The background of the slide is an aerial photograph. The top half shows a hazy city skyline with several prominent skyscrapers. The bottom half shows a wide, flat landscape with a central canal or river that branches out into smaller channels, surrounded by green fields. The sky is a pale, hazy blue.

Cash management and payment choices: a simulation model with international comparisons

Lola Hernandez, Helsinki - June 4th 2015

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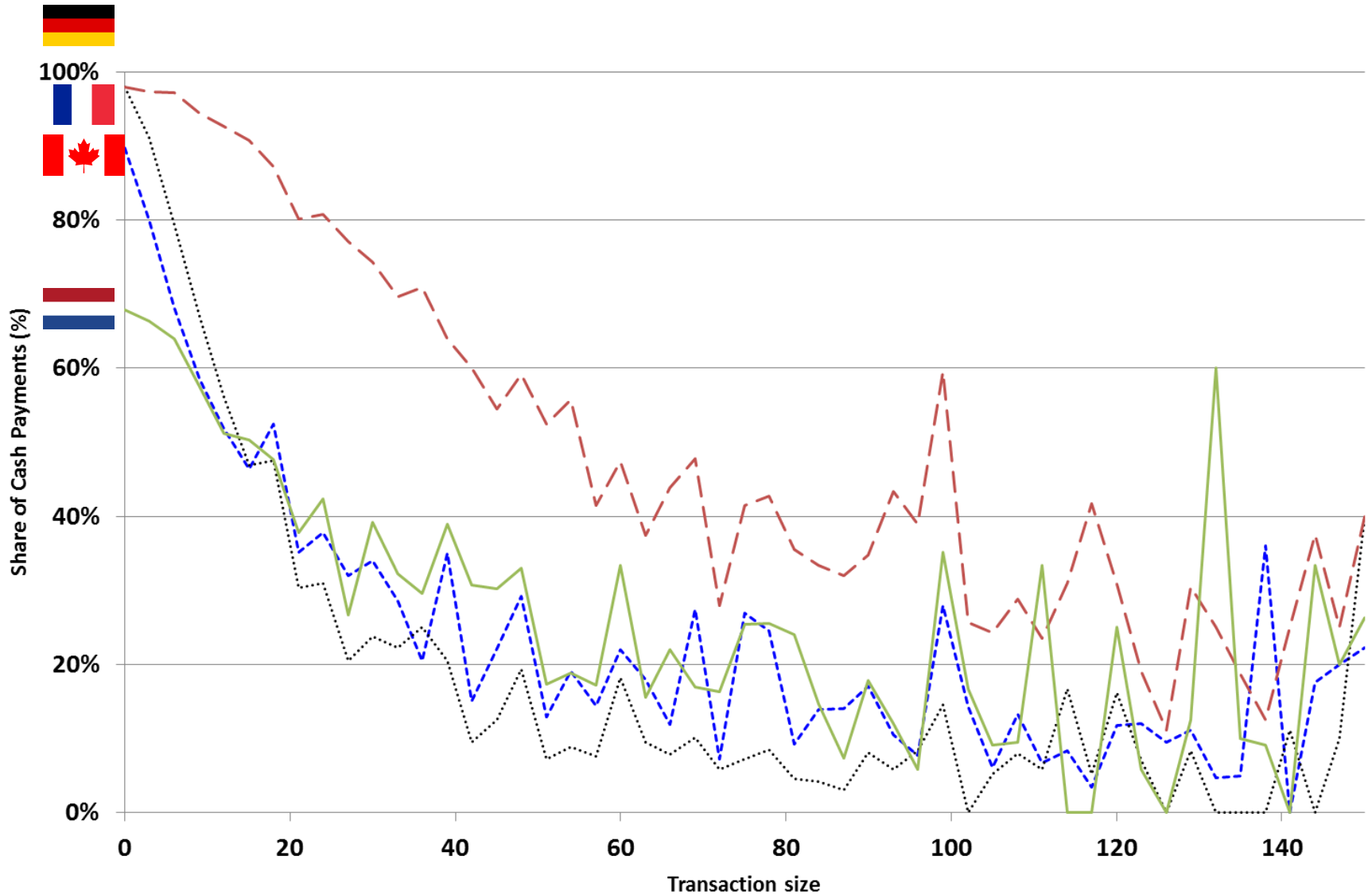
DeNederlandscheBank

EUROSYSTEEM

Outline

- Introduction
- Objective
- Literature
- Model
- Data
- Results
- Concluding remarks

