Sticking to Your Plan: The Role of Present Bias for Credit Card Paydown

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Motivation and Overview

- Substantial credit card borrowing at high cost by US households
- **Goal**: Understand the role of present bias in debt paydown
- **Data**: Sample of users of financial management website

  $\rightarrow$ Many fail to stick with self-set paydown plans
- Parsimonious model to show how to infer present-bias from high-frequency consumption data
- Relate to debt paydown
  - Sophisticated users pay down less the more impatient
  - Planned paydown more predictive of actual for sophisticated users

Present Bias - Definition

Present Bias

- More impatient in short-run ($\beta\delta$) than long-run (δ)

$$U_t = u(c_t) + \beta \sum_{\tau=t+1}^{\infty} \delta^{\tau} u(c_{\tau})$$

$\rightarrow$ Time ***in***consistent

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  - Fully Aware $\rightarrow$ Sophisticated
  - Unaware of changing preferences $\rightarrow$ Naive

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$\rightarrow$ Two features of present bias:

- Extent of short-run impatience (β)
- Sophistication

Analysis Preview

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$\rightarrow$ *Consistent* with important role of present bias

$\rightarrow$ *Inconsistent* with alternative explanations (e.g., credit constraints, unrealistic expectations)

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- Present bias and high frequency consumption patterns: Model intuition
- Present bias and high frequency consumption patterns: Estimation
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Users of a website to help manage and pay down credit card debt (www.readyforzero.com)

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Include users in sample if:

- Linked checking account
- Regular, bi-weekly paychecks
- Data on all linked accounts available from signup till 180 days

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Infer Present Bias from High Frequency Consumption

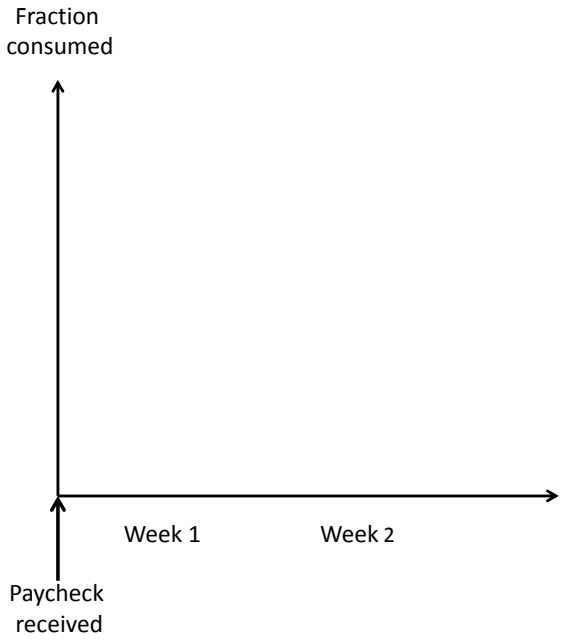
$$U_t = u(c_t) + \beta \sum_{\tau=t+1}^{\infty} \delta^{\tau} u(c_\tau)$$

- Two features of present bias:
  - Extent of short-run impatience (β)
  - Awareness/sophistication (belief about future β)

  $\rightarrow$ Infer from high-frequency consumption
- Paper: Life-cycle model
  - Simulate model
  - Run equivalent of empirical regressions on simulated data
- Now: Focus on intuition

Intuition: Short-run Impatience and Sensitivity to Paycheck

Setup: Consumer receives regular paycheck every 2 weeks



Short-run Impatience and Consumption Over the Paycycle

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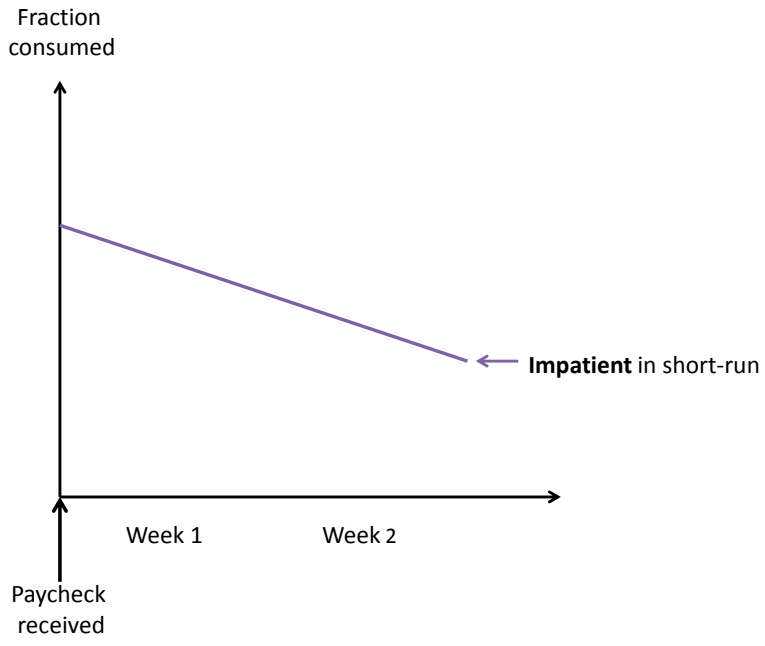

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- Highly value current consumption
- Consume higher fraction immediately after receiving paycheck

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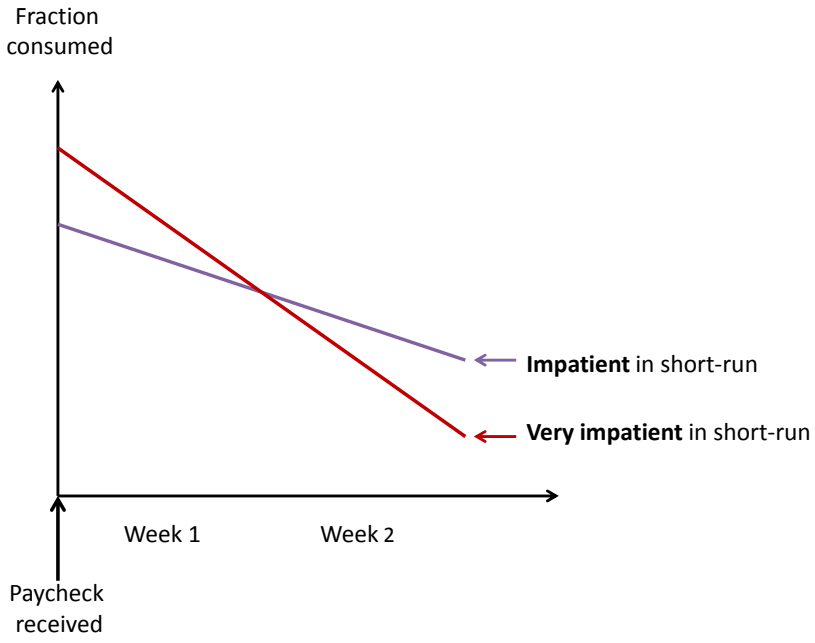

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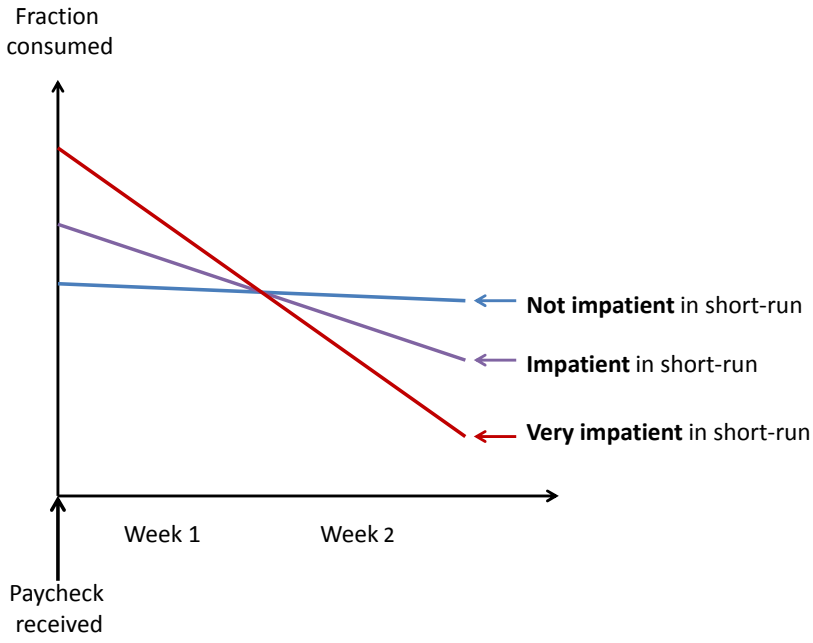

Consumers with low or no short-run impatience

- Smooth consumption over paycycle
- Consumption spending does not depend on *when* paycheck arrives

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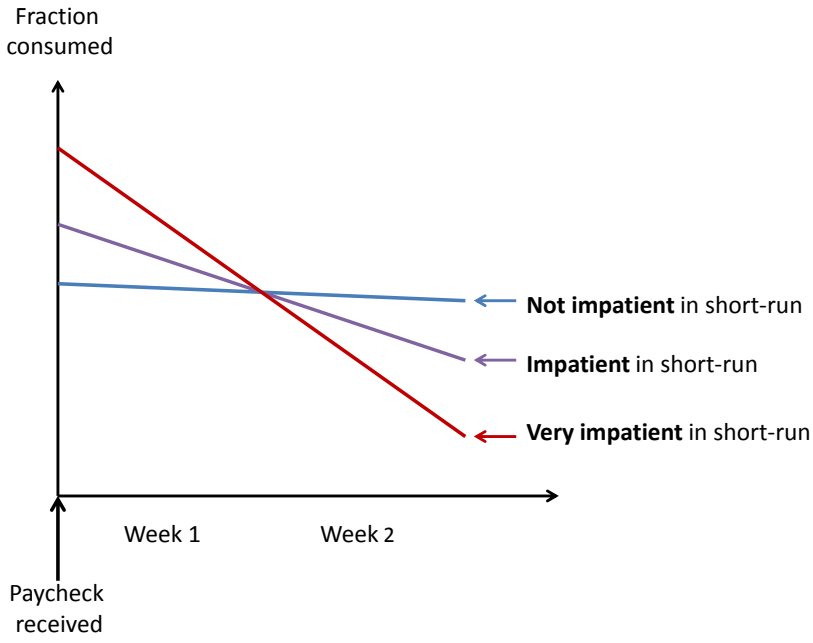

$\rightarrow$ Higher short-run impatience reflected in sensitivity of consumption to paycheck

Sophistication: Euler Equation

- **Naive:** $\hat{\beta} = 1$

  $u'(C_t) = \delta E_t[R\beta u'(\hat{C}_{t+1})]$

- **Sophisticated:** $\hat{\beta} = \beta$

  $u'(C_t) = \delta E_t[R(\beta \frac{\partial C_{t+1}}{\partial X_{t+1}} + (1 - \frac{\partial C_{t+1}}{\partial X_{t+1}}))u'(C_{t+1})].$

