

Durables, Non-Durables, and a Structural Test of Fungibility

Alan Montgomery, Christopher Olivola, Nick Pretnar*

Carnegie Mellon University
Tepper School of Business

May 21, 2018

* Nick acknowledges support from the National Science Foundation Graduate Research Fellowship under Grant No. DGE1252522

Neo-Classical vs. Mental Accounting

Neo-Classical

Mental Accounting

Neo-Classical vs. Mental Accounting

Neo-Classical

- One budget for all consumption
- Doesn't matter which liquidity source (e.g. cash, savings) used for expenditure \Leftrightarrow all liquidity is "perfectly fungible"

Mental Accounting

Neo-Classical vs. Mental Accounting

Neo-Classical

- One budget for all consumption
- Doesn't matter which liquidity source (e.g. cash, savings) used for expenditure \Leftrightarrow all liquidity is "perfectly fungible"

Mental Accounting

- Separate budgets for different commodities
- Use different liquidity sources for different commodity purchases (e.g. credit cards for durables, debit for non-durables)

Fungibility ... What Is It?

“... the notion that money has no labels”

– Richard Thaler

Fungibility ... What Is It?

“... the notion that money has no labels”

– Richard Thaler

- Neo-Classical

- Budget constraint $p \cdot c \leq y$ with y as “net resources”, i.e. sum of available savings, cash, bank balances, etc.
- Example: Consumers enjoy consumption of an apple regardless of how it was purchased.

Fungibility ... What Is It?

“... the notion that money has no labels”

– Richard Thaler

- Neo-Classical

- Budget constraint $p \cdot c \leq y$ with y as “net resources”, i.e. sum of available savings, cash, bank balances, etc.
- Example: Consumers enjoy consumption of an apple regardless of how it was purchased.

- Our Behavioral Refinement

- Consumers care about “method of purchase.”
- “Fungibility” is a trait that varies continuously across consumers.

- Use linked household-level checking account and credit card data to show how marginal propensity to consume (MPC) is an indicator of fungibility.

- Use linked household-level checking account and credit card data to show how marginal propensity to consume (MPC) is an indicator of fungibility.
- Discuss how this relates to durable versus non-durable consumption.

- Use linked household-level checking account and credit card data to show how marginal propensity to consume (MPC) is an indicator of fungibility.
- Discuss how this relates to durable versus non-durable consumption.
- Discuss a modification to the dynamic, neo-classical consumption/savings model that yields a sufficient measure of fungibility at the household level.

Marginal Propensity to Consume (MPC)

Let j be the available balance in some liquidity category, say *credit* or *debit*, and c be consumption, i index households, and t index time:

$$MPC_{it}(j) = \frac{\Delta c_{it}}{\Delta j_{it}} \quad (1)$$

We consider differences in household average \overline{MPC}_i for *credit* and *debit*:

$$\mathcal{D}C_i = \overline{MPC}_i(\text{credit}) - \overline{MPC}_i(\text{debit}) \quad (2)$$

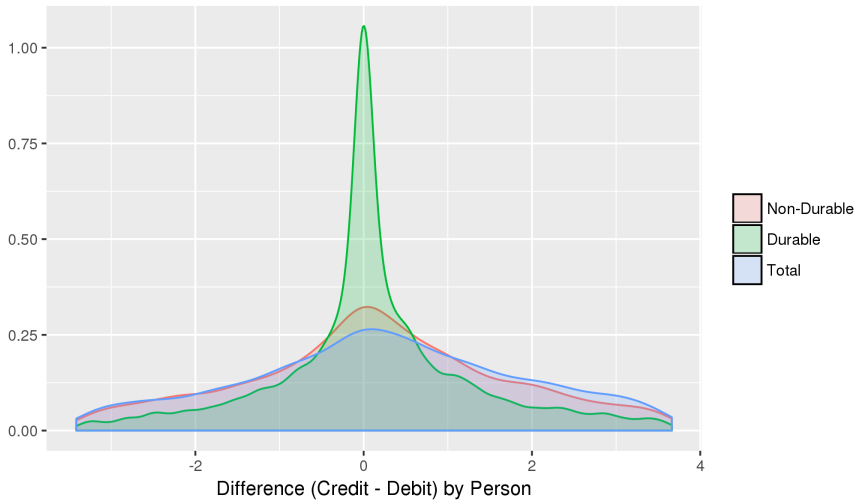
The Median Consumer

Is the median of the differences non-zero?