Role of transaction size



Objective

- Explain cash usage by simulating two cash management & payment choices assumptions used in the payments economics' literature
- Test the model using:
 - Individual payment data
 - Various countries, different payment habits

Literature

- **Theoretical studies:**

Inventory models (Baumol, 1952)

Transaction size models (Whitsell 1989, 1992):

Limits of the existing literature

- **Inventory models:**
 - No transactions (size) but a continuous flow of consumption
 - No share of cash payments for each transaction size
- **Transaction size (TS) models:**
 - Exclusive transaction domains for cash and other payment instruments

Model: two simple assumptions

- **Cash first rule:**

Agents pay cash whenever they have enough cash

- **Minimum Cash Holdings:**

Agents withdraw cash when their cash balance drops below a threshold

How to measure the gap?

An indicator of performance

$$G(S^{th}, S^{obs}) = \sum_{p \in [0, \infty)} \frac{n(p)}{N} |S^{th}(p) - S^{obs}(p)|$$

$S^{th}(p)$, predicted share of cash payments
 $S^{obs}(p)$, observed share of cash payments
 $n(p)$, number of purchases of size p
 N , total number of purchases

Data

- Unique transaction data: shopping diaries
 - 4 countries: NL, CA, DE & FR
 - Diaries's duration varies:
 - NL (1), CA (3), DE (7) & FR (8)
 - 14,378 respondents, 12 year & older
 - 59,904 transactions
 - Data from: 2009 to 2011 (September-November)

Data

- Key data:
 - Observed distribution of cash withdrawals
 - Observed cash payments at the POS
- Excluding transaction: Internet, phone, mail and p2p

Data



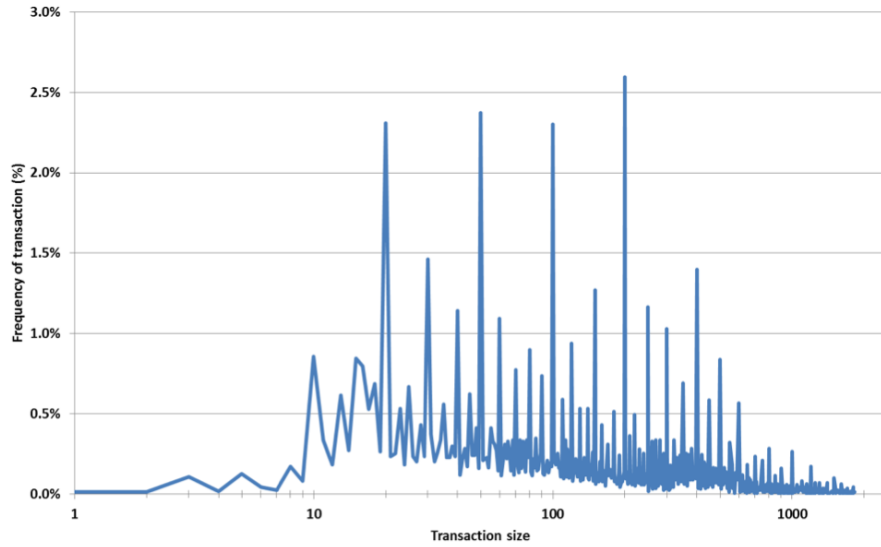
	Canada	France	Germany	The Netherlands
Share of cash payments	50.1	58	81	52
Percentiles of transaction				
10th	2.5	1	3	2
50th	16.9	11.8	15.0	10.2
90th	80	52	63.7	67.5
Av. nr. of daily transactions per	1.7	1.5	1.4	1.7
Av. daily spending per person	Can\$ 65.7 (€43)	€ 38.2	€ 40.5	€ 42.7
Av. amount of a withdrawal	Can\$ 106.8 (€69.8)	€ 63.2	€ 182.6	€ 65.2
Av. daily withdrawals per person	0.17	€ 0.12	€ 0.11	€ 0.18
Av. cash holdings	Can\$ 84.2 (€53.9)	€ 62.4	€ 103.1	€ 44.8
Market share of Cash/ Pin				
equality threshold	Can\$ 29 (€19)	€ 16.0	€ 54.0	€ 15.0