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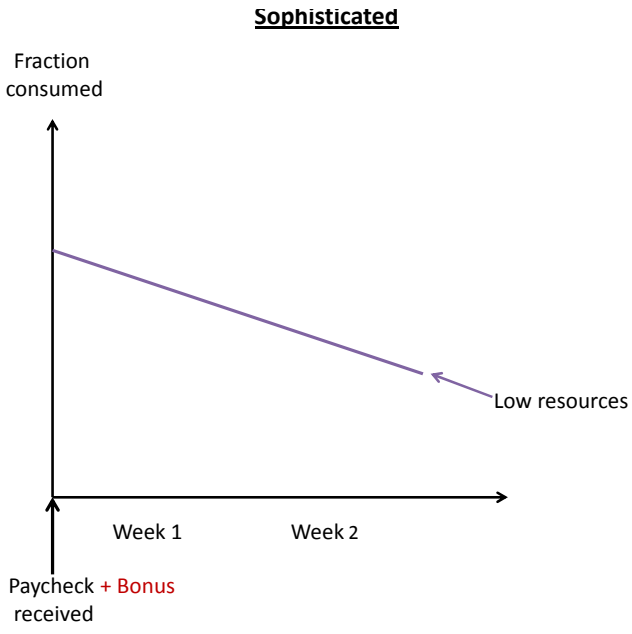
- Marginal propensity to consume $\frac{\partial C_{t+1}}{\partial X_{t+1}}$ unobserved

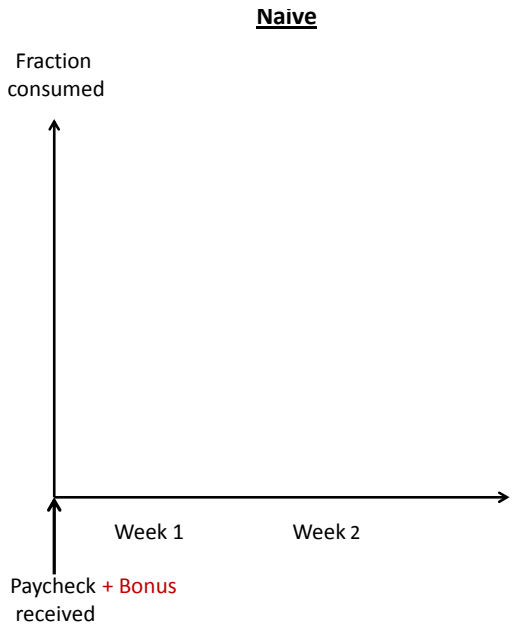
- But: Lower marginal propensity to consume $\frac{\partial C_{t+1}}{\partial X_{t+1}}$ when higher resources (diminishing marginal utility)

  $\rightarrow$ Variation in resources as proxy for variation in $\frac{\partial C_{t+1}}{\partial X_{t+1}}$

Sophistication and Effect of Resources

Setup: Consumer sometimes receives higher net paycheck, e. g. bonus





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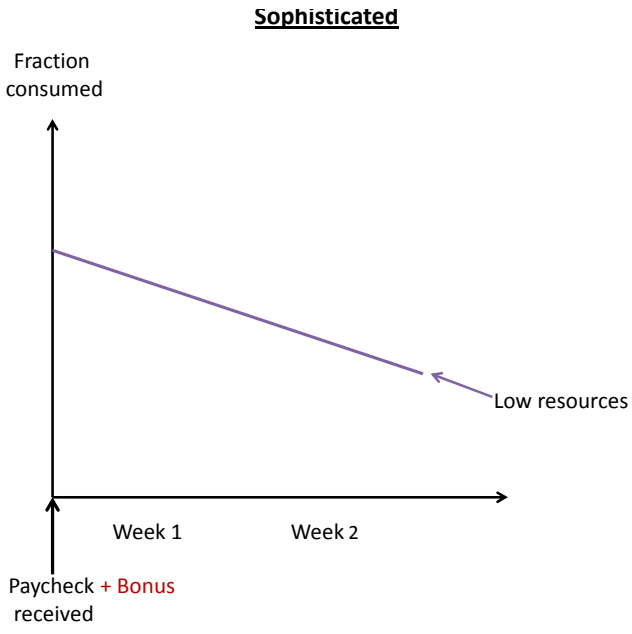

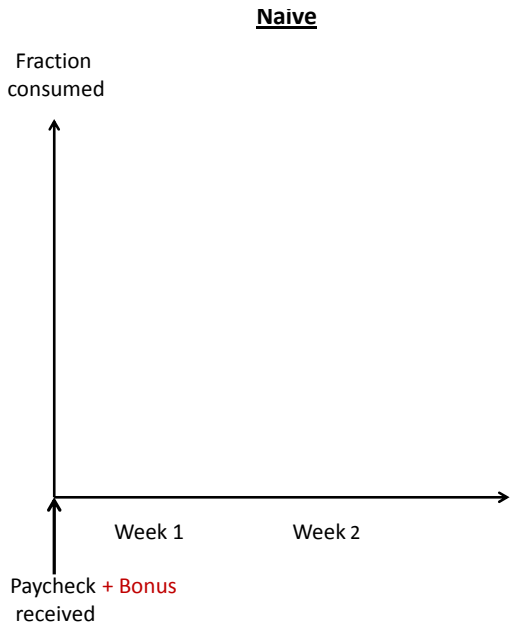

Sophisticated consumer *aware* of

- Future propensity to overconsume, relative to long-run preferences
- Resources being partially consumed rather than further passed on

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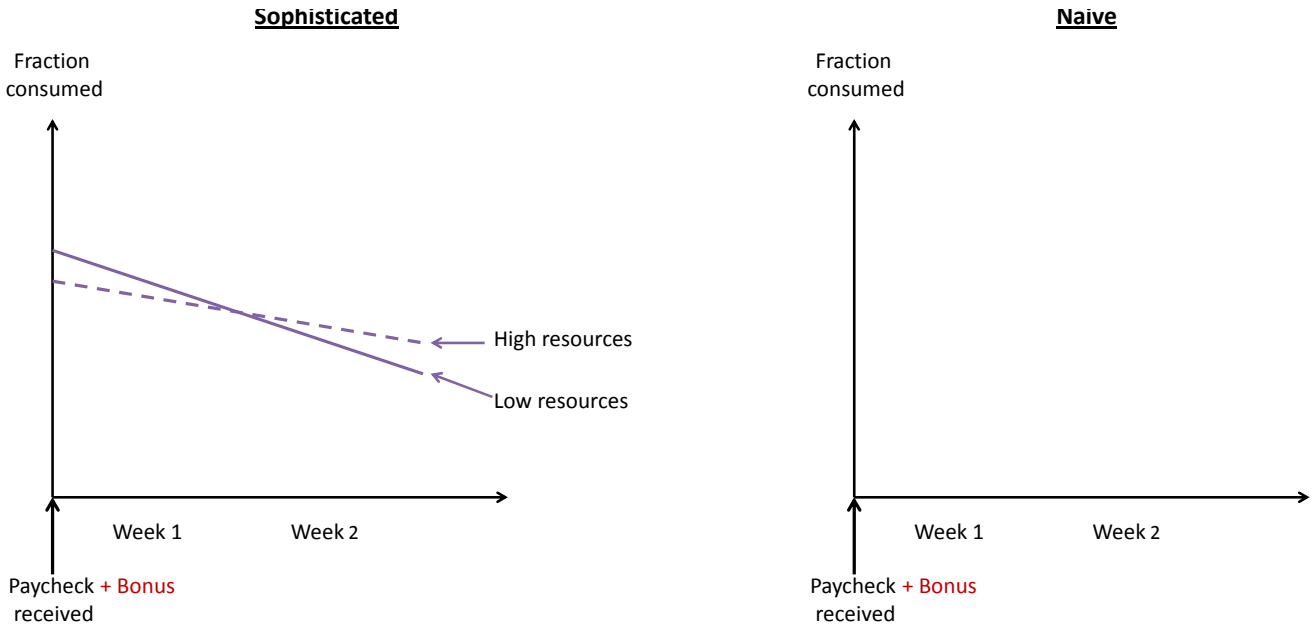

Higher paycheck

$\rightarrow$ Higher consumption, lower marginal propensity to (over)consume

$\rightarrow$ More resources further passed on rather than consumed

$\rightarrow$ More worthwhile to act patiently /pass on resources

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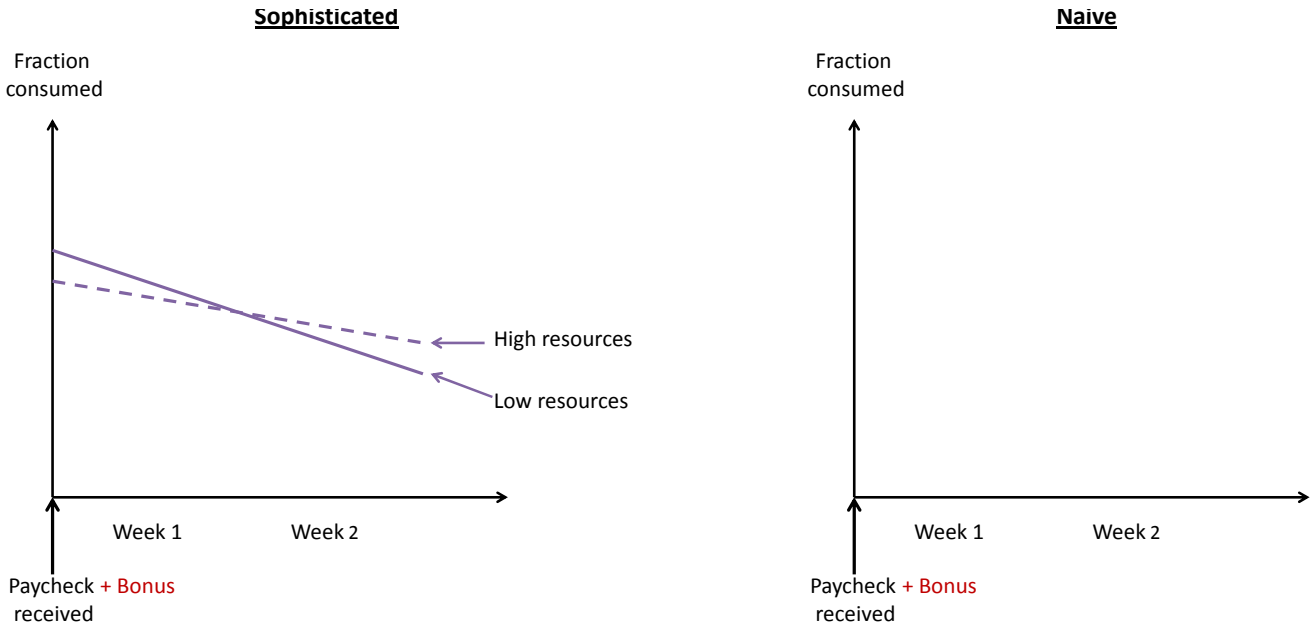