Median consumer is more responsive to credit increases than cash increases, consistent with (Prelec and Loewenstein 1998; Prelec and Simester 2001; Quispe-Torreblanca et al. 2017):

Table: MLE Results for Differences

Model	Median	Wald	p -value
Total	0.185 (0.028)	42.975	5.545e-11
Non-durable	0.048 (0.009)	28.741	8.273e-08
Durable	0.315 (0.037)	72.103	0



An Axiomatic Model

- Goal: Modify the neo-classical household problem so consumers choose which liquidity sources to use for expenditure.

An Axiomatic Model

- Goal: Modify the neo-classical household problem so consumers choose which liquidity sources to use for expenditure.
- To do this, we split the budget constraint into separate constraints for each liquidity source, i.e. *credit* and *debit*.

An Axiomatic Model

- Goal: Modify the neo-classical household problem so consumers choose which liquidity sources to use for expenditure.
- To do this, we split the budget constraint into separate constraints for each liquidity source, i.e. *credit* and *debit*.
- Results:
 - Equilibrium conditions yield a structural test of fungibility.

An Axiomatic Model

- Goal: Modify the neo-classical household problem so consumers choose which liquidity sources to use for expenditure.
- To do this, we split the budget constraint into separate constraints for each liquidity source, i.e. *credit* and *debit*.
- Results:
 - Equilibrium conditions yield a structural test of fungibility.
 - Most consumers behave as if the marginal return to an additional unit of credit is greater than the marginal return to additional cash.

Decision-Theoretic Test Statistic

Q_{it} is gross interest rate on credit card debts for consumer i , and W_{it} is gross rate of return on checking balances. \mathcal{L}_{it}^* denotes the equilibrium Lagrangian function associated with the consumer's DPP:

$$Q_{it} \frac{\Delta \mathcal{L}_{it}^*}{\Delta \text{credit}_{it}} = W_{it} \frac{\Delta \mathcal{L}_{it}^*}{\Delta \text{debit}_{it}} \quad (3)$$

Take expectations over t for each i of both sides to get an expected condition for “fully fungible” consumers:

$$H_0 : \mathbb{E}_i \left\{ Q_{it} \frac{\Delta \text{debit}_{it}}{\Delta \text{credit}_{it}} - W_{it} \right\} = 0 \quad (4)$$

The Median Consumer

Table: Structural Test of Fungibility

Median	Wald	p-value
-1.029 (0.041)	619.749	0

The Median Consumer

Table: Structural Test of Fungibility

Median	Wald	p-value
-1.029 (0.041)	619.749	0

- Median consumer behaves “as if” marginal utility from credit increases is greater than cash increases.

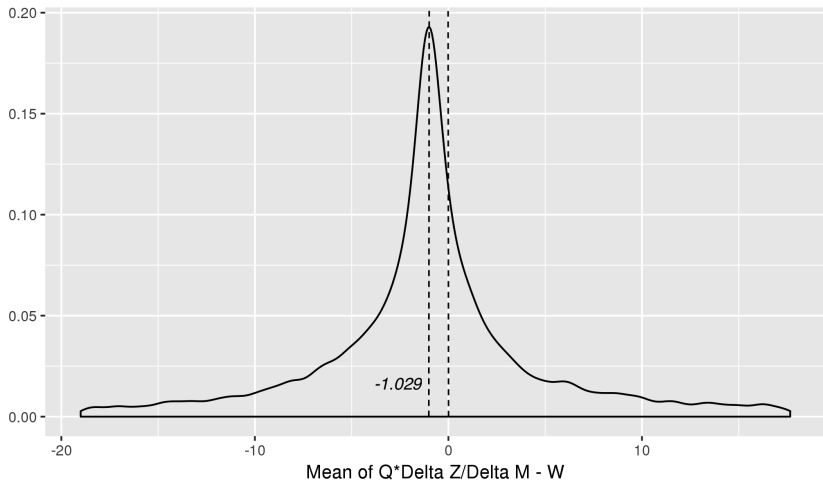
The Median Consumer

Table: Structural Test of Fungibility

Median	Wald	p-value
-1.029 (0.041)	619.749	0

- Median consumer behaves “as if” marginal utility from credit increases is greater than cash increases.
- Median consumer behaves “as if” liquidity is “not fully fungible,” since 0 is perfect fungibility.