Data

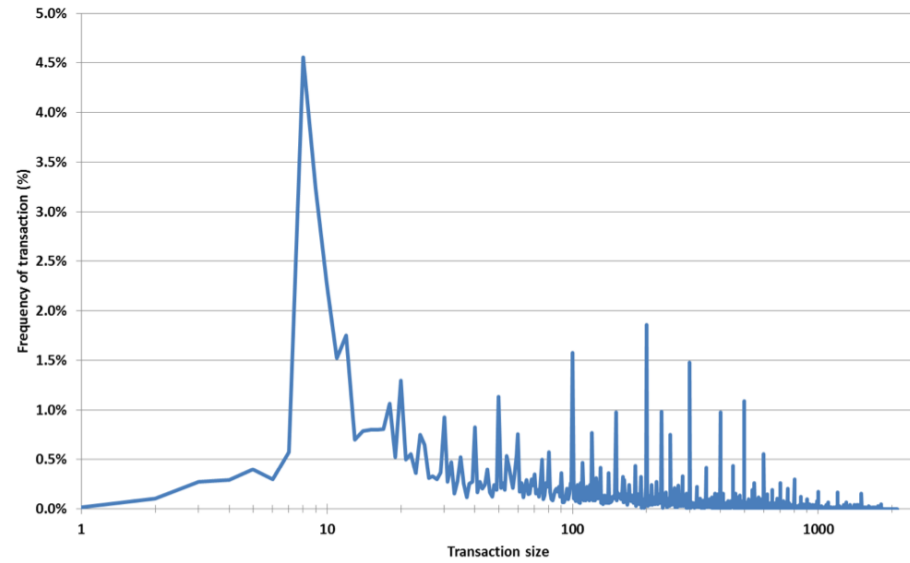
- CA, DE, NL:
 - ↳ 95 to 97% of payments are paid with cash & card
- FR:
 - ↳ 88 % with cards&cards; 9 % with cheques
- We then simulate a cash-card model

Frequency of transactions per transaction size (log scale)