→ **Sophisticates less sensitive to paycheck when resources high**

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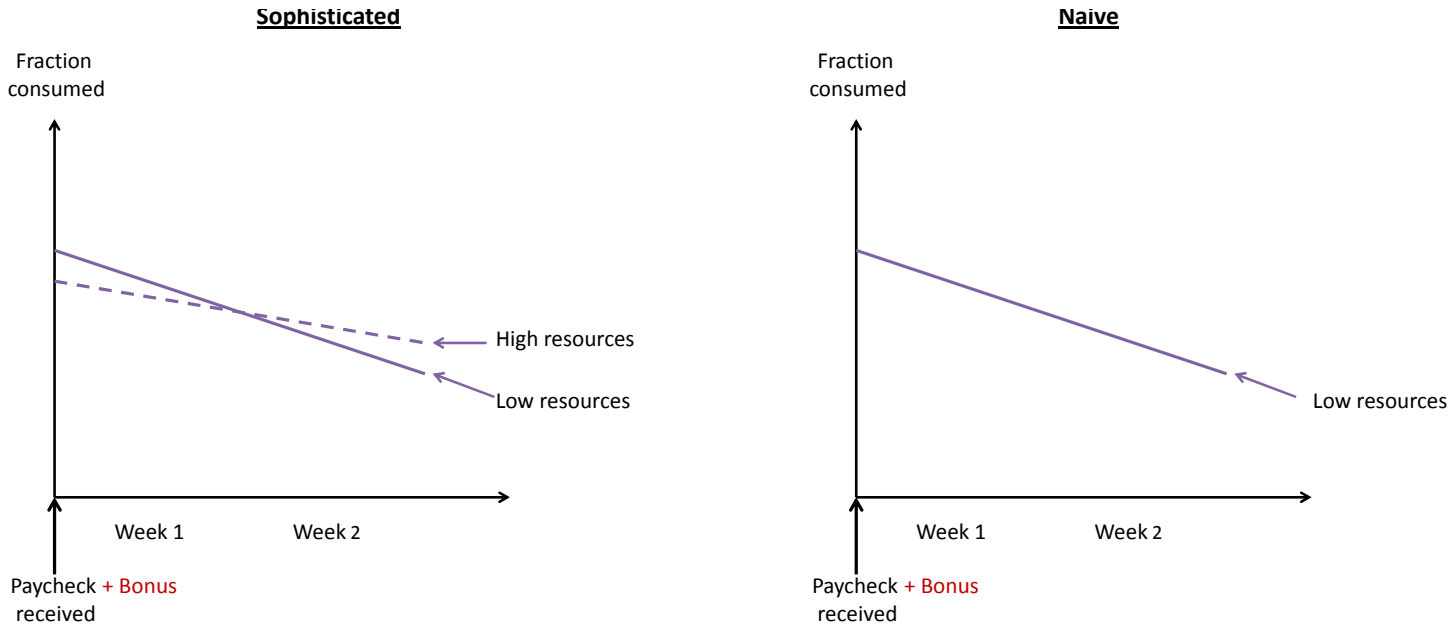

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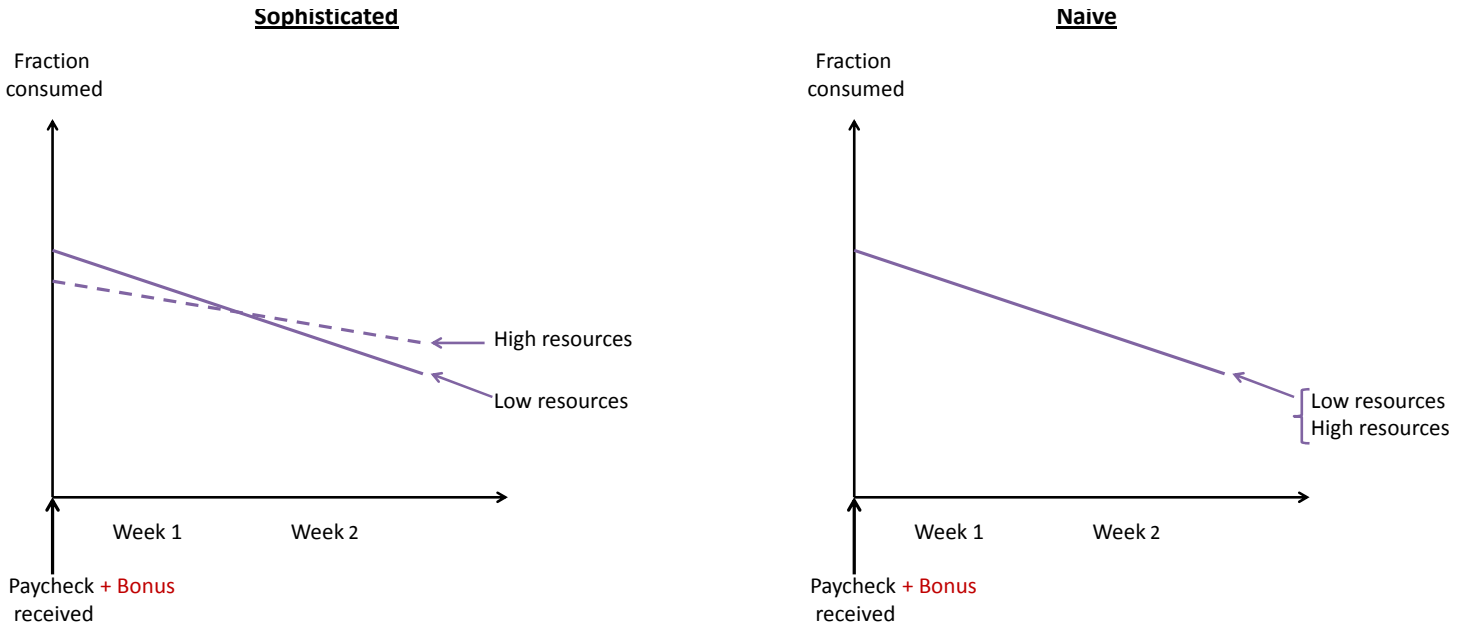

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  $\rightarrow$ Intertemporal trade-off unaffected by level of resources

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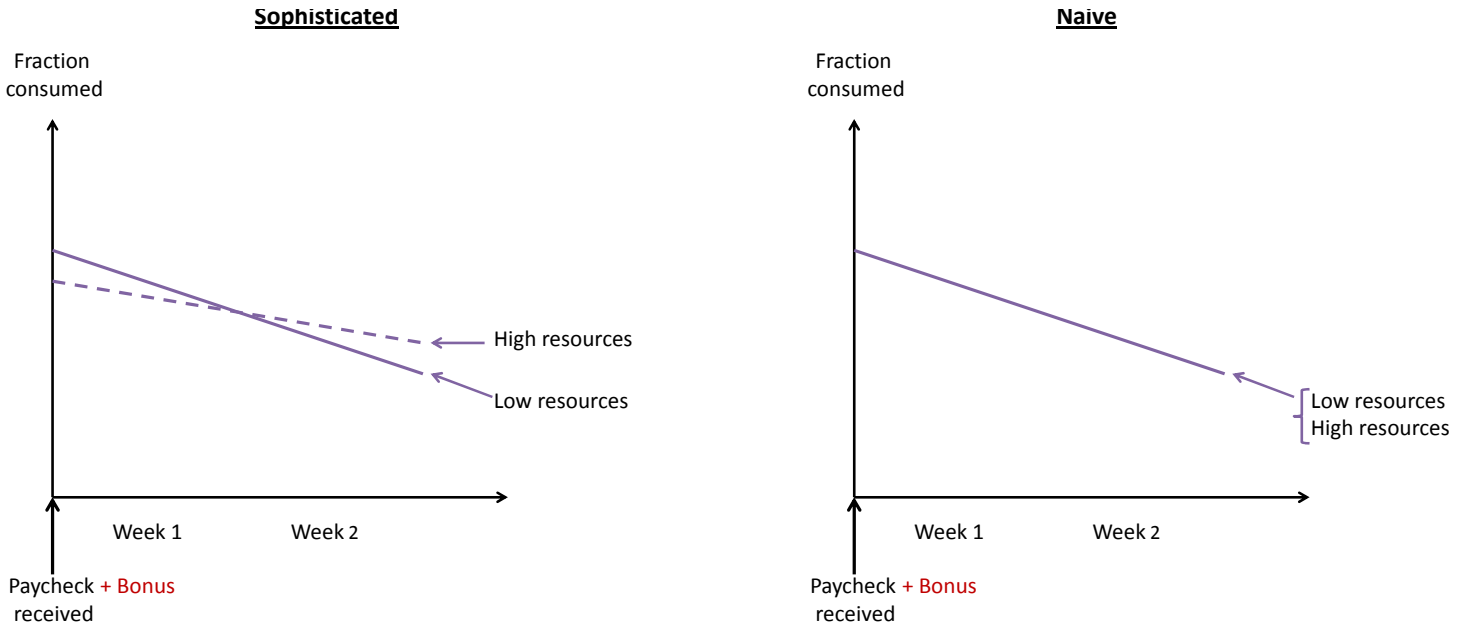

→ **Level of resources affects trade-off for sophisticates only**

→ **Sophistication reflected in effect of resources**

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Estimating Sensitivity to Paycheck

Estimate **separately for each user**

$$log(E_{it}) = \alpha_i + payweek_{it}\gamma_{1i} + X'_{it}\psi_i + \varepsilon_{it}$$

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	Sensitivity to Paycheck Receipt					
	Obs.	Mean	Std. Dev.	25th pctile	50th pctile	75th pctile
Sensitivity (γ_1) - Pooled estimates						
Short-Run Consumables	516	0.061	0.009	t-stat = 6.94		
Restaurants&Entertainment	516	0.047	0.008	t-stat = 5.74		
Sensitivity (γ_1) - Individual estimates						
Short-Run Consumables	516	0.061	0.211	-0.081	0.049	0.199
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Effect of Resources on Sensitivity (γ_3)						
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$\rightarrow$ Extent of sensitivity as proxy for level of short-run impatience

Effect of Resources and Sophistication

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Sophisticated $\Leftrightarrow$ *Negative* effect of resources on sensitivity (γ_{3i})

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Methodology: Estimating Effect of Resources?

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  - Spending E_{it} affects $resources_{i,t+1}$ directly
  - Spending E_{it} potentially affects "taste for consumption" in $t+1$, i.e. $\varepsilon_{i,t+1}$

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- Solution
  - Measure resources at beginning
  - Instrument for level of resources
    $\rightarrow$ Simulated balances as simulated instrument

Methodology: Simulated Instrument

Idea: Isolate exogenous part of variation, filter out endogenous part

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- Fixed timing of payments

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$\rightarrow$ What would have happened if only exogenous variation, no endogenous response?

