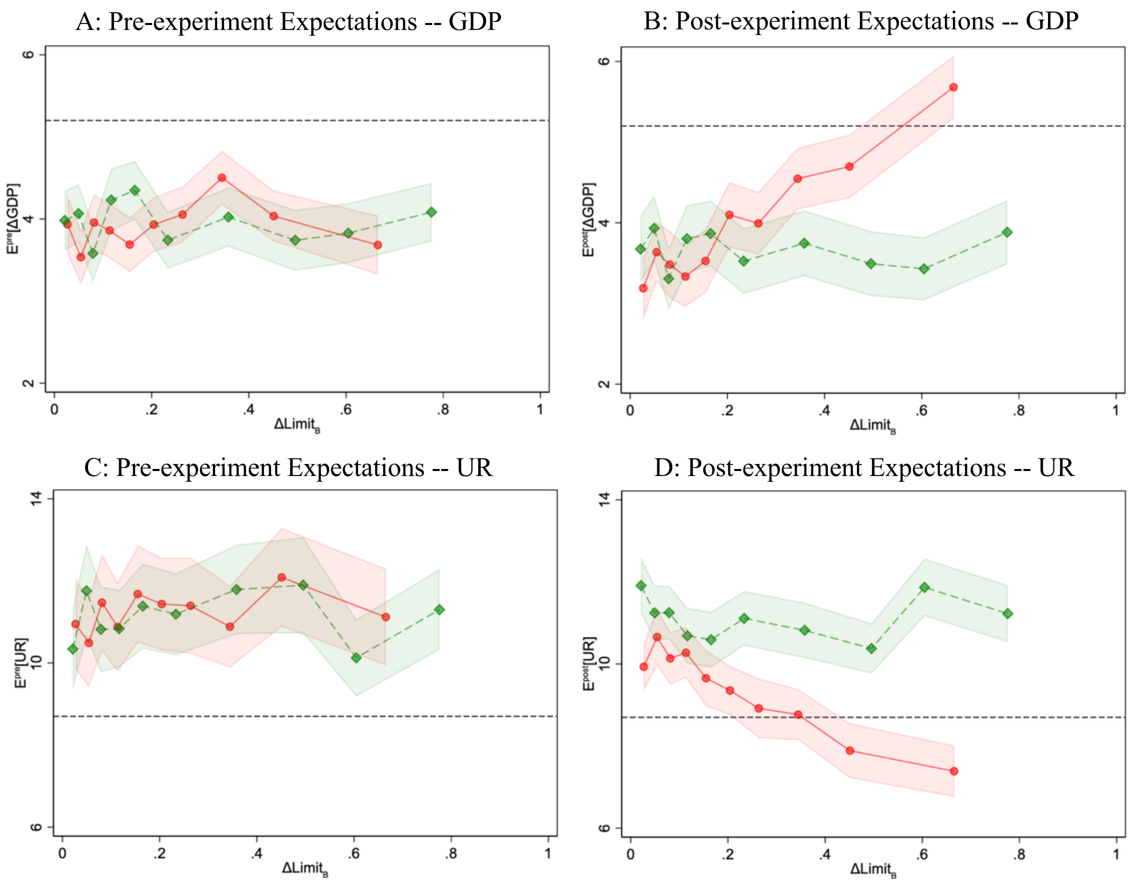
Note: This figures plots the log changes in consumption expectations (left column) and income expectations (right column) using the sample receiving both surveys (sample II). Panels A and B give the control group; panels C and D give the treatment group 1; panels E and F give the treatment group 2. The illustration is based on samples winsorized at 5% level.

Figure A.4. Expectations and Realizations of Income Changes – log Scale



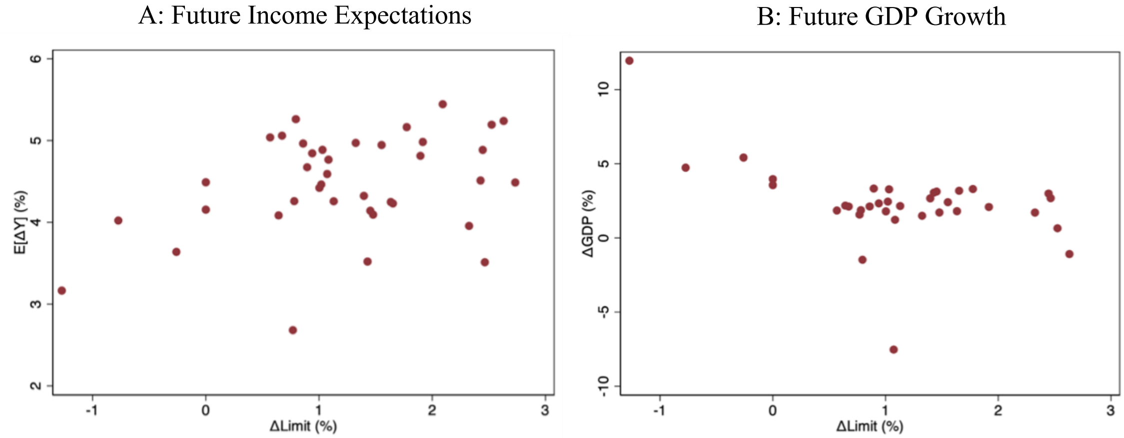
Note: This figure plots consumer expectations of and realized log income changes versus the pre-determined log limit changes focusing on control and treatment 1. The *x*-axis is the log limit changes as proposed by the bank before the random assignment. The *y*-axis of the four panels is consumer pre-experiment expected log income changes, realized log income changes 12 months around the experiment, post-experiment expected log income changes, and expectation errors after the experiment, respectively. Expectation errors are defined as the differences between post-experiment expectations and income realizations. All variables are residualized by age, degree, gender, industry fixed effects, and city fixed effects.

Figure A.5. Expectations of the Macroeconomy



Note: This figure plots consumer macroeconomic expectations versus the pre-determined limit changes focusing on control and treatment 1. The *x*-axis is the limit changes as proposed by the bank before the random assignment. The *y*-axis of the four panels is consumer pre-experiment expected GDP growth and changes in unemployment rate, post-experiment expected GDP growth and changes in unemployment rate. All variables are residualized by age, degree, gender, industry fixed effects, city fixed effects.

Figure A.6. Limit Growth and Income Growth in the US



This figure plots the relationship between measures of future income growth and year-on-year quarterly credit limit growth. On both panels, the x-axis is the log changes in aggregate credit limits from quarter t - 3 to quarter t (from New York Fed's Survey of Consumer Expectations). On Panel A, the y-axis is the average quarter-t one-year-ahead expected income growth from New York Fed's Survey of Consumer Expectation. On Panel B, the y-axis is the quarterly GDP growth from quarter t to quarter t+3. Data is from Fred. Sample periods are from 1999Q1 to 2023Q3.

