Retail Payment Innovations and Cash Usage: Accounting for Attrition Using Refreshment Samples

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Cashless Society?

- Retail payment innovations: contactless credit card (CTC), multi-purpose and single-purpose stored-value card (SVCm and SVCs).
- These innovations are fast, easy to use and gaining acceptance.
- Will these innovations replace cash? Are we headed towards the cashless society?

Our Contributions

- Estimate the impact of retail payment innovations (PI) on cash usage:

$$CR_{it} = \alpha_i + \beta \cdot PI_{it} + X_{it} \cdot \gamma + u_{it}$$

  where CR denotes the cash usage (volume & value), α is unobserved heterogeneity, and X are demographic variables.
- Accounting for unobserved heterogeneity and non-random attrition results in about $\approx -3\%$ smaller than cross-sectional estimates ($\approx -10\%$).

Table 5: CTC cash ratios by value (in percent)

	2010		2011		2012	
	U	N-U	U	N-U	U	N-U
Overall	13	23	12	23	12	23

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Age: 18-34	12	24	12	22	11	23
35-49	12	23	11	22	10	22
50-64	13	22	13	23	13	23
65+	14	24	12	23	13	24

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35-49	12	23	11	22	10	22
50-64	13	22	13	23	13	23
65+	14	24	12	23	13	24
Income: <25K	21	35	18	37	20	36
25-34K	19	30	15	28	19	28
35-44K	15	25	18	24	12	26
45-59K	15	23	14	22	13	21
60-69K	13	20	10	21	13	19
70+K	9	16	9	15	9	16

Note: CTC users (U) and non-users (N-U).

Rotating Panel (Attrition)

- We exploit the panel dimension of Canadian Financial Monitor (CFM) from 2010 to 2012.
- Survey on household finances; 12,000 households each year.
- Attrition rate above 50%!
- Data replenished annually to maintain a constant yearly sample size and make each year's representative.

Table 8: Attrition and refreshment in the CFM

Panels	2010-11	2011-12
Beginning sample size:	11,695	12,241
Stayers	5,699	6,079
- Attritors	5,996	6,162
+ Refreshment sample	6,542	4,944
End sample size	12,241	11,023

Without Correcting for Attrition

When attrition is missing-completely-at-random (MCAR):

$$E\left[\Delta CR - \beta \cdot \Delta PI - \Delta X \cdot \gamma | S = 1, x_{t-1}, x_t\right] = 0, \qquad (1)$$

where $S = 0$ for attritors and $S = 1$ for stayers.

- Test: Moffit, Fitzgerald, and Gottschalk (1999).
- Reject the MCAR hypothesis, thus we focus on other attrition models.

Correcting for Non-random Attrition

$$E\left[\frac{\Delta CR - \beta \cdot \Delta PI - \Delta X \cdot \gamma}{g(\cdot)}\middle| S = 1, x_{t-1}, x_t\right] = 0, \qquad (2)$$

Survival function: $g(\cdot) \equiv \Pr(S = 1|z_1, z_2)$, where $z_t \equiv \{CR_t, PI_t, X_t\}$.

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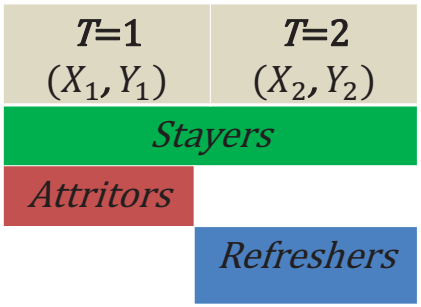
Two-period model



1. Missing-at-random (MAR): $g(k_1(z_1))$.
2. Selection-on-unobservables (HW): $g(k_2(z_2))$.
3. Additive Non-ignorable (AN): $g(k_1(z_1) + k_2(z_2))$.