$\rightarrow$ Use simulated /hypothetical variable as instrument for actual

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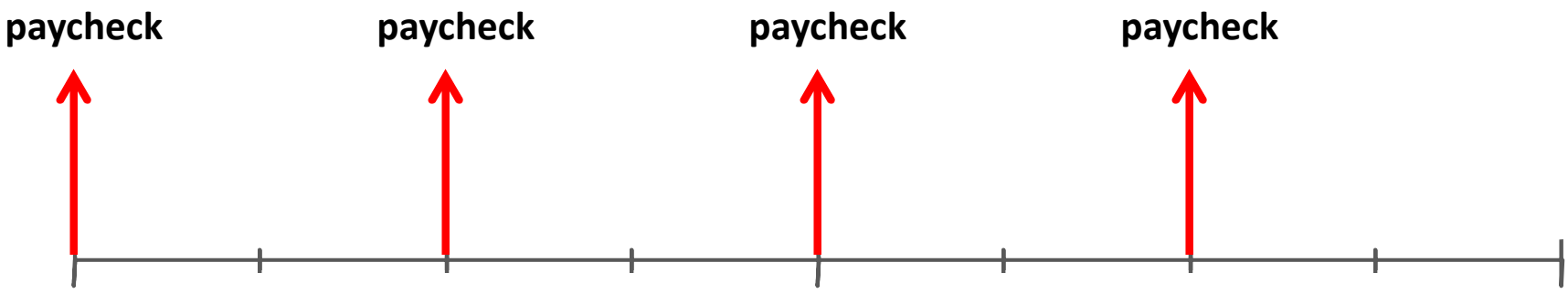
Hypothetical balances based on regular, expected payments

- **Regular payments**: same amount, regularly (7, 14 or 30 days)
- **Idea:** Affect available resources, but independent of past or future discretionary spending

Regular Payments and Simulated Balances



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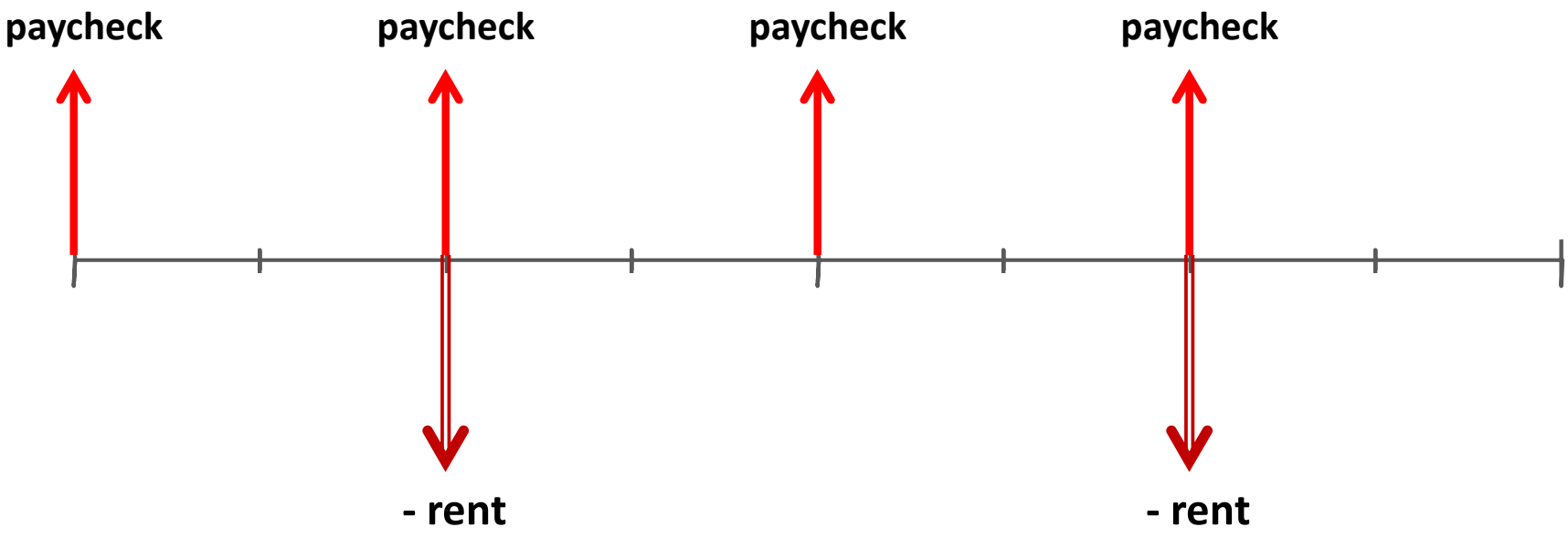

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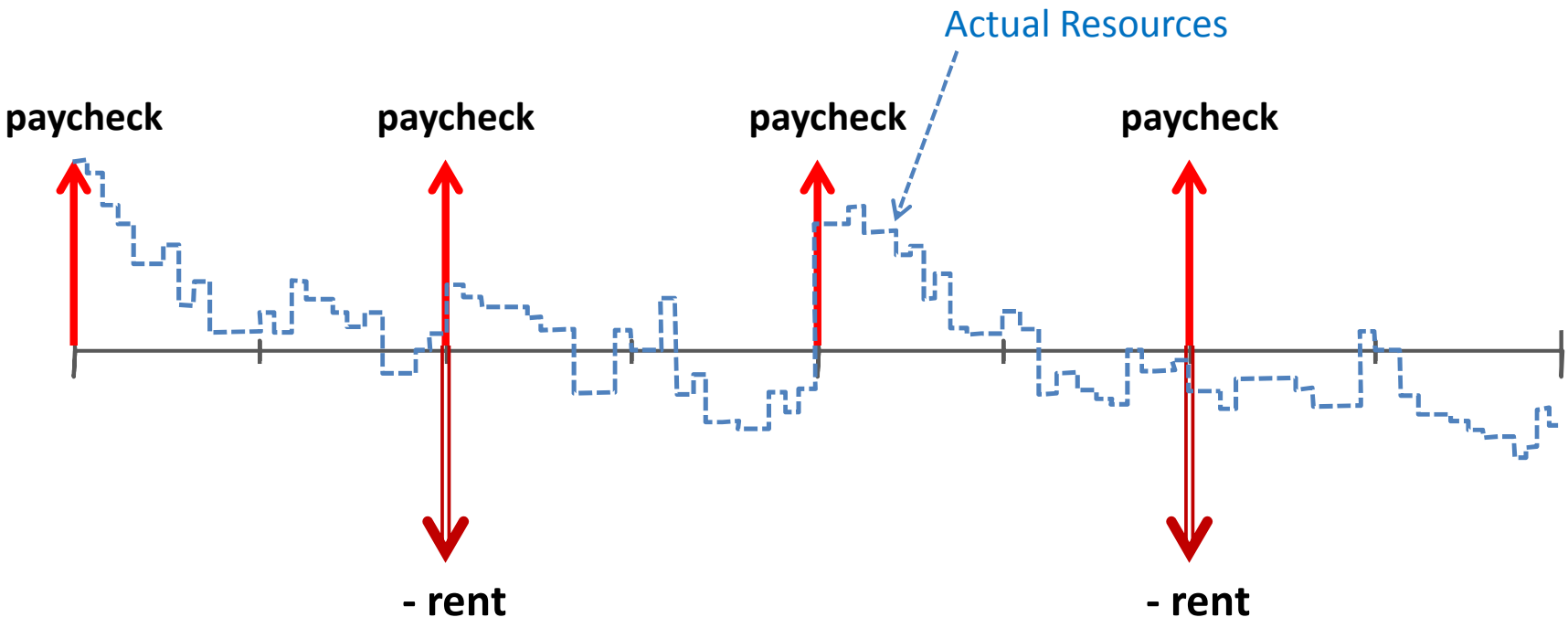

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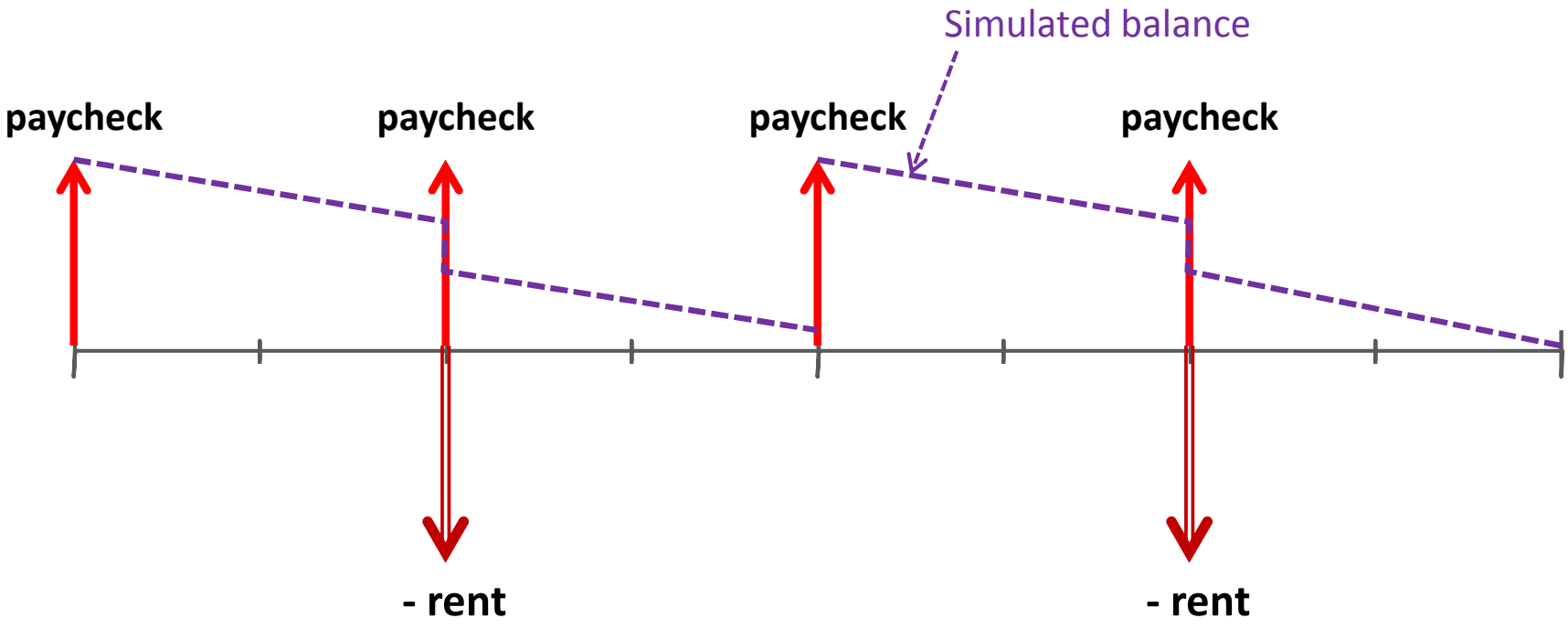