Table A.1. Sample Comparison

	Age	Female	College	Income	Spending	Debt	Debt|Debt>0	Limit	ΔLimit	Liq Wealth	Tot Wealth	𝔼[ΔY%]
A: Whole Sample – with Survey												
Mean	38.56	0.43	0.50	11.09	6.82	7.58	17.96	86.78	12.99	91.69	483.45	4.22
SD	10.32	0.49	0.50	9.52	2.11	13.10	14.82	103.51	9.47	173.67	644.03	15.94
N	7095	7095	7095	2816	3321	7095	2991	7093	7095	7095	7095	2816
B: Sample with Spending												
Mean	38.21	0.43	0.51	11.31		7.48	17.70	90.05	12.77	95.61	499.30	3.62
SD	10.67	0.50	0.50	9.92		13.16	15.09	105.90	9.34	160.54	683.08	17.22
p	0.11	0.97	0.65	0.42		0.73	0.57	0.14	0.28	0.28	0.25	0.21
N	3321	3321	3321	1911		3321	1404	3319	3321	3321	3321	1911
C: Sample with Income												
Mean	38.67	0.42	0.50		6.86	7.39	17.98	90.34	12.88	98.10	502.96	
SD	10.37	0.49	0.50		2.10	13.44	15.74	112.53	9.30	183.94	668.77	
p	0.65	0.46	0.96		0.49	0.50	0.97	0.13	0.60	0.10	0.18	
N	2816	2816	2816		1911	2816	1156	2814	2816	2816	2816	
D: Non-respondents												
Mean	38.61	0.43	0.48	11.83	7.85	6.92	16.66	93.44	13.55			
SD	10.19	0.50	0.50	9.19	3.16	11.28	12.01	104.63	9.67			
p	0.82	0.62	0.09	0.01	0.00	0.01	0.00	0.00	0.00			
N	4385	4385	4385	1743	2035	4385	4385	4385	4385			

Note: This table gives the summary statistics for different sub samples. Panels A, B, C, and D respectively summarize the whole sample of Sample II, sample II with spending information, sample II with income information, and the non-respondents in sample II. All variables are winsorized at 1% - 99% level.

Table A.2: Spending Responses – Non-Missing Income and Spending Sample

	ΔB - 6M	ΔB - 12M	C - 6M	C - 12M
	(1)	(2)	(3)	(4)
ΔL × T1	0.127***	0.149***	0.197***	0.266***
	(0.024)	(0.022)	(0.026)	(0.040)
ΔL × T2	0.084***	0.102***	0.137***	0.191***
	(0.026)	(0.023)	(0.031)	(0.042)
1st-stage F		723.97		
N	1911	1911	1911	1911

Note: This table studies the effects of limit extensions on borrowing and spending behaviors focusing on the sample with non-missing income and spending information. All variables are winsorized at the 1% - 99% level. Standard errors clustered at industry×city level are in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

Table A.3: The Effects of Treatments on Beliefs – Non-Relation Sample

	Δ𝔼[C]	Δ𝔼[Y]	Δ𝔼[W]	Δ𝔼[Hrs]	𝔼[u]
	(1)	(2)	(3)	(4)	(5)
ΔL × T1	0.310**	0.360***	0.002	0.000	-0.266
	(0.149)	(0.053)	(0.001)	(0.000)	(0.195)
ΔL × T2	-0.071	0.017	-0.000	0.000	-0.087
	(0.135)	(0.062)	(0.002)	(0.000)	(0.261)
	𝔼[d]	Δ𝔼[L] - 1Y	Δ𝔼[L] - 5Y	Δ𝔼[GDP]	Δ𝔼[UR]
	(6)	(7)	(8)	(9)	(10)
ΔL × T1	-0.176	1.158	0.909	0.259***	-1.752***
	(0.205)	(1.001)	(1.551)	(0.087)	(0.509)
ΔL × T2	0.024	1.280	1.447	0.034	-0.004
	(0.246)	(1.080)	(1.983)	(0.055)	(0.546)
1st-stage *F*			1022.98		
N	2837	2837	2837	2837	2837

Note: This table studies the effects of limit extensions on beliefs focuing on the sample whose credit card utilizations are from other banks. ΔE[C], ΔE[Y], ΔE[W], and ΔE[Hrs] are respectively the differences between expected total spending, total income, total wealth, and hours to work every week over the 12 months after and before the experiment. E[u] and E[p(d)] are the expected unemployment probability and delinquent probability over the 12 months after the experiment. ΔE[L] - 1Y and ΔE[L] - 5Y are the expected growth rate of one-year and five-year credit limits. T1 and T2 are respectively the two treatment group identifiers. ΔL is the changes in credit limit. All variables are winsorized at the 1% - 99% level. Standard errors clustered at industry×city level are in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

Table A.4. Comparison with Whole Sample

	Mean	SD	P25	Median	P75
	A: Surveyed Sample				
Age	38.57	10.33	31	38	46
Female	0.43	0.49	0	0	1
Spending	6.83	2.04	5.54	6.66	7.98
Income	10.94	8.57	5.22	8.27	13.63
Debt	7.26	11.22	0	0	12.82
Debt|Debt > 0	17.75	13.47	9.74	14.68	21.39
Limit	86.22	99.96	23.74	48.75	106.12
	B: Whole Sample				
Age	38.83	10.71	30	39	48
Female	0.47	0.50	0	0	1
Spending	7.45	3.04	5.40	6.57	8.89
Income	11.88	9.72	5.42	8.92	17.22
Debt	7.14	13.29	0	0	14.21
Debt|Debt > 0	17.55	15.78	8.56	15.24	21.97
Limit	93.22	121.51	9.03	53.24	146.99

Note: This table compares the surveyed sample and a 10% random sample of active users from the bank database. All variables are winsorized at 1% - 99%.

