Discussion of

Dynamic consumer cash inventory model

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* The views expressed here do not necessarily represent those of the Bank of Italy.

This paper

- Builds a dynamic structural model of cash management and payment choices with random expenditures
- Estimates the model on data from the Canadian Methods-of-Payment survey (MOP) for the years 2009, 2013 and 2017
  - repeated cross section of Canadian households, around 5000 in total
  - rich, individual-level information on cash/non-cash purchases, withdrawals (size and frequency) and cash holdings
- **Findings:**
  - heterogeneous estimation is valuable
  - a worsening of the cash infrastructure has a idiosyncratic (bimodal) effect on payment and withdrawal choices
- **Policy relevance:** some consumers (especially younger and poorer ones) more damaged by bank closures

Literature and contribution

- Paper adds to a growing literature on payment method choices that uses inventory models.
  - ❏ seminal cash management model (Baumöl, 1952; Tobin, 1956)
  - \+ payment choices (Whitesell, 1989; Alvarez and Lippi, 2017)
  - \+ random expenditures (Briglevics, Schuh, et al., 2020; Lippi and Moracci, 2025)
- **Main contributions:**
  - ❏ a tractable way to embed payments in a stochastic inventory model
  - ❏ heterogeneity in withdrawal costs through an ATM-density measure
  - ❏ estimating distributions of parameters instead of values
  - ❏ counterfactuals at the household level

The model

Key ingredients

- Household i needs to finance expenditure $s_{i,t}$ that is stochastic and revealed at the beginning of day t. Need to decide
  - cash withdrawal today $w_{i,t}$
  - cash expenditure $c_{i,t} \leq \min\{s_{i,t}, h_{i,t-1} + w_{i,t}\}$, where $h_{i,t-1}$ are cash holdings carried forward from $t-1$
- Clearly, current choices impact end-of-period cash holdings $h_{i,t}$ that enter future expected utility (daily discount β)
- Households
  - derive utility $u(c_{i,t}) = \alpha \ln(1 + c_{i,t}) + (1 - \alpha) \ln(1 + s_{i,t} - c_{i,t})$
  - face cash holding costs $\gamma h_{i,t}$
  - face withdrawal costs $F \ln(1 + d_i)$
- Estimate $\{\alpha, \gamma, F\}$ via GMM: representative vs heterogeneous

Results

- **Model fit:** individual-level estimation improves fit to observed moments wrt (1) representative estimation; (2) estimation by subgroups
- **Parameter estimates:** stark differences between representative vs heterogeneous estimation
  - withdrawal costs F have increased over time
  - cash preferences α of low income consumers have risen as well
- **Impact of changes in cash infrastructure:** bimodal response to a 25% increase in withdrawal costs/distance
  - a quarter of consumers abandon cash, with sizeable welfare losses
  - other consumers withdraw more to economize on costly adjustments

Thoughts on the paper

- A nice, novel model combining payment choices and cash inventory management by households in a "tractable" fashion

  → predictions on withdrawal frequency/size, average cash holdings and cash/card expenditure shares

- Clever use of individual-level data to estimate full distributions of parameters and household-specific counterfactuals

- Policy-relevant exercise on the effect of a worsening cash infrastructure

  → enables to speak about consequences for any subgroup of the population you have in mind

Some comments

1. Frictions
   - uncertainty/lumpiness
   - imperfect acceptance
2. Insights on the model's solution
3. Smaller points

My comments

1. Frictions - uncertainty/large payments

- In the model, households know s_{it} at the beginning of the day
  only source of uncertainty is "how much will I spend tomorrow?"
  - HHs always have "enough" cash to perform their transactions
    $\rightarrow$ no *cash shortfalls*
  - they can split daily expenditure $s_{i,t}$ in cash and non-cash as they like
    $\rightarrow$ no *lumpy payments*
- In practice,
  - some payments are unexpected
    how many? how unexpected? difficult to say
  - households often don't have enough cash to meet their next payment
    for euro area $\simeq$ 16% of transactions in 2024
  - sometimes all daily expenditure comes from a large unique payment

My comments

1. Frictions - acceptance

- In the model, all payments can be settled using cash or non-cash methods
  - HHs choose the share of cash/non-cash payments $c_{i,t}/s_{i,t} \in [0,1]$
- In other work (Engert, Shcherbakov, and Stenzel, 2024) you report that around 7% of Canadian merchants accepted only cash in 2023.
  for euro area $\simeq$ 11% of transactions in 2024 were *forced cash transactions*
  - can such constraints be integrated in the framework?
    by imposing a floor on $c_{i,t}/s_{i,t}$, for instance?
  - is cash universally accepted?
    in euro area, only 95% of transactions can be settled using cash
    does a decrease in acceptance have similar effects to a rise in F?

My comments

2. Insights on the model's solution

- Properties of the model's solution (withdrawal and payment policy functions) could be discussed in greater depth
- Some figures on the shape of $\mathbb{E}_{s_{i,t+1}}[V(h_{i,t})]$ would be helpful and better connect the paper with the literature
  - is the withdrawal policy of the (s, S) (trigger-target) form?
- How do payment choices $(c_{i,t}/s_{i,t})$ depend on cash holdings $h_{i,t-1}$ and expenditure size $s_{i,t}$?
  - does the model match the stylized facts that cash usage increases as h rises and as s fall?
  - does card usage rise when $s \to h$, as in Lippi and Moracci (2025)?
- Comparative statics: how does d_i affect inventory/payment choices

My comments

3. Smaller points

- **Parameters/welfare in monetary units.** The per-period utility contains $\gamma h_{i,t}$, which is measured in CAD. Can the estimated parameters/average costs/welfare losses be restated in CAD?
- **Urban/rural comparison.** Estimated per-distance-unit withdrawal costs F are higher in rural locations (Table 7): is this compensated by a higher average d_i?
- **Opportunity cost of time.** Given that you have income data, I would love to see a scatter of the estimated individual F and the hourly wage.
- **Concavity of shoeleather costs.** The BT *shoeleather cost* is given by $F \ln(1 + d_i)$ - is concavity appropriate here?
- **Value vs volume?**

Taking stock

- A very promising paper, which provides a **completely novel way** to incorporate payment choices into dynamic inventory models
- A key insight from the model solution is exploited to reduce dimensionality of state space and enable **individual-level estimation**
- Highly policy relevant **application**: heterogenenous effects and welfare costs of a (possibly) weakening cash infrastructure
- A few minor adjustments can make the paper
  - (in general) easier to follow
  - (on the theory side) more comparable to other models of cash management with nontrivial payment choices
  - (on the applied side) a wonderful tool to explore the heterogeneous welfare implications (in \$) of changes in the cash infrastructure (... and possibly more!)

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