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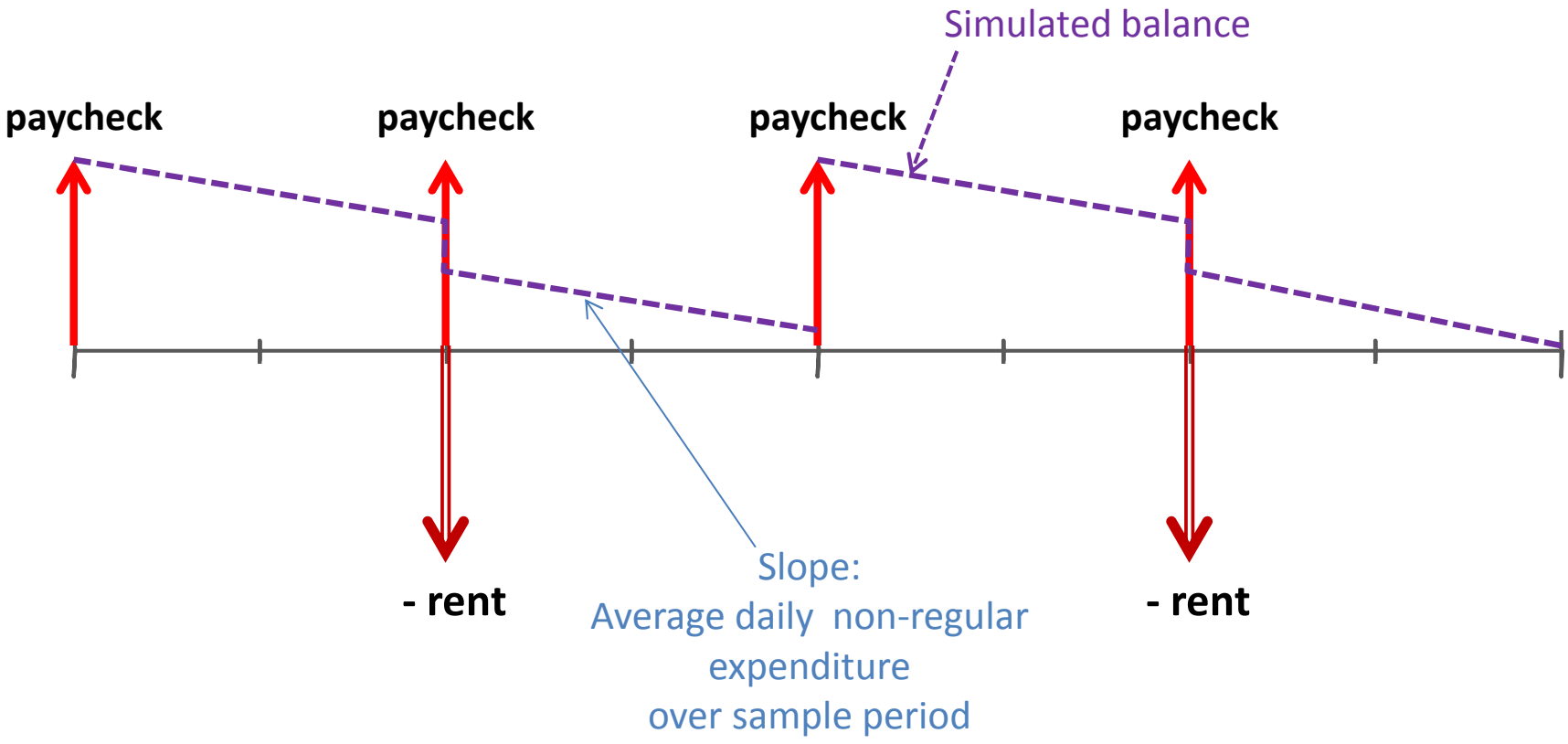

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Regression Results - Debt Paydown

$$\begin{aligned} Paydown_i = \mu_0 &+ Sensitivity_i \mu_{1n} + PlannedPaydown_i \mu_{2n} \\ &+ Sensitivity_i * Sophist_i \mu_{1s} \\ &+ PlannedPaydown_i * Sophist_i \mu_{2s} \\ &+ X_i' \lambda + \nu_i \end{aligned}$$

Methodology: Estimated Regressors

$$
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$\rightarrow$ Need to correct standard errors

$\rightarrow$ Bootstrap standard errors

Methodology: Bootstrap Standard Errors

- Idea
  - Draw sample from data with replacement
  - Estimate regression specification for each sample draw
  - Compute standard errors based on sample draws

Methodology: Bootstrap Standard Errors

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  - Draw sample from data with replacement
  - Estimate regression specification for each sample draw
  - Compute standard errors based on sample draws
- Good news: Bootstrap Package in Stata
- Bad news: Exact specification depends on specifics of estimation at hand

Regression Results - Debt Paydown

$$\begin{aligned} Paydown_i = \mu_0 &+ Sensitivity_i \mu_{1n} + PlannedPaydown_i \mu_{2n} \\ &+ Sensitivity_i * Sophist_i \mu_{1s} \\ &+ PlannedPaydown_i * Sophist_i \mu_{2s} \\ &+ X_i' \lambda + \nu_i \end{aligned}$$

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	Paydown 90 Days		Paydown 180 Days	
	Short-run Consumables	**Restaurant& Entertainment**	**Short-run Consumables**	**Restaurant& Entertainment**
Sensitivity	8.511	-3.293	6.461*	7.547*
	(0.241)	(0.613)	(0.099)	(0.083)
Planned paydown	0.179*	0.280***	0.129	0.177**
	(0.056)	(0.002)	(0.133)	(0.033)
Sensitivity * Sophisticated	-33.293***	-13.820	-10.179*	-17.774***
	(0.004)	(0.188)	(0.082)	(0.006)
Planned paydown * Sophisticated	0.371*	0.086	0.391*	0.295
	(0.098)	(0.666)	(0.065)	(0.119)
Sophisticated	4.157	-8.474	-1.099	-7.299
	(0.469)	(0.127)	(0.797)	(0.077)
Constant	-12.035***	-7.636*	-8.585***	-6.217**
	(0.000)	(0.064)	(0.000)	(0.010)
Controls	Y	Y	Y	Y
Number of individuals	516	516	516	516

P-values of bootstrapped standard errors in parentheses. Significance: * (p<0.10), ** (p<0.05), *** (p<0.01).

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Debt Paydown and Present Bias

Patterns of debt paydown are

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Backup Slides

Classification into Sophisticated / Naive

- Classify based on effect of resources on sensitivity (coefficient on $payweek * resources$)
- Higher reduction in sensitivity leads to lower paydown?

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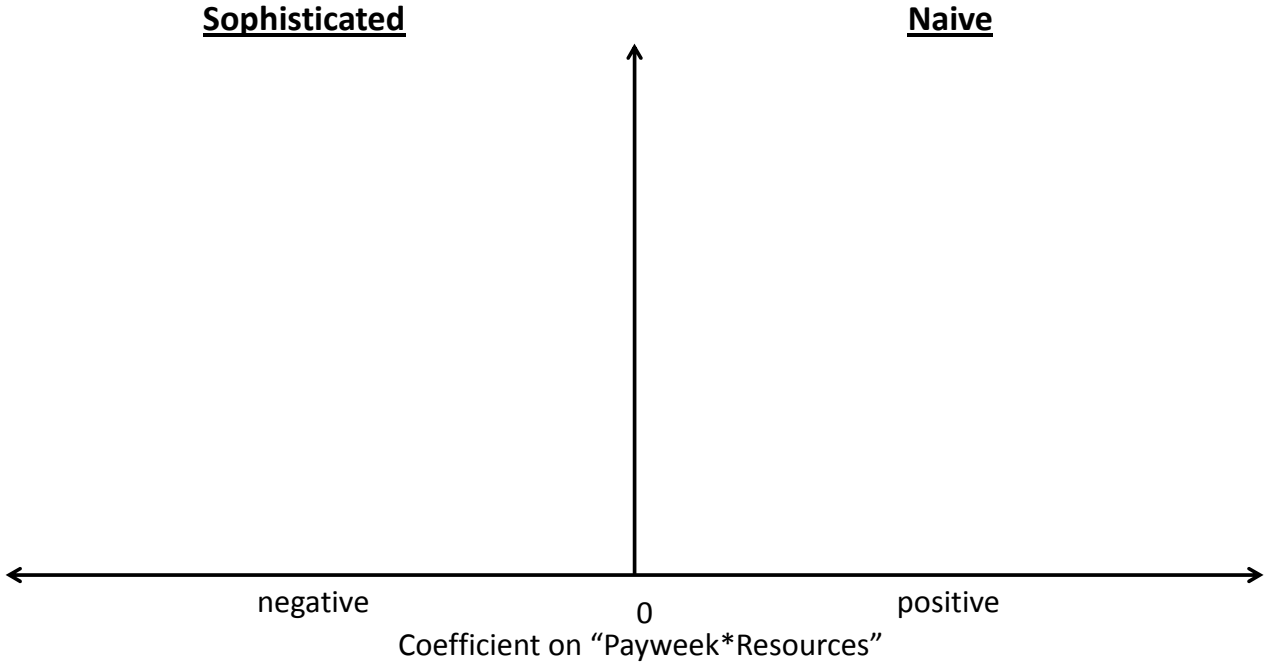

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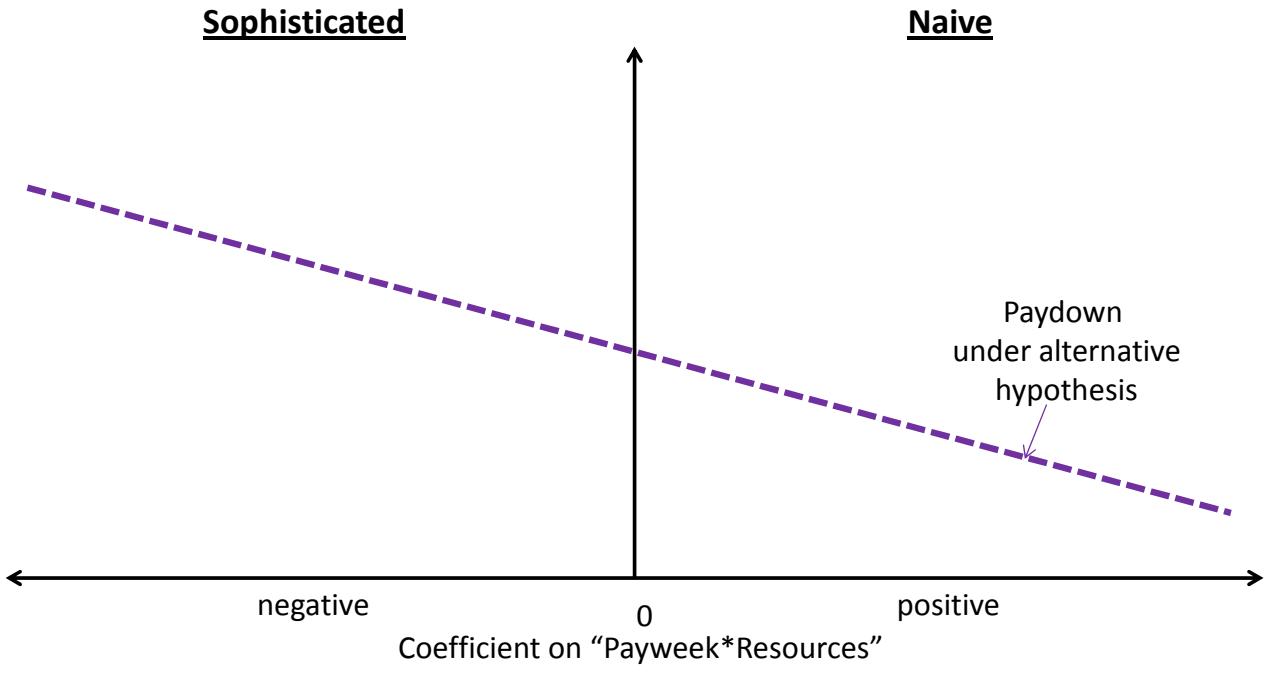