Table A.5. Heterogeneity in Spending Responses

	More Constrained			Less Constrained		
	ΔE[Y]	C-12M	C-12M	ΔE[Y]	C-12M	C-12M
	(1)	(2)	(3)	(4)	(5)	(6)
ΔL × T1	0.434***	0.310***		0.256***	0.215***	
	(0.062)	(0.035)		(0.078)	(0.043)	
ΔL × T2	0.042	0.213***		-0.013	0.145***	
	(0.095)	(0.039)		(0.089)	(0.052)	
ΔL			0.202***			0.149***
			(0.043)			(0.039)
ΔE[Y]			0.249**			0.261
			(0.108)			(0.166)
1st-stage *F*		632.88	24.25		528.68	9.18
N	1656	1656	1656	1665	1665	1665
	High Volatility			Low Volatility		
	ΔE[Y]	C-12M	C-12M	ΔE[Y]	C-12M	C-12M
	(7)	(8)	(9)	(10)	(11)	(12)
ΔL × T1	0.456***	0.326***		0.232***	0.200***	
	(0.064)	(0.039)		(0.077)	(0.042)	
ΔL × T2	0.071	0.219***		-0.035	0.144***	
	(0.092)	(0.044)		(0.085)	(0.049)	
ΔL			0.200***			0.151***
			(0.054)			(0.036)
ΔE[Y]			0.276**			0.210
			(0.137)			(0.139)
1st-stage *F*		607.17	21.47		562.50	9.80
N	1586	1586	1586	1735	1735	1735
	Less Experience			More Experience		
	ΔE[Y]	C-12M	C-12M	ΔE[Y]	C-12M	C-12M
	(13)	(14)	(15)	(16)	(17)	(18)
ΔL × T1	0.403***	0.288***		0.278***	0.234***	
	(0.072)	(0.047)		(0.070)	(0.036)	
ΔL × T2	0.019	0.192***		0.013	0.168***	
	(0.092)	(0.049)		(0.093)	(0.044)	
ΔL			0.187***			0.164***
			(0.042)			(0.045)
ΔE[Y]			0.250**			0.249
			(0.115)			(0.175)
1st-stage *F*		616.12	20.10		545.23	10.14
N	1636	1636	1636	1685	1685	1685

Note: This table reports the changes in subjective income expectation around the experiment. The left-hand side variables are C-12M. Constrained is based on utilization ratio, defined as if the ratio of unsecured debt balance to total credit limit is below the median. Uncertainty is subjective pre-experiment macroeconomic uncertainty. Experience is the number of bank-initiated credit limit increases. Sample split are based on the pre-experiment sample median. All variabels are winsorized at the 1% and 99% level. Standard errors clustered at industry×city level are in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Table A.6. ITT on Credit Limit Changes by Groups

	ΔL	ΔL	ΔL
	(1)	(2)	(3)
T1	-0.613	-0.420	-0.346
	(0.526)	(0.560)	(0.573)
T2	0.156	-0.002	0.222
	(0.667)	(0.688)	(0.574)
More Constrained	-0.245		
	(0.475)		
High Volatility		-0.224	
		(0.481)	
More Experience			0.401
			(0.407)
More Constrained × T1	0.600		
	(0.598)		
More Constrained × T2	0.355		
	(0.737)		
High Volatility × T1		0.235	
		(0.621)	
High Volatility × T2		0.682	
		(0.729)	
More Experience × T1			0.079
			(0.586)
More Experience × T2			0.201
			(0.806)
p-values	0.21	0.20	0.28
N	7095	7095	7095

Note: This table reports the changes in credit limit by treatment groups and the characteristics groups. The left-hand side variables are *Δ*L. Constrained is based on utilization ratio, defined as if the ratio of unsecured debt balance to total credit limit is below the median. Uncertainty is subjective pre-experiment macroeconomic uncertainty. Experience is the number of bank-initiated credit limit increases. Sample split are based on the pre-experiment sample median. The *p*-values give the *p*-values testing that all the regression coefficients are zero. All variabels are winsorized at the 1% and 99% level. Standard errors clustered at industry×city level are in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

III. Assessing the Degree of Updating

A. Predictability of Prior Expectations and Credit Limits on Future Incomes

This section studies the predictive ability of consumer prior expectations and bank credit decision on future income changes. In Table A.7, Panel A focuses on the current sample with non-missing income information. Columns (1) to (3) focus on changes in level, and columns (4) to (6) focus on changes in log.

I also study the bank's predictive ability of consumer income over a longer period. Since the bank does not directly forecast their customers' incomes, there is not a measure of bank "belief". To get such a measure, I build a machine learning model to predict consumer income with observable information. In particular, I use a random 10% sample from the bank from 2015 to 2024 with non-missing income. I then build a deep neural network to predict income change over the next 12 months around the time when the bank decides to increase the credit limit. The model is split into a 70% of training sample and a 30% of test sample. The model is fit on the training sample with3-fold cross validation.

There are three types of predictors. The first is categorical that includes age, gender, education, occupation dummy, and city dummy. The second is continuous including annual province-level GDP growth, quarterly personal income growth, industry average income growth, personal credit limit growth, and credit score over the past three years. The third type is based on transaction history. The bank broadly splits the products and services into 10 types. I then calculate the quarterly expenditure to total income for each category over the past three years.

In the end, I use the fitted model to predict the income changes using the test sample. The relationship between the bank's belief and future realized changes is in Panel B of Table A.7. Besides, I also focus on this sample to study the relationship between credit limit changes and income changes.

B. Calibrating the Degree of Learning

To quantify the degree of belief updating implied by observed data, I calibrate the Kalman gain K using the relative informativeness of prior expectations and credit supply signals in predicting realized income. Table A.7 reports the R^2 values from separate regressions of future income on:

- consumer prior expectation $\mathrm{E}_0[\Delta \mathrm{Y}]$ ($R^2 = 0.248$)
- credit limit changes $\Delta \mathrm{L}$ ($R^2 = 0.081$).

I assume a standard Bayesian filtering setup where the true outcome $\Delta \mathrm{Y}$ (future income) is observed with noises. The prior and signals are respectively

$$\mathbb{E}_0[\Delta \mathrm{Y}] = \Delta \mathrm{Y} + \epsilon_E, \qquad \Delta \mathrm{L} = \Delta \mathrm{Y} + \epsilon_L.$$

with $\epsilon_E \sim N(0, \sigma_E^2)$ and $\epsilon_L \sim N(0, \sigma_L^2)$ independent of each.

In this case, the Kalman gain K, which measures how much weight a Bayesian learner puts on the signal ΔL, is:

$$K = \frac{\sigma_E^2}{\sigma_E^2 + \sigma_L^2}.$$

Using the identity $R^2 = var(X)/(var(X) + var(\epsilon))$, one can solve for the variance ratio as

$$\frac{\sigma_L^2}{\sigma_E^2} = \frac{1 - R_L^2}{R_L^2}\frac{R_E^2}{1 - R_E^2}.$$

This gives $K = 1/(1 + \sigma_L^2/\sigma_E^2)$.

From columns (1) and (2), $R_E^2 = 0.220$ and $R_L^2 = 0.072$. This yields $K \approx 0.22$ and $\theta \approx 0.90$.