Three-period AN Model

Define $S_2S_3 = 1$ if a unit observed in the initial sample (period 1) survives both in periods 2 and 3.
The survival function

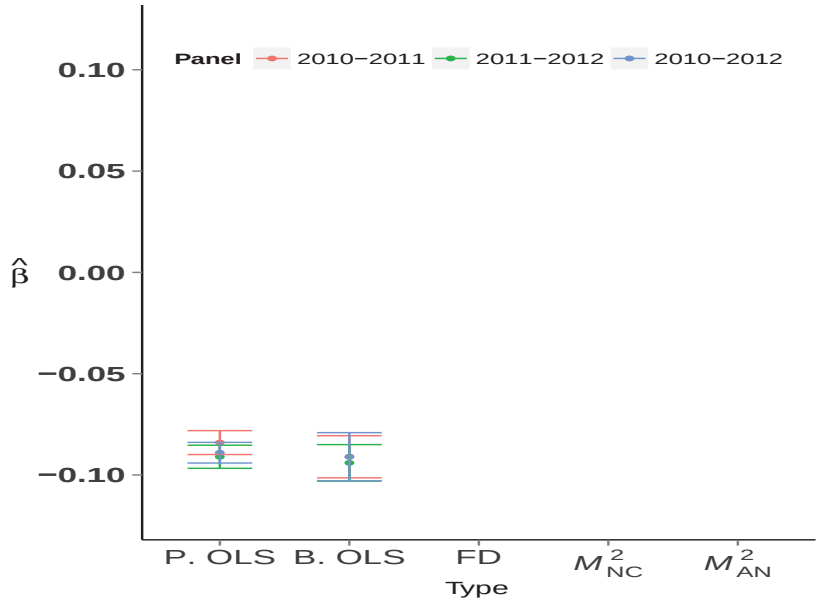
$$\Pr\left(S_2S_3 = 1|\ z_1, z_2, z_3\right) \equiv g(k_1(z_1) + k_2(z_2) + k_3(z_3))$$

is identified as

$$\begin{aligned}
E\left[\frac{S_2S_3}{g\left(k_1(z_1) + k_2(z_2) + k_3(z_3)\right)} - 1|R_1 = 1, z_1\right] &= 0, \\
E\left[\frac{S_2S_3}{g\left(k_1(z_1) + k_2(z_2) + k_3(z_3)\right)} - 1|R_2 = 1, z_2\right] &= 0, \\
E\left[\frac{S_2S_3}{g\left(k_1(z_1) + k_2(z_2) + k_3(z_3)\right)} - 1|R_3 = 1, z_3\right] &= 0,
\end{aligned}$$

where the dummy R_t indicates whether a unit belongs to the representative sample in period t, for $t = 1, 2, 3$.

Figure 8: Results for CTC (Value)



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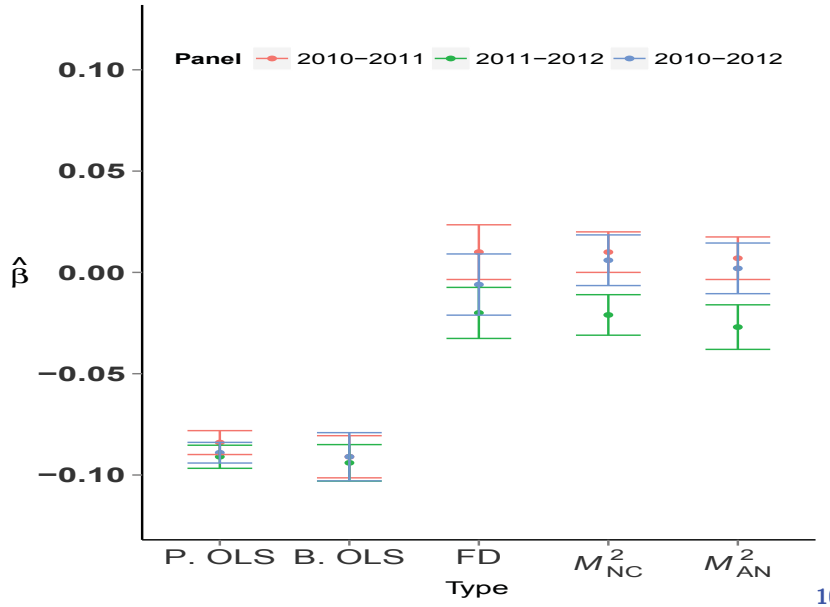