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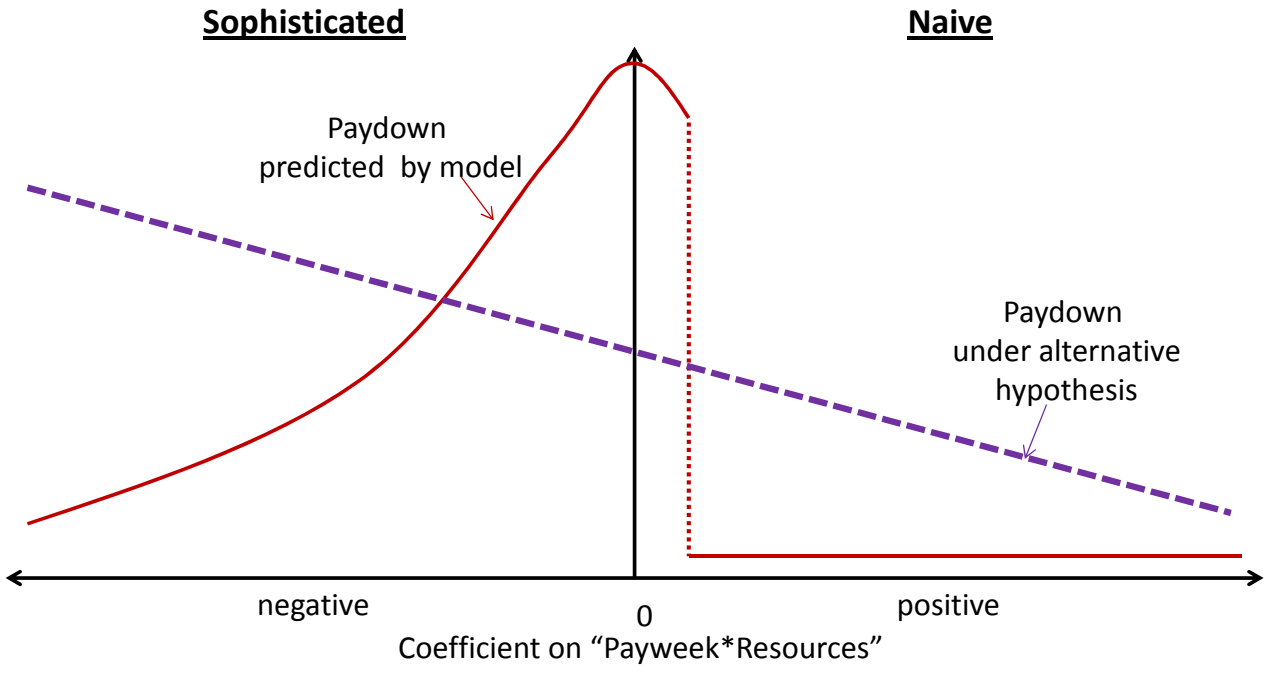

Classification into Sophisticated / Naive

$$Paydown_i = \mu_0 + (coefficient\_on\_payweek * resources)\mu_1 + X_i'\lambda + \nu_i$$

	Paydown 90 Days				Paydown 180 Days			
	I	II	III	IV	V	VI	VII	VIII
Short-run Consumables								
Coefficient on	-0.439	0.114	-0.224	0.683	-0.497	-0.539	-0.376	-0.075
Resources*Payweek	(0.432)	(0.935)	(0.675)	(0.602)	(0.145)	(0.551)	(0.238)	(0.927)
Winsorized	1%	5%	1%	5%	1%	5%	1%	5%
Controls			Y	Y			Y	Y
N	516							
75th - 25th percentile	0.251							
Restaurant & Entertainment								
Coefficient on	-0.070	0.185	-0.075	0.492	0.320	0.843	0.267	0.925
Resources*Payweek	(0.864)	(0.867)	(0.847)	(0.643)	(0.218)	(0.182)	(0.271)	(0.118)
Winsorized	1%	5%	1%	5%	1%	5%	1%	5%
Controls			Y	Y			Y	Y
N	516							
75th - 25th percentile	0.305							

P-values in parentheses. Significance: * (p<0.10), ** (p<0.05), *** (p<0.01).

▸ Back

Robustness - Credit Constraints

Sensitivity caused by credit constraints?

- Estimation restricted to when spending of payweek affordable in non-payweek

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  $\rightarrow$ Baseline: *Category spending* possible

  $\rightarrow$ Now: 1. *Total discretionary spending* possible

  2. Category spending possible with *buffer stock* (10^{th} percentile of resources)

Robustness - Credit Constraints

	Short-Run Consumables			Restaurant & Entertainment		
	buffer	total discretionary	no restriction	buffer	total discretionay	no restriction
Dependent Variable: Paydown 90 Days						
Sensitivity	6.135	8.934	8.362	-8.555	-2.250	-2.222
	(0.369)	(0.158)	(0.221)	(0.146)	(0.737)	(0.723)
Planned paydown	0.180*	0.180*	0.179*	0.282***	0.280***	0.280***
	(0.058)	(0.058)	(0.079)	(0.002)	(0.001)	(0.001)
Sensitivity	-28.158***	-31.647***	-32.144***	-6.802	-15.936	-16.284
* Sophisticated	(0.013)	(0.002)	(0.006)	(0.471)	(0.115)	(0.136)
Planned paydown	0.380*	0.372*	0.368	0.094	0.094	0.083
* Sophisticated	(0.096)	(0.100)	(0.101)	(0.638)	(0.634)	(0.658)
Sophisticated	3.061	3.610	4.394	-9.066	-8.519	-8.246*
	(0.587)	(0.529)	(0.401)	(0.105)	(0.129)	(0.091)
Dependent Variable: Paydown 180 Days						
Sensitivity	4.428	3.920	5.593	2.950	7.126*	8.671**
	(0.276)	(0.326)	(0.126)	(0.464)	(0.077)	(0.049)
Planned paydown	0.139	0.139	0.139*	0.177**	0.177**	0.178**
	0.138	0.136	(0.135)	(0.036)	(0.034)	(0.024)
Sensitivity	-8.115	-6.921	-8.567	-12.701*	-17.812***	-19.583***
* Sophisticated	(0.238)	(0.271)	(0.130)	(0.058)	(0.002)	(0.005)
Planned paydown	0.420*	0.418*	0.416*	0.301	0.300	0.292
* Sophisticated	(0.071)	(0.071)	(0.065)	(0.113)	(0.114)	(0.114)
Sophisticated	-1.455	-1.550	-1.260	-7.672*	-7.395*	-6.991**
	(0.736)	(0.723)	(0.769)	(0.061)	(0.073)	(0.038)
Controls						
Median Paycheck	Y	Y	Y	Y	Y	Y
Original Debt	Y	Y	Y	Y	Y	Y
Nr of individuals	516	516	516	516	516	516

Back

Robustness: Credit Constraints

Back

Excluding Low Sensitivity

Classification into sophisticated/naive of low sensitivity users

- Not meaningful theoretically
- More likely to be potentially misclassified

$\rightarrow$ Exclude users with low estimated sensitivity/short-run impatience

Robustness: Impatient users drive results

$$Paydown_i = \mu_0 + Sensitivity_i \mu_{1n} + PlannedPaydown_i \mu_{2n}$$
$$+ Sensitivity_i * Sophist_i \mu_{1s} + PlannedPaydown_i * Sophist_i \mu_{2s} + X_i' \lambda + \nu_i$$

	Paydown 90 Days				Paydown 180 Days			
		Exclude if sensitivity in the lowest				Exclude if sensitivity in the lowest		
	Baseline	**10%**	**15%**	**20%**	**Baseline**	**10%**	**15%**	**20%**
Short-run Consumables								
Sensitivity	8.511	9.471	10.684	10.626	6.461*	5.963	6.379	6.087
	(0.241)	(0.212)	(0.161)	(0.169)	(0.099)	(0.141)	(0.117)	(0.139)
Planned paydown	0.179*	0.152	0.129	0.153*	0.129	0.118	0.102	0.117
	(0.056)	(0.126)	(0.196)	(0.086)	(0.133)	(0.172)	(0.252)	(0.180)
Sophisticated * Sensitivity	-33.293***	-33.412**	-32.203**	-30.319**	-10.179*	-10.352*	-9.786	-8.326
	(0.004)	(0.006)	(0.009)	(0.020)	(0.082)	(0.093)	(0.117)	(0.198)
Sophisticated * Planned paydown	0.371*	0.398*	0.414*	0.402*	0.391*	0.368*	0.388*	0.384*
	(0.098)	(0.094)	(0.082)	(0.082)	(0.065)	(0.080)	(0.071)	(0.079)
Sophisticated	4.157	7.080	6.068	6.494	-1.099	0.712	0.726	0.538
	(0.469)	(0.266)	(0.356)	(0.342)	(0.797)	(0.878)	(0.881)	(0.917)
Median paycheck	Y	Y	Y	Y	Y	Y	Y	Y
Original debt	Y	Y	Y	Y	Y	Y	Y	Y
Constant	Y	Y	Y	Y	Y	Y	Y	Y
Number of individuals	516	465	439	413	516	465	439	413

P-values of bootstrapped standard errors in parentheses. Significance: * ($p<0.10$), ** ($p<0.05$), *** ($p<0.01$).