Table A.7: Ex Ante Beliefs, Credit Supply, and Realized Income

	A: Based on the Experiment					
	ΔY	ΔY	ΔY	Δ log Y	Δ log Y	Δ log Y
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{E}_0[\Delta Y]$	0.595***		0.603***			
	(0.022)		(0.022)			
ΔL		0.229***	0.238***			
		(0.019)	(0.018)			
$\mathbb{E}_0[\Delta \log Y]$				0.661***		0.631***
				(0.027)		(0.027)
Δ log L					0.247***	0.204***
					(0.016)	(0.014)
R^2	0.220	0.072	0.297	0.307	0.090	0.368
N	2810	2810	2810	2807	2807	2807
	B: 10% Random Sample					
	ΔY	ΔY	ΔY	Δ log Y	Δ log Y	Δ log Y
	(7)	(8)	(9)	(10)	(11)	(12)
$\mathbb{E}_B[\Delta Y]$	0.343***		0.322***			
	(0.017)		(0.018)			
ΔL		0.679***	0.087*			
		(0.062)	(0.049)			
$\mathbb{E}_B[\Delta \log Y]$				0.432***		0.411***
				(0.022)		(0.021)
Δ log L					0.697***	0.092*
					(0.052)	(0.050)
R^2	0. 093	0.064	0. 093	0. 098	0.069	0. 098

Note: ΔY is income changes in CNY, $\mathbb{E}_0[\Delta Y]$ is the prior income change expectations, ΔL is bank-proposed limit changes. Δ log Y, $\mathbb{E}_0[\Delta \log Y]$, and Δ log L are respectively in logs. $\Delta\mathbb{E}_B[Y]$ is the banks' predicted income change over the next 12 months. All variables are winsorized at 1% and 99% level. Standard errors clustered at *industry*×*city* level are in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Table A.8: Treatments and Labor Supply Adjustment

	Job Change (1)	Self-empolyed (2)	Change Residence (3)	Lost Job (4)
T1	-0.051	0.046	0.036	-0.033
	(0.050)	(0.043)	(0.055)	(0.038)
T2	-0.007	0.028	0.020	-0.011
	(0.064)	(0.052)	(0.076)	(0.052)
N	7095	7095	7095	7095

Note: Job Change, Self-employed, Change Residence, and Lost Job are respectively dummy variables for having a job change, becoming self-employed, having changed place of living, and becoming unemployed during the 12 months after the experiment. T1 and T2 are respectively the two treatment group identifiers. Coefficients are divided by the pre-determined average increase in credit limit to give an interpretation of marginal propensity. All estimates are multiplied by 100. All variables are winsorized at the 1% - 99% level. Standard errors clustered at industry×city level are in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

IV.Survey

A. Pre-experiment Survey

Please read the following information carefully.

The use of credit cards is one important channel for residents to make daily consumption. To better understand the impact of credit cards on people's lives, we selected a certain number of active users to participate in a survey. The survey is expected to take between 5 to 10 minutes. If you choose to take the survey, you will be awarded 20 CNY.

This survey is in collaboration with third-party research scholars. The surveys will only be analyzed for scientific research purposes and will not be evaluated by this bank. We will not disclose participants' personal information in any respect. We will not, to any extent, change the types of financial products we provide, including credit scores, credit limits, deposit rates, etc., based on the participants' personal answers. Therefore, please answer based on your true thoughts.

- Yes
- No

1. How many banks do you usually use for transaction purposes?
    a. 1
    b. 2
    c. 3 or more
2. Your total income over the past 12 months was

    Note: income includes wages, salaries, bonuses, commission, etc., excluding capital gains and financial return from financial investments.

3. What was the total amount of your spending during the past 12 months (excluding investment and purchases of durable goods including housing, cars, etc.)?
4. What is the current value of your total wealth?

    Note: total wealth is the value of all assets such as cash, savings, houses, stock market wealth, and all other liquid and fixed assets minus all debts you owe.

5. How many hours on average do you work every week over the past 12 months?
6. Over the next 12 months, conditional on not being unemployed, what's the level of total income you are most likely to get?
7. What's the most likely level of your total wealth in 12 months?
8. Over the next 12 months, how much would you most likely spend on average every month (excluding investment and purchases over durable goods including housing, cars, etc.)?
9. Compared to your current total credit limit across all financial institutions or platforms, how much would your total credit limit be (in percentage) in one year?
    a. Decreases by more than 50%
    b. Decreases by between 25% and 50%
    c. Decreases by between 10% to 25%
    d. Decreases by between 0% to 10%
    e. Stays roughly the same.
    f. Increases by between 0% to 10%
    g. Increases by between 10% to 25%
    h. Increases by between 25% and 50%
    i. Increases by more than 50%
10. Compared to your current total credit limit across all financial institutions or platforms, how much would your total credit limit be (in percentage) in five years?
    a. Decreases by more than 50%
    b. Decreases by between 25% and 50%
    c. Decreases by between 10% to 25%
    d. Decreases by between 0% to 10%

e. Stays roughly the same.
f. Increases by between 0% to 10%
g. Increases by between 10% to 25%
h. Increases by between 25% and 50%
i. Increases by between 50% and 100%
j. Increases by between 100% and 200%
k. Increases by more than 200%

11. How much will the overall Chinese economy change (in percentage relative to the current level) over the next year?

    a. Decreases by more than 20%
    b. Decreases by between 15% and 20%
    c. Decreases by between 10% to 15%
    d. Decreases by between 5% to 10%
    e. Decreases by between 2.5% to 5%
    f. Decreases by between 0% to 2.5%
    g. Stays roughly the same.
    h. Increases by between 0% to 2.5%
    i. Increases by between 2.5% to 5%
    j. Increases by between 5% to 10%
    k. Increases by between 10% to 25%
    l. Increases by between 25% and 30%
    m. Increases by more than 20%

12. How much will the unemployment rate (in percentage relative to the current level) be over the next year?

    a. Decreases by more than 20%
    b. Decreases by between 15% and 20%
    c. Decreases by between 10% to 15%
    d. Decreases by between 5% to 10%
    e. Decreases by between 2.5% to 5%
    f. Decreases by between 0% to 5%
    g. Stays roughly the same.
    h. Increases by between 0% to 2.5%
    i. Increases by between 2.5% to 5%
    j. Increases by between 5% to 10%
    k. Increases by between 10% to 15%
    l. Increases by between 15% and 20%
    m. Increases by more than 20%

13. How confident are you in evaluating whether the overall economy is functioning effectively at the moment?

a. not very confident
b. somewhat confident
c. very confident

14. Suppose the overall economy in China grows by 5% relative to the current level over the next year, how would this affect your total income over the same period?

    a. Decreases by more than 50%
    b. Decreases by between 30% and 50%
    c. Decreases by between 20% to 30%
    d. Decreases by between 10% to 20%
    e. Decreases by between 5% to 10%
    f. Decreases by between 0% to 5%
    g. Stays roughly the same.
    h. Increases by between 0% to 5%
    i. Increases by between 5% to 10%
    j. Increases by between 10% to 20%
    k. Increases by between 20% to 30%
    l. Increases by between 30% and 50%
    m. Increases by more than 50%

15. Suppose the unemployment rate in China decreases by 10% relative to the current level over the next year, how would this affect your total income over the same period?

    a. Decreases by more than 50%
    b. Decreases by between 30% and 50%
    c. Decreases by between 20% to 30%
    d. Decreases by between 10% to 20%
    e. Decreases by between 5% to 10%
    f. Decreases by between 0% to 5%
    g. Stays roughly the same.
    h. Increases by between 0% to 5%
    i. Increases by between 5% to 10%
    j. Increases by between 10% to 20%
    k. Increases by between 20% to 30%
    l. Increases by between 30% and 50%
    m. Increases by more than 50%

16. (Random 30%) Suppose banks increase your credit card limit by 5000 CNY this month. This would mean that the banks expect your total income to be changed by ___ in the next 12 months. [20]

    Note: use a negative number for decreases.