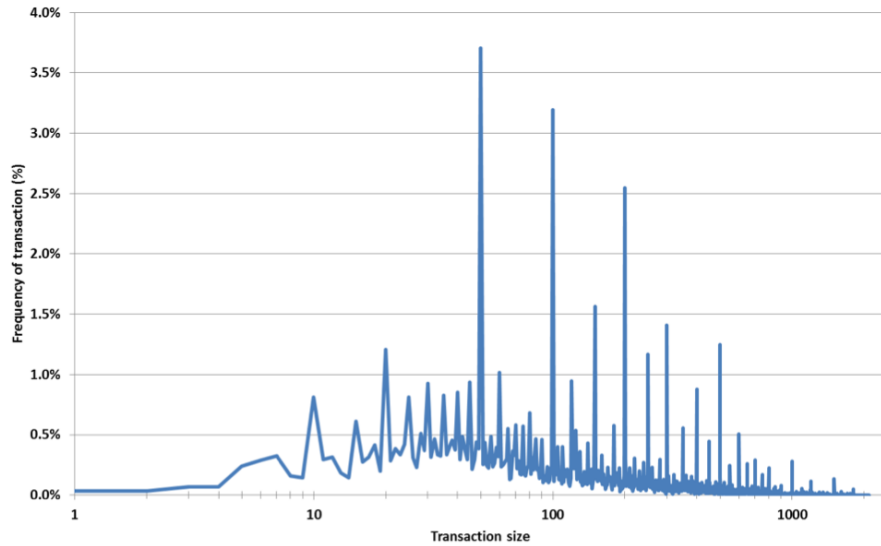
Canada



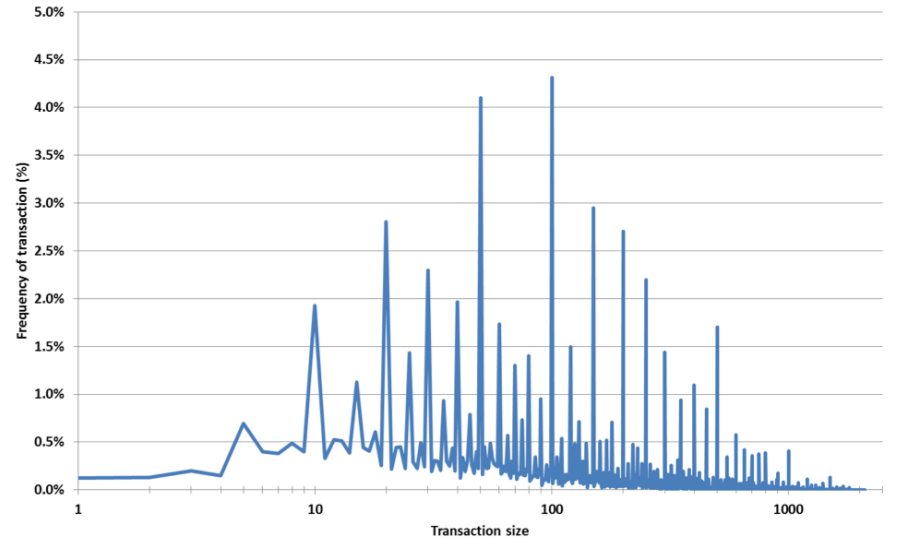
France



Germany

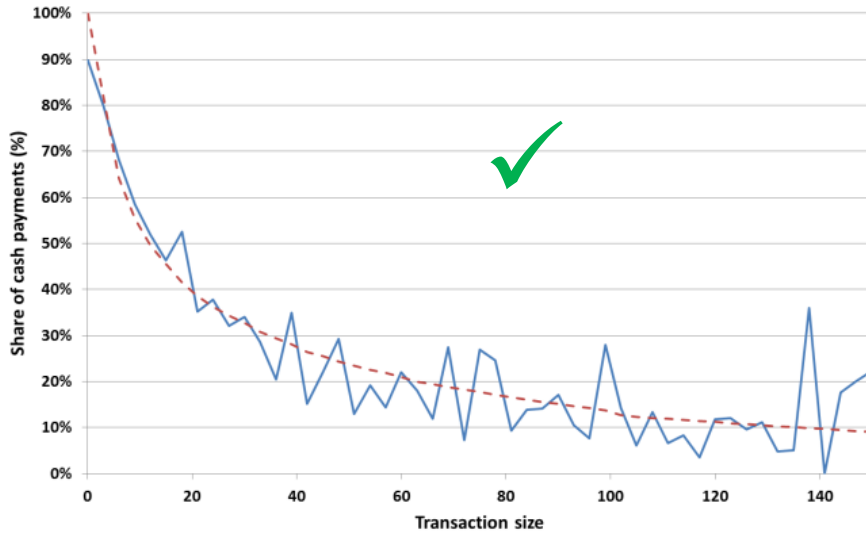


The Netherlands

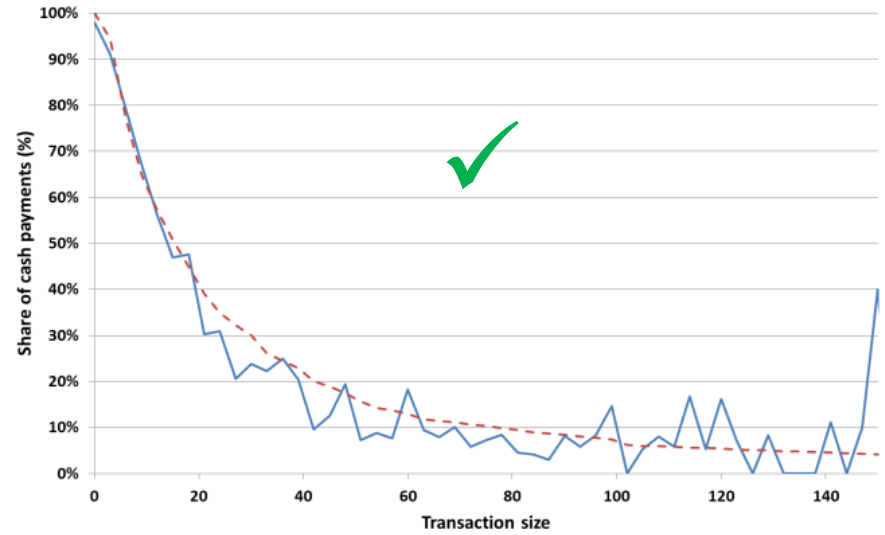


Results

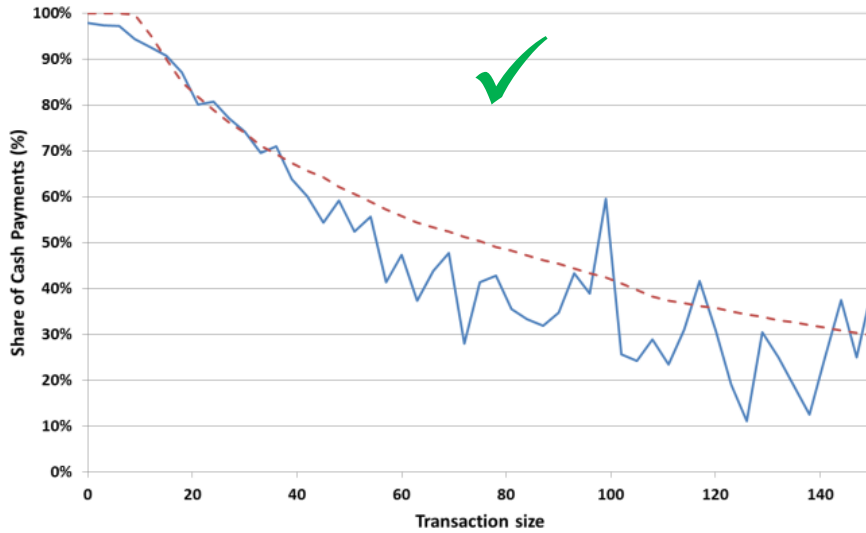
Canada



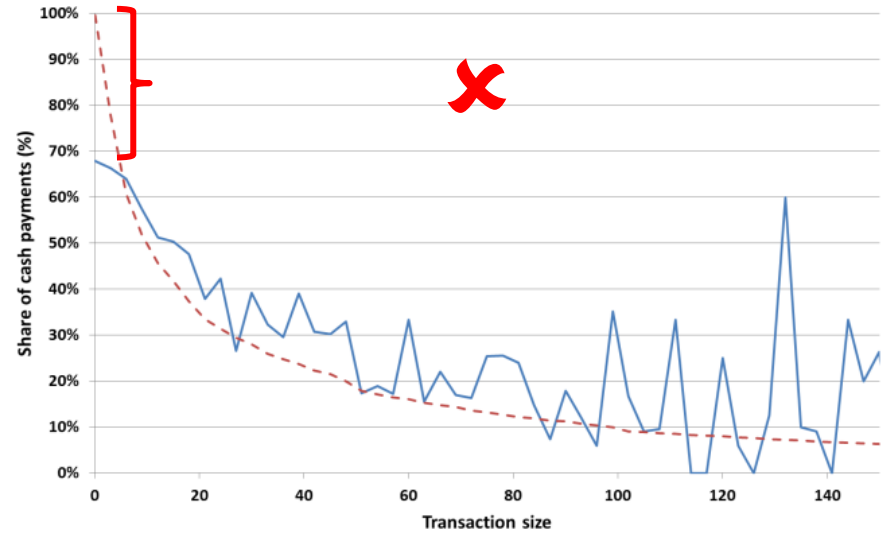
France



Germany



The Netherlands



Results

Cash first rule

- FR, DE & CA: payment patterns are well described by the model
 - Average deviation btw observed and replicated share of cash payments = small (3,5 to 5 %)
 - Low impact of deviation of high-value transactions
 - Gaps between observed and predicted transactions are minimum

Results

Cash first rule



NL: model doesn't describe payment pattern

Country (Can\$/ €)	0-20	20-50	50-100	>100	Deviation
Canada	2.8	1.0	0.6	0.5	5.0
France	1.6	1.2	0.4	0.4	3.5
Germany	1.7	0.6	1.0	0.5	3.8
The Netherlands	9.4	1.8	0.4	0.5	12.1

- BTW 45% to 78% of the total gaps are due to a bad prediction on low-value purchases |0-20|

Indicating: important role of alternative instrument for low-value payments

“Cash first” rule doesn't apply in the NL


→ - Also: card surcharge: from 22 % (2006) to 2 % (2011)

Results

Minimum cash holdings

Country (Can\$/ €)	Minimum cash holdings
Canada	2.8
France	4
Germany	10.9
The Netherlands	2.6

- The Dutch have the lowest cash holdings
- Difference between countries:
 - Higher use of cash in DE (in line with data & literature)
 - Related to payment landscapes: costs of cash withdrawals

 DE: fee between €4 to €5 → incentive to withdraw even if consumers hold enough cash

 CA: withdrawal fee ~ CAN\$1,5 (€0,98)

 NL: no fee !

Concluding remarks

- ‘Cash first’ & ‘minimum cash holding’ assumptions describe payment patterns from FR, DE & CA, but not from NL
- Changes in payment infrastructures help explain:
 - why in some countries consumers choose “cash first” for low-value transactions
 - while in others they use cash & cards interchangeably

Thank you!

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