Robustness: Impatient users drive results

$$Paydown_i = \mu_0 + Sensitivity_i \mu_{1n} + PlannedPaydown_i \mu_{2n} + Sensitivity_i * Sophist_i \mu_{1s} + PlannedPaydown_i * Sophist_i \mu_{2s} + X_i' \lambda + \nu_i$$

	Paydown 90 Days				Paydown 180 Days			
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	Baseline	**10%**	**15%**	**20%**	**Baseline**	**10%**	**15%**	**20%**
Restaurant & Entertainment								
Sensitivity	-3.293	-3.014	-2.948	-2.154	7.547*	7.557*	7.897*	7.953*
	(0.613)	(0.652)	(0.669)	(0.760)	(0.083)	(0.084)	(0.084)	(0.092)
Planned paydown	0.280**	0.258**	0.277**	0.293**	0.177**	0.173**	0.178**	0.181*
	(0.002)	(0.004)	(0.003)	(0.002)	(0.033)	(0.047)	(0.048)	(0.053)
Sophisticated * Sensitivity	-13.820	-12.811	-11.693	-15.479	-17.774***	-17.270**	-17.443**	-19.011**
	(0.188)	(0.248)	(0.315)	(0.194)	(0.006)	(0.007)	(0.009)	(0.007)
Sophisticated * Planned paydown	0.086	0.115	0.103	0.090	0.295	0.313	0.312	0.331
	(0.666)	(0.573)	(0.624)	(0.682)	(0.119)	(0.120)	(0.131)	(0.121)
Sophisticated	-8.474	-7.792	-8.656	-6.562	-7.299*	-7.833*	-7.750	-7.155
	(0.127)	(0.213)	(0.192)	(0.337)	(0.077)	(0.080)	(0.102)	(0.156)
Median paycheck	Y	Y	Y	Y	Y	Y	Y	Y
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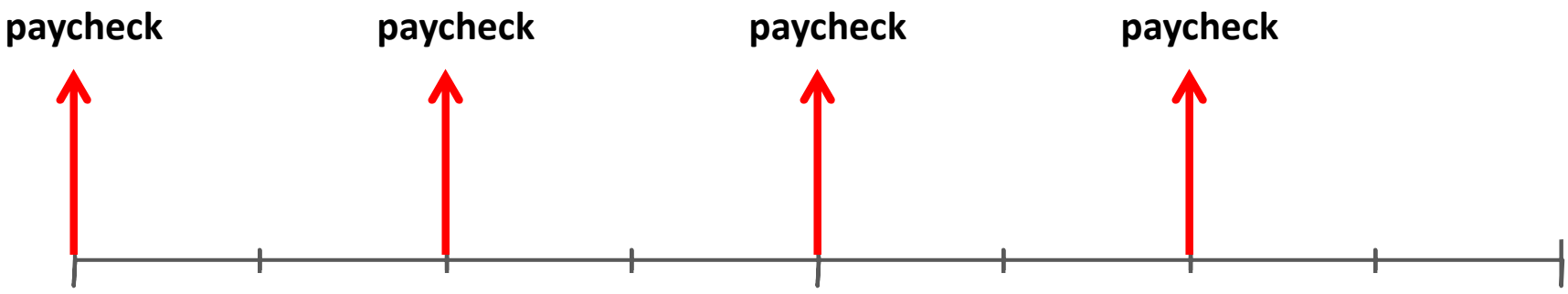
Regular Payments and Simulated Balances



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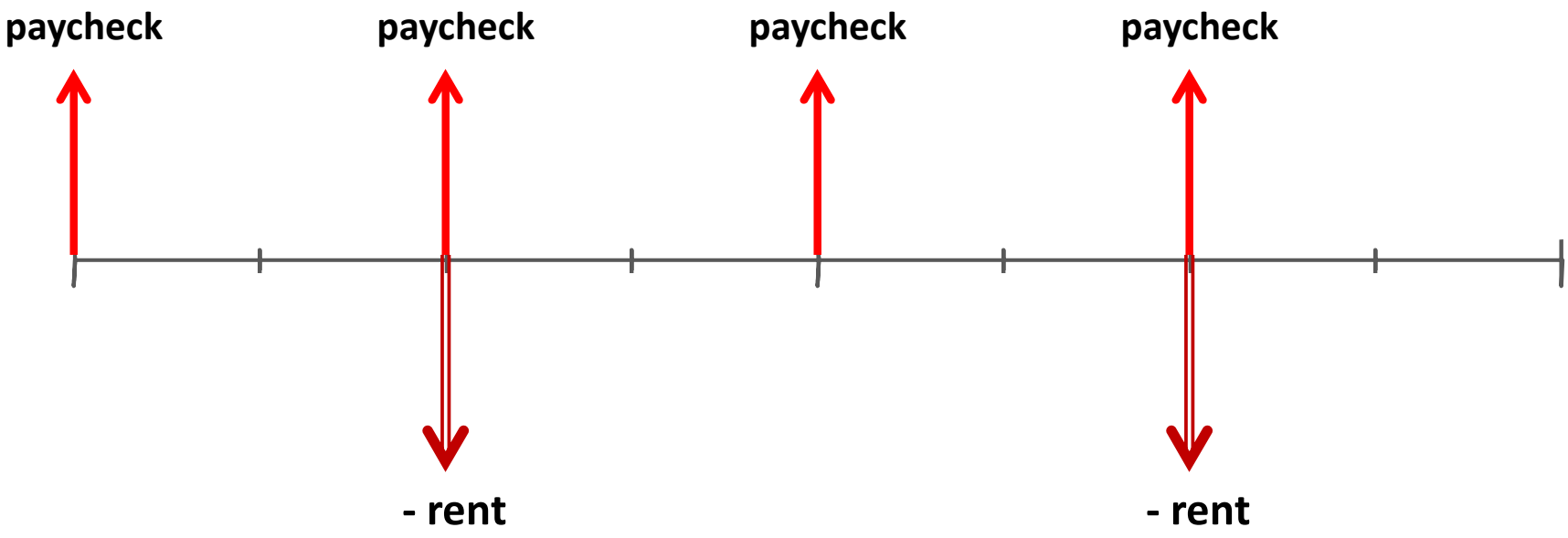

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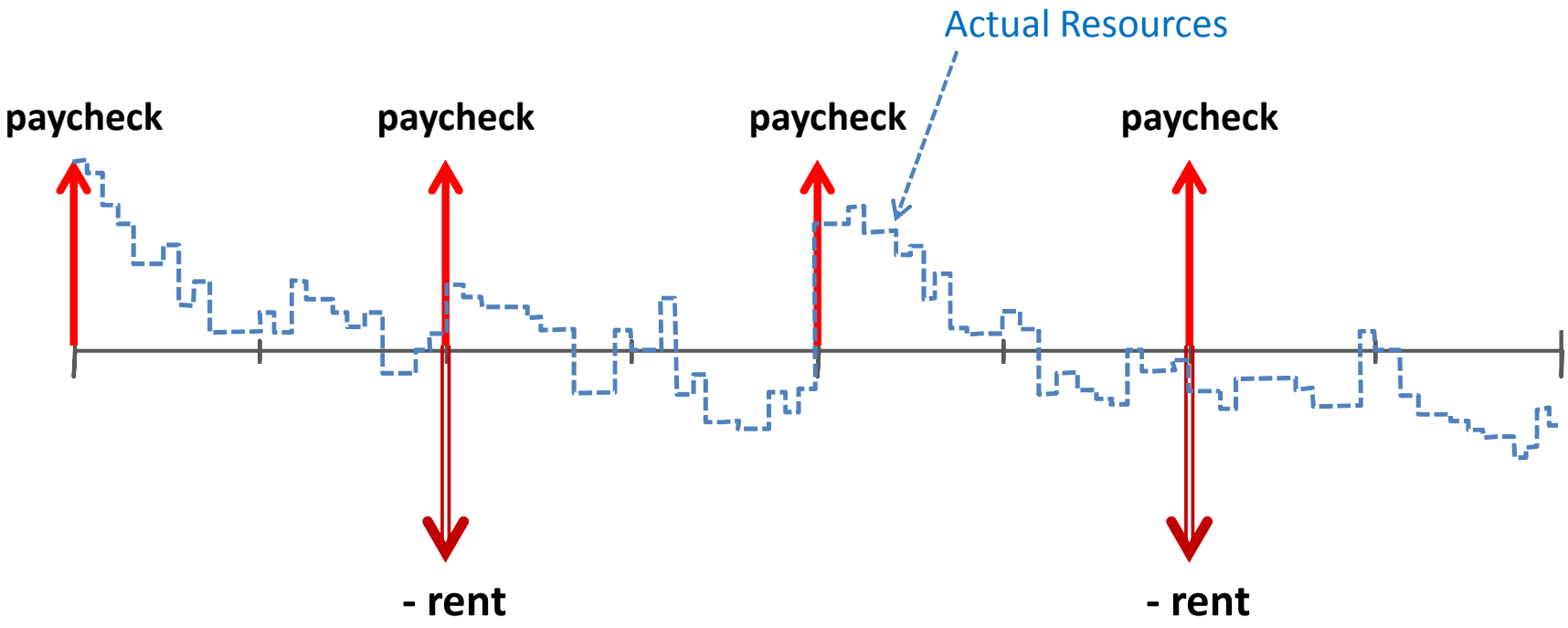

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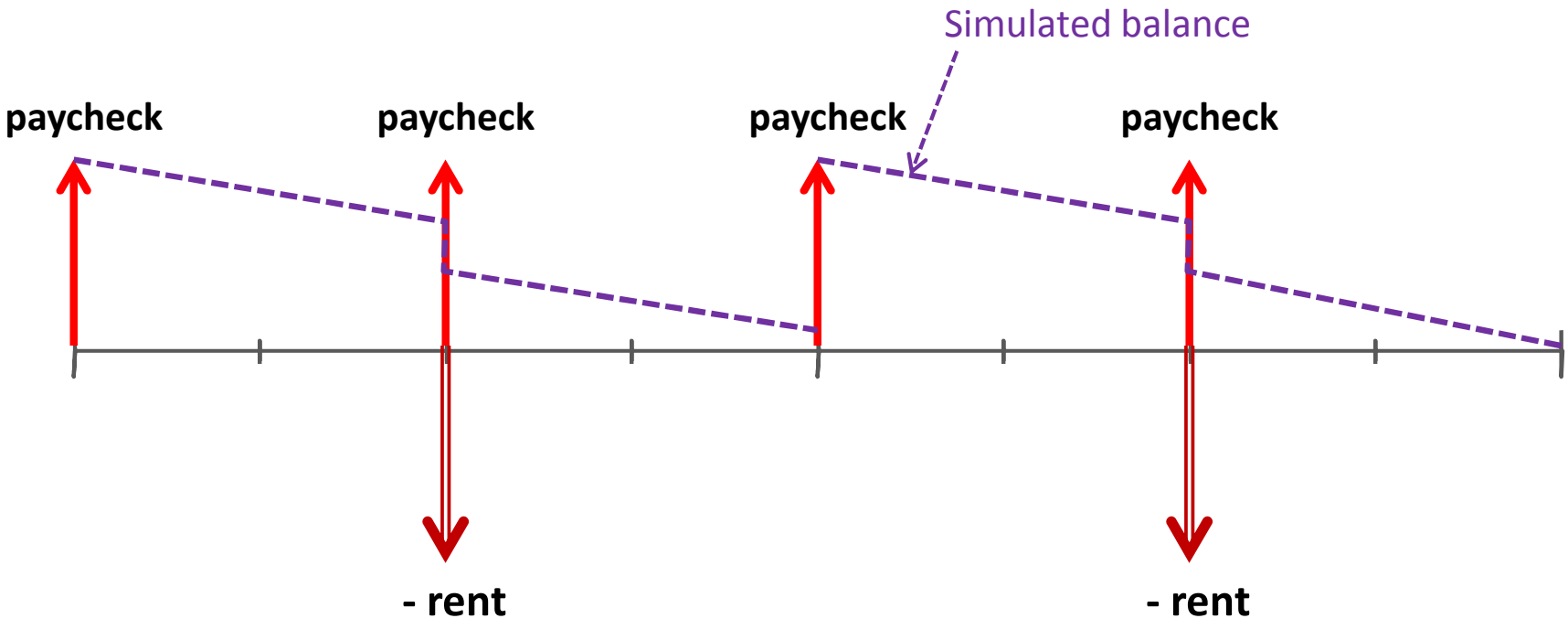