[20] Questions 16 to 18 are sent to the same set of individuals.

17. (Random 30%) Suppose banks increase your credit card limit by 10000 CNY this month. This would mean that the banks expect your total income to be changed by ___ in the next 12 months.

    Note: use a negative number for decreases.

18. (Random 30%) Rather than receiving 100 Yuan today, which options would you choose? (select all that apply)

    a. 100 Yuan in 6 months.
    b. 102.5 Yuan in 6 months.
    c. 105 Yuan in 6 months.
    d. 107.5 Yuan in 6 months.
    e. 110 Yuan in 6 months.
    f. 112.5 Yuan in 6 months.
    g. 115 Yuan and more in 6 months.

B. Post-experiment Survey

Please read the following information carefully.

About three weeks ago, you completed a survey we sent. This is a follow-up survey that we would like to ask some more information. The survey is expected to take between 5 to 10 minutes. If you choose to take the survey, you will be awarded 20 CNY.

This survey is in collaboration with third-party research scholars. The surveys will only be analyzed for scientific research purposes and will not be evaluated by this bank. We will not disclose participants' personal information in any respect. We will not, to any extent, change the types of financial products we provide, including credit scores, credit limits, deposit rates, etc., based on the participants' personal answers. Therefore, please answer based on your true thoughts.

- Yes
- No

1. Please assign probability to the percentage change of the total income you are most likely to get over the next 12 months, conditional on not being unemployed.

   Note: income includes wages, salaries, bonuses, commission, etc., excluding capital gains and financial return from financial investments. The sum has to sum to 100%

   Decreases by more than 50% ___%
   Decreases by between 20% and 50% ___%
   Decreases by between 10% and 20% ___%
   Decreases by between 5% to 10% ___%
   Decreases by between 0% to 5% ___%
   Stays roughly the same ___%
   Increases by between 0% to 5% ___%
   Increases by between 5% to 10% ___%
   Increases by between 10% and 20% ___%
   Increases by between 20% and 50% ___%
   Increases by more than 50% ___%

2. Please assign probability to the percentage change of the total wealth in 12 months.

   Note: the sum has to sum to 100%

   Decreases by more than 50% ___%
   Decreases by between 20% and 50% ___%
   Decreases by between 10% and 20% ___%
   Decreases by between 5% to 10% ___%
   Decreases by between 0% to 5% ___%
   Stays roughly the same ___%
   Increases by between 0% to 5% ___%
   Increases by between 5% to 10% ___%
   Increases by between 10% and 20% ___%
   Increases by between 20% and 50% ___%
   Increases by more than 50% ___%

3. Please assign probability to the percentage change of your total spending over the next 12 months (excluding investment and purchases over durable goods including housing, cars, etc.).

   Note: the sum has to sum to 100%

   Decreases by more than 50% ___%
   Decreases by between 20% and 50% ___%
   Decreases by between 10% and 20% ___%
   Decreases by between 5% to 10% ___%
   Decreases by between 0% to 5% ___%
   Stays roughly the same ___%
   Increases by between 0% to 5% ___%

Increases by between 5% to 10%	___%
Increases by between 10% and 20%	___%
Increases by between 20% and 50%	___%
Increases by more than 50%	___%

4. How many hours on average will you work every week over the next 12 months?
5. What's the probability that you will lose your job over the next 12 months?
6. What's the probability that you will not be able to make a payment to your borrowing over the next 12 months?

   Note: Please answer zero if you do not plan to borrow over the next 12 months.

7. Compared to your current total credit limit across all financial institutions or platforms, please assign probability to the percentage change of total credit limit in one year?

   Note: the sum has to sum to 100%

Decreases by more than 50%	___%
Decreases by between 20% and 50%	___%
Decreases by between 10% and 20%	___%
Decreases by between 5% to 10%	___%
Decreases by between 0% to 5%	___%
Stays roughly the same	___%
Increases by between 0% to 5%	___%
Increases by between 5% to 10%	___%
Increases by between 10% and 20%	___%
Increases by between 20% and 50%	___%
Increases by more than 50%	___%

8. Compared to your current total credit limit across all financial institutions or platforms, please assign probability to the percentage change of total credit limit in five years?

   Note: the sum has to sum to 100%

Decreases by more than 50%	___%
Decreases by between 20% and 50%	___%
Decreases by between 10% and 20%	___%
Decreases by between 5% to 10%	___%
Decreases by between 0% to 5%	___%
Stays roughly the same	___%
Increases by between 0% to 5%	___%
Increases by between 5% to 10%	___%
Increases by between 10% and 20%	___%

Increases by between 20% and 50% ___%
Increases by more than 50% ___%

9. Please assign probability to the percentage change of the overall Chinese economy over the next year.

   Note: the sum has to sum to 100%

   Decreases by more than 50% ___%
   Decreases by between 20% and 50% ___%
   Decreases by between 10% and 20% ___%
   Decreases by between 5% to 10% ___%
   Decreases by between 0% to 5% ___%
   Stays roughly the same ___%
   Increases by between 0% to 5% ___%
   Increases by between 5% to 10% ___%
   Increases by between 10% and 20% ___%
   Increases by between 20% and 50% ___%
   Increases by more than 50% ___%

10. Please assign probability to the percentage change of the unemployment (in percentage relative to the current level) over the next year.

   Note: the sum has to sum to 100%

   Decreases by more than 50% ___%
   Decreases by between 20% and 50% ___%
   Decreases by between 10% and 20% ___%
   Decreases by between 5% to 10% ___%
   Decreases by between 0% to 5% ___%
   Stays roughly the same ___%
   Increases by between 0% to 5% ___%
   Increases by between 5% to 10% ___%
   Increases by between 10% and 20% ___%
   Increases by between 20% and 50% ___%
   Increases by more than 50% ___%

V. Simulating a Consumption Model with Income-Inference

1. Consumer Preferences

Household preferences follow the literature on consumer credit and default (e.g. Chatterjee et al. (2007) and Livshits et al. (2007)). Consumers maximize their expected lifetime utility with flow utility of:

$$\frac{c^{1-\gamma}-1}{1-\gamma}-\chi\, d,$$

with a per-period discount rate of β. γ is the coefficient of relative risk aversion, and $d=1$ if the consumer chooses to default at the end of period t.