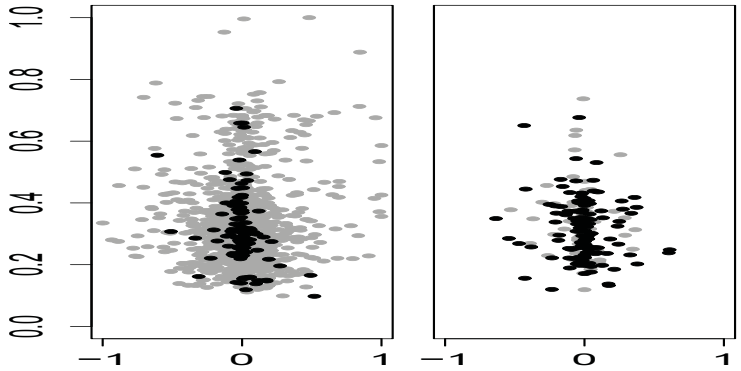
Understanding the results

Correcting for attrition ($1/g(\cdot)$) may affect the estimated $\widehat{\beta}$ through different channels:

$$E\left[\frac{\Delta CR - \beta \cdot \Delta PI - \Delta X \cdot \gamma}{g(\cdot)}\middle| S = 1, x_{t-1}, x_t\right] = 0$$

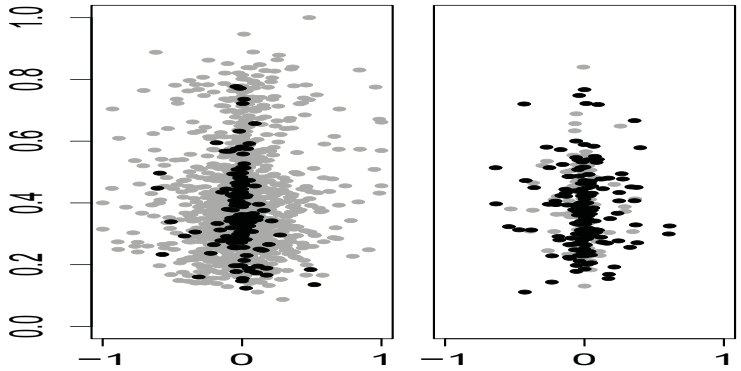
- Extensive margin: Switchers $\Delta PI \neq 0$ vs. non-switchers $\Delta PI = 0$.
- Intensive margin: ΔCR associated with New-users $\Delta PI = 1$ vs. stop-users $\Delta PI = -1$.
- Survival probability: $1/g(\cdot)$

Figure 2: 2010-2012: $\widehat{g}(\cdot)$ versus ΔCR value for CTC



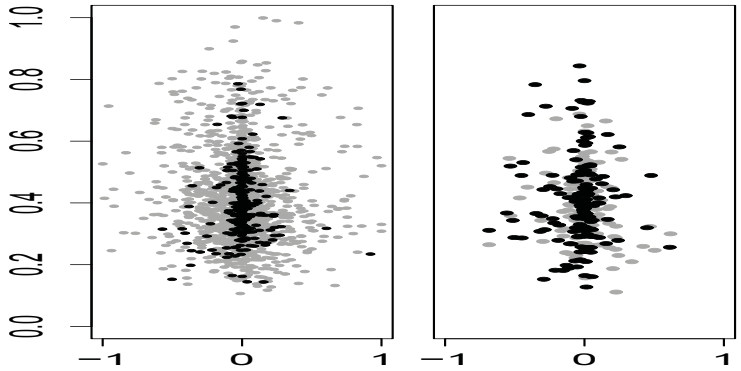
Note: Left side pane: never-users (0,0) in grey, always-users (1,1) in black; Right side pane: stop-users (1,0) in grey, new-users (0,1) in black.