Distribution of Fungibility



- Individuals appear to behave as if the marginal consumption value of an additional \$1 of available credit is significantly greater than the marginal consumption value of an additional \$1 of available cash.
- Median individual is thus significantly “non-fungible.”
- Distribution of “fungibility” is heavy-tailed, though most of the mass concentrated “near” 0.

“Models are to be used, not believed.”

– Henri Thiel

“Models are to be used, not believed.”

– Henri Thiel

- Neo-classical consumption/savings model is the best we have to explain broad, long-run aggregate trends.

“Models are to be used, not believed.”

– Henri Thiel

- Neo-classical consumption/savings model is the best we have to explain broad, long-run aggregate trends.
- Yet ... many consumers appear to behave in ways inconsistent with model's short-run predictions (holding credit card debt and savings simultaneously)

“Models are to be used, not believed.”

– Henri Thiel

- Neo-classical consumption/savings model is the best we have to explain broad, long-run aggregate trends.
- Yet ... many consumers appear to behave in ways inconsistent with model's short-run predictions (holding credit card debt and savings simultaneously)
- Neo-classical model can be readily adapted to incorporate mental accounting features.

“Models are to be used, not believed.”

– Henri Thiel

- Neo-classical consumption/savings model is the best we have to explain broad, long-run aggregate trends.
- Yet ... many consumers appear to behave in ways inconsistent with model's short-run predictions (holding credit card debt and savings simultaneously)
- Neo-classical model can be readily adapted to incorporate mental accounting features.
- Mental accounting style models can help explain some of the short-run variation in consumer behavior.

Appendix

Consumer's Full Dynamic Problem

nd is non-durable consumption, k is the stock of durable goods, δ depreciation rate of durables, a is other assets, z is cash, m credit, b credit card debt, s marginal savings, and e credit card payments:

$$V_t(a_t, k_t, z_t, m_t) = \max_{\substack{\theta_{at}, \theta_{lt}, \theta_{mt} \\ s_t, e_t}} u_t(nd_t, k_t) + \beta \cdot \mathbb{E}_t V_{t+1}(a_{t+1}, k_{t+1}, z_{t+1}, m_{t+1}) \quad (5)$$

$$\text{s.t. } a_{t+1} \leq (1 - \theta_{at}(nd_t) - \theta_{at}(d_t))R_t \cdot a_t + s_t \quad (6)$$

$$z_{t+1} \leq W_t(l_t + (1 - \theta_{zt}(nd_t) - \theta_{zt}(d_t))z_t - e_t - s_t) \quad (7)$$

$$b_{t+1} - m_{t+1} \leq Q_t(b_t - m_t + (\theta_{mt}(nd_t) + \theta_{mt}(d_t))m_t - e_t) \quad (8)$$

$$k_{t+1} \leq (1 - \delta)k_t + d_t \quad (9)$$

$$p_t^{nd} \cdot nd_t = \theta_{at}(nd_t)R_t \cdot a_t + \theta_{zt}(nd_t)z_t + \theta_{mt}(c_t)m_t \quad (10)$$

$$p_t^d \cdot d_t = \theta_{at}(d_t)R_t \cdot a_t + \theta_{zt}(d_t)z_t + \theta_{mt}(d_t)m_t \quad (11)$$

Denote the Lagrangian multipliers on (6), (7), and (8) as μ_{at} , μ_{zt} , and μ_{mt} . Let η_t be the multiplier on the durable goods law of motion. Equilibrium conditions:

$$\frac{\partial u_t}{\partial nd_t} = \mu_{at} p_t^{nd} \quad (12)$$

$$\frac{\partial u_t}{\partial nd_t} = W_t \mu_{zt} p_t^{nd} \quad (13)$$

$$\frac{\partial u_t}{\partial nd_t} = Q_t \mu_{mt} p_t^{nd} \quad (14)$$

$$\eta_t = \mu_{at} p_t^d \quad (15)$$

$$\eta_t = W_t \mu_{at} p_t^d \quad (16)$$

$$\eta_t = Q_t \mu_{mt} p_t^d \quad (17)$$

Choices of s_t and e_t provide conditions on the Lagrange multipliers:

$$\mu_{at} = W_t \mu_{zt} \quad (18)$$

$$Q_t \mu_{mt} = W_t \mu_{zt} \quad (19)$$

μ 's represent the marginal change in period t total value with respect to a relaxation of the constraint describing the respective law of motion for balances.