When defaulting, consumers incur a fixed non-pecuniary utility cost ("stigma") $\chi>0$. In addition, consumers receive a pair of additively separable i.i.d. shocks, $\xi \in \{\xi_N, \xi_D\}$, which are attached to the options to default or repay and are drawn from a type one extreme value distribution with scale parameter of ω. These shocks capture the fact that many defaults are associated with events such as marital disruptions and medical expenses, which I do not model explicitly. With these shocks, the model generates a positive probability of default across the whole range of borrowing. In addition, as suggested in Dempsey and Ionescu (2023), the introduction of utility shocks associated with defaulting smooths out individuals' repayment probability functions, which eases the computation of the model.

The budget constraint in period t is

$$a' = \begin{cases} (1-r)(a-c)+y' & if \quad d=0 \\ (1-\nu)y' & if \quad d=1 \end{cases}$$

$$a \geq -l$$

where a is the total amount of available resources. l is the credit limit, and $\nu \in [0,1]$ is the marginal rate of garnishment. When consumers do not default, their wealth in the next period is the sum of their income and gross savings.

When consumers default, their savings become zero; at the same time, they need to pay a garnishment cost equal to ν times their income in the following period. For simplicity, I assume that consumers' borrowing capacity does not change upon default, which allows us to discard one additional state variable.[21] The interest rates differ for saving and borrowing and take the values

$$r = \begin{cases} r_b & if \quad a < 0 \\ r_s & if \quad a \geq 0 \end{cases}$$

2. Income Process

The model has discrete time and infinite horizon. A unit mass of consumers is subject to idiosyncratic income risk. For each individual i, income y' in the next period follows (as in Blundell and Preston (1998) and Carroll (1997)):

$$\log y' = \alpha + z' + \epsilon'$$

$$z' = \rho z + \eta'$$

where ϵ' and η' are i.i.d. normal shocks with $\mathbb{E}[\exp \epsilon'] = 1$ and $\mathbb{E}[\exp \eta'] = 1$. The variances of $\epsilon'$and η' are σ_ϵ^2 and σ_η^2, respectively. α is the life-cycle component, which I assume is constant and common knowledge. Throughout the analysis, I set $\alpha = 0$ to demean the log income process. Consumers do not know the true value of z and need to make inferences based on Bayesian learning.

3. Banks

There is a representative bank operating in a perfectly competitive market. The bank only operates for one period. At the beginning of each period, the bank receives a signal of the persistent component of consumers' current income, which follows

$$s = z + \tau.$$

τ is i.i.d. normal with $\mathbb{E}[\exp \tau] = 1$ and $var(\tau) = \sigma_\tau^2$. The bank sets a uniform credit limit to the consumers such that the equilibrium average default is equal to a fixed number ψ. Denote the credit supply function as $l = \boldsymbol{l}(s)$. Assume $\boldsymbol{l}$ is monotonic and continuous.

4. Expectations Formation

The Kalman-filtering problem with respect to the persistent component of $\log y'$ follows Guvenen (2007). In each period, consumers observe $\log y'$ and credit limit to update their beliefs about z.

[21] Some studies assume that defaults go hand in hand with a temporary inability to borrow, that is, l= 0 (Chatterjee et al., 2007; Livshits et al., 2007; Dempsey and Ionescu, 2023), but Livshits et al. (2007) show the costs of default from changing borrowing capacities are quantitatively small.

Here I focus on a revealing equilibrium so that consumers correctly infer s from l. The forecast for z' is normally distributed with variance σ_z^2 and mean given by

$$\hat{z}' = \rho\hat{z} + \left(1+\theta_y\right)\kappa_y(\log y' - \rho\hat{z}) + (1+\theta_l)\kappa_l(s-\rho\hat{z}).$$

where κ_y and κ_l are the Kalman gains of the learning process from current income and credit limit. Following Bordalo et al. (2019) and D'Acunto et al. (2024), I allow consumers to over-extrapolate recent news, as captured by θ_y and θ_l.

Given an infinite horizon, I follow the common assumption that a sufficient number of periods have passed such that consumers are in a learning steady state, that is, consumers' Kalman gains are constant each period. θ's are the degree of overreaction, it can be microfounded with overconfidence in terms of overestimating the precision of the signals in the spirit of Bordalo et al. (2020) and Angeletos, Huo and Sastry (2021).

5. Optimality Conditions

Consumers' problem is characterized by a set of four state variables $\Theta = \{a, \hat{z}, y, s\}$. Given the overall state Θ, the consumer's value function is

$$V(\Theta) = \max\{V_D(\Theta), \mathrm{V}_N(\Theta)\}.$$

The continuation value from defaulting is

$$V_D(\Theta) = \max_c \frac{c^{1-\gamma}-1}{1-\gamma} - \chi\, d + \beta\mathbb{E}_{\Theta}\left[V\left((1-\nu)y', \hat{z}', y', s'\right)\right] + \xi_D$$

The continuation value from not defaulting is

$$V_N(\Theta) = \max_c \frac{c^{1-\gamma}-1}{1-\gamma} + \beta\mathbb{E}_{\Theta}[V(a', \hat{z}', y', s')] + \xi_N$$

Given that ξ follows a type one extreme value distribution, the probability of default is

$$pd = \left(1+\exp\left\{\frac{V_N(\Theta)-V_D(\Theta)}{\omega}\right\}\right)^{-1}$$

6. Model Solution

I use value function iteration to solve the model. For a set of state variables $\{a, \hat{z}, y, s\}$, the procedure of solving the model is as follows:

1. Discretize credit limit l into $n_l = 25$ grid points and s into $n_s = 10$. For each l_i and s_j:

a. Discretize the state for current wealth into $n_a = 100$ grid points over l_i and $a_{max} = 30$. The maximum value is set to roughly match the maximum in the data, which is around 30 times the average income.

b. Discretize $\hat{z}$ and y into five values using the Tauchen methods. Given $\hat{z}$, y, and s_j, get $\mathbb{E}[y']$ and $p(y')$ based on

$$\hat{z}' = \left(1 - \left(1 + \theta_y\right)\kappa_y - (1 + \theta_l)\kappa_l\right)\rho\hat{z} + \left(1 + \theta_y\right)\kappa_y \log y + (1 + \theta_l)\kappa_l s.$$

c. Given each combination of $\{a, \hat{z}, y, s, l\}$, use value function iteration to solve for V_N, V_D, and V.

d. Given the value functions, solve for the policy functions for consumption and default.

e. Linearly interpolate to get the optimal policy functions c_d, c_n, and d. Get optimal $c = (1 - d) \times c_n + d \times c_d$.