Figure C.4: 2010-2011: $\widehat{g}(\cdot)$ versus ΔCR value for CTC



Note: Left side pane: never-users (0,0) in grey, always-users (1,1) in black; Right side pane: stop-users (1,0) in grey, new-users (0,1) in black.

Figure C.4: 2011-2012: $\widehat{g}(\cdot)$ versus ΔCR value for CTC



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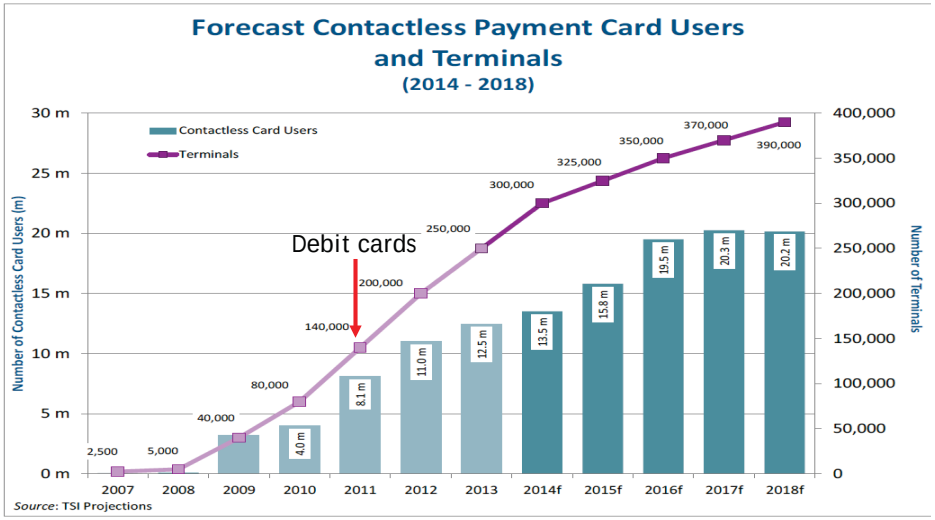
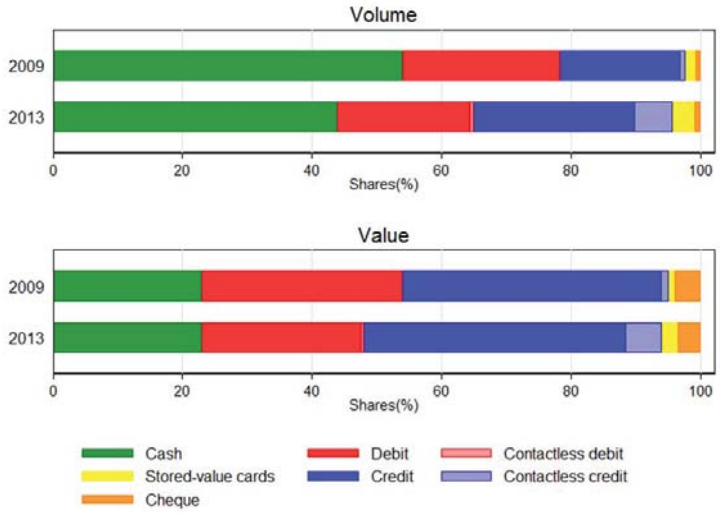
Contactless S-curve?



Cross-Validation



2009/2013 Bank of Canada Methods-Of-Payment Diaries.

Summary

- CTC are displacing cash (and debit card) usage.
- In terms of value it is about 0-3% per annum.
- Monitor situation - tipping point of S-curve?
- 2015 Merchant Cost Study $\Rightarrow$ 2-sided markets.

Thanks/Merci/Kiitos!!!