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	(0.002)	(0.004)	(0.003)	(0.002)	(0.033)	(0.047)	(0.048)	(0.053)
Sophisticated * Sensitivity	-13.820	-12.811	-11.693	-15.479	-17.774***	-17.270**	-17.443**	-19.011**
	(0.188)	(0.248)	(0.315)	(0.194)	(0.006)	(0.007)	(0.009)	(0.007)
Sophisticated * Planned paydown	0.086	0.115	0.103	0.090	0.295	0.313	0.312	0.331
	(0.666)	(0.573)	(0.624)	(0.682)	(0.119)	(0.120)	(0.131)	(0.121)
Sophisticated	-8.474	-7.792	-8.656	-6.562	-7.299*	-7.833*	-7.750	-7.155
	(0.127)	(0.213)	(0.192)	(0.337)	(0.077)	(0.080)	(0.102)	(0.156)
Median paycheck	Y	Y	Y	Y	Y	Y	Y	Y
Original debt	Y	Y	Y	Y	Y	Y	Y	Y
Constant	Y	Y	Y	Y	Y	Y	Y	Y
Number of individuals	516	465	439	413	516	465	439	413

Regular Payments and Simulated Balances

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Summary Statistics by Sophistication

	Sophistication based on					
	Short-run consumables			Restaurant & Entertainment		
	Naïve	Sophisticated	t-test for equality (p-value)	Naïve	Sophisticated	t-test for equality (p-value)
Sensitivity to Paycheck						
Average sensitivity	0.051	0.072	0.263	0.063	0.059	0.829
Median sensitivity	0.043	0.059		0.049	0.049	
Income and Debt						
Income - Mean	3,808	3,802	0.975	3,718	3,905	0.292
Credit Card Debt - Mean	14,144	13,693	0.713	14,194	13,652	0.659
Credit Card Debt - Median	9,430	10,133		9,672	9,997	
Credit Card Debt / Income - Mean	3.786	4.773	0.306	3.941	4.558	0.507
Total Discretionary Spending						
avg. $	1,844.0	1,755.8	0.307	1,772.3	1,841.5	0.426
avg. % of income	52.9	51.6	0.598	51.5	53.3	0.493
avg. % spend on credit cards	34.3	33.9	0.854	33.6	34.7	0.690
Short-run Consumables						
avg. $ - mean	560.9	537.0	0.503	550.8	549.6	0.981
avg. % spend on credit cards	31.1	31.1	0.981	30.5	31.8	0.633
Restaurant & Entertainment						
avg. $ - mean	298.6	282.6	0.289	292.2	290.6	0.917
avg. % spend on credit cards	32.4	32.4	0.978	31.3	33.6	0.423
Planned Paydown - 90 Days						
Mean	2,540.1	2,409.7	0.574	2,588.4	2,359.0	0.324
Median	1,795.1	1,723.3		1,688.8	1,795.1	
Payments Made - 90 Days						
Mean	3,375.0	2,895.0	0.201	3,343.4	2,949.4	0.303
Median	1,686.1	1,629.9		1,785.9	1,506.3	
Change in debt						
Avg. change - 90 days	-693.0	-784.2	0.735	-763.0	-700.3	0.816
Median. change - 90 days	-209.1	-232.4		-241.7	-200.6	
Avg. change - 180 days	-787.1	-1,210.8	0.216	-832.8	-1,142.3	0.369
Median change- 180 days	-395.3	-419.0		-502.2	-366.5	
N	285	231		276	240	

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Summary Statistics by Sophistication

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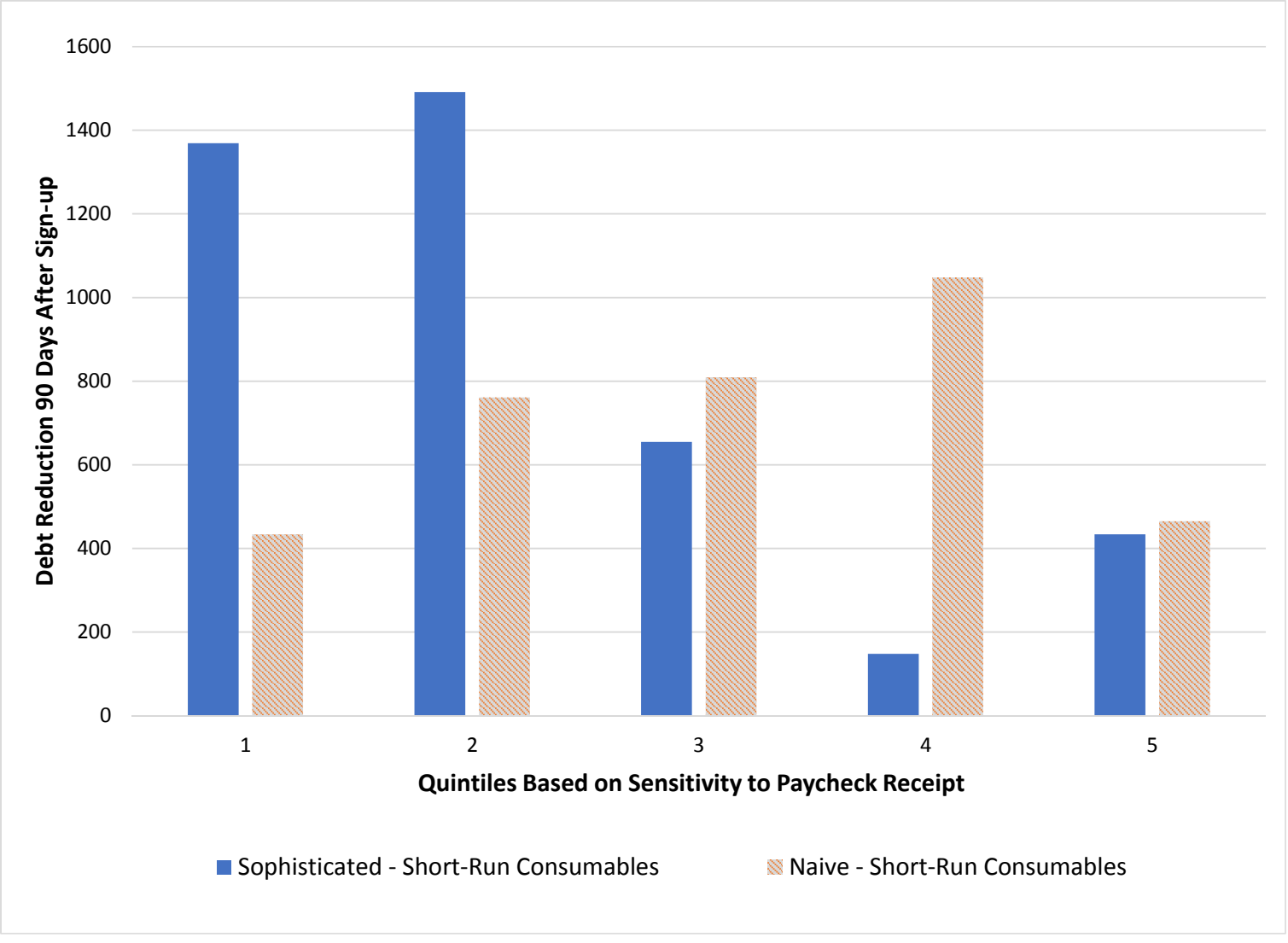
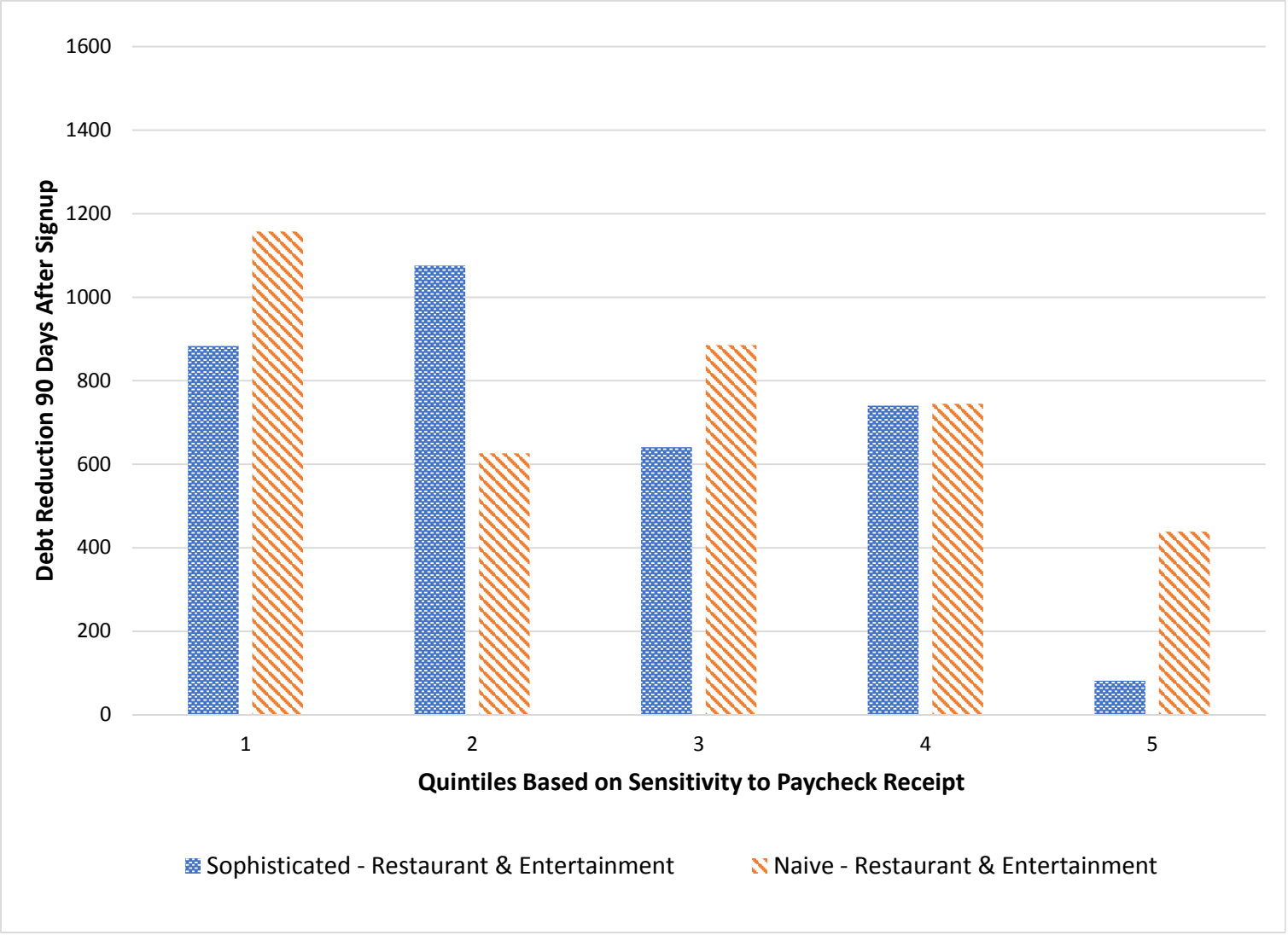
Debt Paydown by Sensitivity



Debt Paydown by Sensitivity



Paydown and Sensitivity to Paycheck

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