2. For each l_i, linearly interpolate c the d over s to get optimal s^* such that the default rate is equal to ψ.

3. Given s^*, get the optimal policy functions c^* and d^*.

7. Simulating the experiment

I use the model to study the effects of limit extension on consumption choices, focusing on the steady-state distribution and under the benchmark case when consumers learn information from credit extensions. Table A.9 gives the parameters. The calibration process is simplified, e.g., setting a uniform credit limit to everyone, so the results should be taken qualitatively.

I simulate 10000 individuals until the steady state. Then I study the effects of increasing credit limit by 15% on consumption with and without incorporating the income-inference channel. The magnitude is selected to match the experiment.

Figure A.7 plots the results. Panel A gives the equilibrium relationship between credit limit (x axis) and bank signals (y axis). Credit limit is scaled by the sample average income. As shown, a higher credit limit signals a higher bank belief. Panel B gives the MPCL across the wealth distribution. The red solid line gives that when consumers learn from the equilibrium relationship between credit limit and bank signal, and the blue dashed line without learning. The plot shows that learning increases spending responses across the saving distribution, and the weight is larger for high-liquidity consumers given slack constraints from spending over expected future income. In sum, the results are consistent with the propositions in the main text.

Table A.9. Parameter Estimates

Panel A First-Stage Parameters	Estimates (1)
ρ	0.97
σ_η	0.12
σ_ϵ	0.33
σ_τ	0.37
γ	2.00
ν	0.10
r_b	0.08
r_s	0.02
θ_y	1.68
θ_l	0.94
ω	4.00

Panel B Second-Stage Parameters	Estimates (2)	S.E. (3)
β	0.93	(0.01)
χ	15.03	(0.05)

Panel C Targeted Moments	Data (4)	Model (5)
w/c	0.97	0.97
$p(d)$	2.54%	2.54%

Notes: this table presents the parameters used to simulate the model. Panel A selects the parameters mostly based on simple statistical estimation from the data. Value of θ_y is selected from D'Acunto et al. (2024). Parameters in Panel B are estimated using Simulated Method of Moments.

Figure A.7.A: Credit Limit and Bank Signals

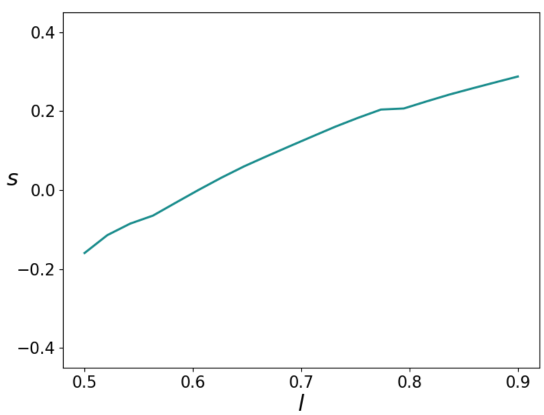
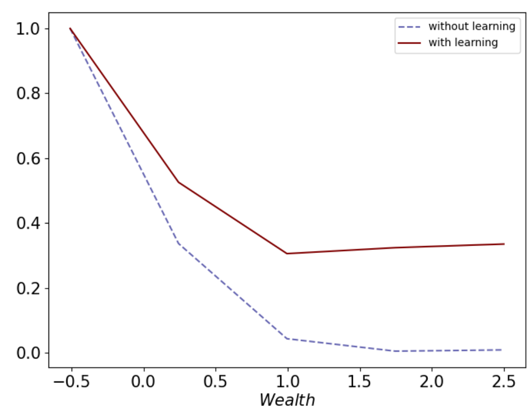


Figure A.7.B: MPCL across Saving



VI. NY Fed Survey of Consumer Expectations

This section provides results on changes in income expectations around account closures using NY Fed's Survey of Consumer Expectations data. Specifically, Credit Access Survey asks the same participants mostly three times a year and has the following question:

> N14. When answering this question, please consider all kinds of credit you have, including credit cards (including retail/store cards), mortgages, home-based loans (such as home equity lines of credit), auto loans, student loans as well as all other personal loans. In the past 12 months, did any of the following happen?
>
> Please select all that apply
>
> - I closed at least one of my accounts voluntarily (1)
> - My lender(s) closed at least one of my accounts (2)
> - My lender(s) lowered the credit limit on a credit card or home equity line of credit (4)
> - None of the above (3)

Each participant answers this question mostly every four months, identifying those who select a certain event in the current survey but does not select this event in the previous survey gives those who have experienced this event over the past four months. To extract a relatively exogenous event, I focus on the second option. I define $Closure_{i,t} = 1$ if the second option is selected in the surveys in round t but not $t-1$. Therefore, let s be the month of filling the survey, $Closure_{i,s} = 1$ if participant i has experienced at least one account closure from month $s-3$ to s but not from month $s-11$ to $s-4$.

Then I use the Survey of Consumer Expectations (SCE) to get expectations of future income growth. SCE surveys the same participants 12 times a year, so I can measure belief changes around $Closure$. The question I use is

> Q25v2part2. By about what percent do you expect your total household income to [increase/decrease as in Q25v2]? Please give your best guess.
>
> Over the next 12 months, I expect my total household income to [increase/decrease] by __ %

I define $\Delta\mathbb{E}_{it+1}[y] = \mathbb{E}_{it+1}[y] - \mathbb{E}_{it-1}[y]$ as the difference between answer to this question that are closest but after the time of $Closure_{i,t}$ and the answer that are closest but equal or before the time of $Closure_{i,t-1}$. Therefore, $\Delta\mathbb{E}[y]$ measures the changes in expectations of income growth over the next 12 months. With these measures, I can study the relationship between account closure and changes in beliefs. The specification is

$$\Delta\mathbb{E}_{it+1}[y] = \beta_1\, Closure_{i,t} + X_{i,t}\gamma_1 + \epsilon_{i,t}. \tag{A.5}$$

A concern of this specification is that the forecasting periods are different for $E_{it+1}[y]$ and $\mathbb{E}_{it-1}[y]$. As an alternative specification, I also fit

$$\mathbb{E}_{it+1}[y] = \beta_2\, Closure_{i,t} + X_{i,t}\gamma_2 + \gamma_3\mathbb{E}_{it-1}[y] + \epsilon_{i,t}. \tag{A.6}$$

Note that this exercise faces many issues like endogeneity and selection problem, the results are nonetheless suggestive. The results are in Table A8, columns (1) to (4) give results for specification (A.5) and column (5) gives that for (A.6). Focusing on column (4) that controls for individual fixed effects and year-month × income group and year-month × debtor fixed effects, the estimate indicates that those who have at least one account closure over the past four months revised down their income expectations over the future 12 months by 6.13%. Therefore, consumers also tend to change their personal income expectation around account closures.

In column (6), I estimate (A.5) with income growth from t to the last available survey. Note that the realized income growth is usually over a shorter period than 12 months due to data limitation. Though, column (6) shows that account closure forecasts lower future realized income.

Table A.10: Account Closure and Changes in Income Growth Expectations

	$\Delta\mathbb{E}_{t+1}[y]$				$\mathbb{E}_{t+1}[y]$	$y_T - y_t$
	(1)	(2)	(3)	(4)	(5)	(6)
$Closure$	-4.36**	-4.81**	-5.24***	-6.13***	-4.70***	-1.90**
	(1.97)	(1.92)	(1.97)	(1.89)	(1.53)	(0.88)
$\mathbb{E}_{t-1}[\mathrm{Y}]$					0.07**	
					(0.03)	
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Income Group FE	No	Yes	Yes	No	No	No
Debtor FE	No	Yes	Yes	No	No	No
YM FE	No	No	Yes	No	No	No
Income Group×YM FE	No	No	No	Yes	Yes	Yes
Debtor×YM FE	No	No	No	Yes	Yes	Yes
N	7386	7386	7386	7383	7383	7383

Note: Income Group splits subjects into 20 groups in each survey round based on total household income in $t-1$. Debtor is a dummy variable labelling those who hold positive debt in $t-1$. YM FE is year-month fixed effects. Expectations are winsorized at 1% - 99% level in each year. Standard errors are clustered at individual level.

VII. US Survey

1. How many credit cards do you use for daily spending?

    a. 0
    b. 1
    c. 2
    d. 3
    e. 4 or more

2. What's the total level of your credit limit over all financial institutions?

    a. less than 2000
    b. 2000 – 5000
    c. 5000 – 10000
    d. 10000 – 20000
    e. 20000 – 40000
    f. 40000 – 70000
    g. 70000 – 100000
    h. more than 10000

The following messages are each sent to a random 10% of the participants

(10%) For the following questions, we would like you to consider the scenario that your bank has decided to increase your credit card limit by 10%.

(10%) For the following questions, we would like you to consider the scenario that your bank has decided to increase your credit card limit by 15%.

(10%) For the following questions, we would like you to consider the scenario that your bank has decided to increase your credit card limit by 20%.

(10%) For the following questions, we would like you to consider the scenario that your bank has decided to increase your credit card limit by 25%.

(10%) For the following questions, we would like you to consider the scenario that your bank has decided to increase your credit card limit by 30%.

(10%) For the following questions, please imagine a scenario where your bank has chosen you at random to raise your credit card limit by 10%. This decision by the bank is entirely random and not influenced by any assessment of pertinent factors.

(10%) For the following questions, please imagine a scenario where your bank has chosen you at random to raise your credit card limit by 15%. This decision by the bank is entirely random and not influenced by any assessment of pertinent factors.

(10%) For the following questions, please imagine a scenario where your bank has chosen you at random to raise your credit card limit by 20%. This decision by the bank is entirely random and not influenced by any assessment of pertinent factors.

(10%) For the following questions, please imagine a scenario where your bank has chosen you at random to raise your credit card limit by 25%. This decision by the bank is entirely random and not influenced by any assessment of pertinent factors.

(10%) For the following questions, please imagine a scenario where your bank has chosen you at random to raise your credit card limit by 30%. This decision by the bank is entirely random and not influenced by any assessment of pertinent factors.

3. How much do you think your spending would change over the next year?
    a. decreases by more than 20%
    b. decreases by 15% to 20%
    c. decreases by 10% to 15%
    d. decreases by 5% to 10%
    e. decreases by 0% to 5%
    f. stays the same
    g. increases by 0% to 5%
    h. increases by 5% to 10%
    i. increases by 10% to 15%
    j. increases by 15% to 20%
    k. increases by more than 20%
4. How much do you think your income would change over the next year?
    a. decreases by more than 20%
    b. decreases by 15% to 20%
    c. decreases by 10% to 15%
    d. decreases by 5% to 10%
    e. decreases by 0% to 5%
    f. stays the same
    g. increases by 0% to 5%
    h. increases by 5% to 10%
    i. increases by 10% to 15%
    j. increases by 15% to 20%
    k. increases by more than 20%
5. How much do you think your savings would change over the next year?
    a. decreases by more than 20%
    b. decreases by 15% to 20%
    c. decreases by 10% to 15%
    d. decreases by 5% to 10%

e. decreases by 0% to 5%
f. stays the same
g. increases by 0% to 5%
h. increases by 5% to 10%
i. increases by 10% to 15%
j. increases by 15% to 20%
k. increases by more than 20%

6. What's the probability that you would default on your debt over the next year?
7. How many hours would you work on average every week over the next year?
8. How much do you think your credit limit over all financial institutions would change over the next year?

    a. decreases by more than 20%
    b. decreases by 15% to 20%
    c. decreases by 10% to 15%
    d. decreases by 5% to 10%
    e. decreases by 0% to 5%
    f. stays the same
    g. increases by 0% to 5%
    h. increases by 5% to 10%
    i. increases by 10% to 15%
    j. increases by 15% to 20%
    k. increases by more than 20%

Table A.11. US Survey Results

	$\mathbb{E}$[Δlog C]	$\mathbb{E}$[Δlog Y]	$\mathbb{E}$[Δlog W]	$\mathbb{E}$[p(d)]	$\mathbb{E}$[Hrs]	$\mathbb{E}$[Δlog L]
	Panel A: No Information					
Δlog Limit	0.190**	0.234***	0.068	0.101	-0.391	0.099*
	(0.088)	(0.078)	(0.079)	(0.095)	(3.712)	(0.058)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	344	344	344	344	344	344
	Panel B: Random Extensions					
Δlog Limit	0.021	0.074	-0.016	0.065	0.002	0.080*
	(0.075)	(0.063)	(0.065)	(0.062)	(0.329)	(0.045)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	348	348	348	348	348	348

Note: This table presents results about hypothetical limit extensions on expectation. E[Δlog C], E[Δlog Y], E[Δlog W], and E[Δlog L] are respectively the expected next-year growth of total consumption, income, wealth, and credit limits. E[p(d)] and E[Hrs] are respectively the expected default probability and hours planned to work over the next year. Data is based on part-time and full-time employees with credit cards from SurveyMonkey. Results are winsorized at 1% - 99% level.

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