An empirical demand model for e commerce

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An empirical demand model for e-commerce

Summary

- We developed an empirical model for spatially differentiated e-commerce demand
- Implemented in the Parcel Modules of HARMONY Tactical Freight Simulator
- Ordered logit model estimated on data from Mobility Panel Netherlands 2017 (MPN)

Methodology

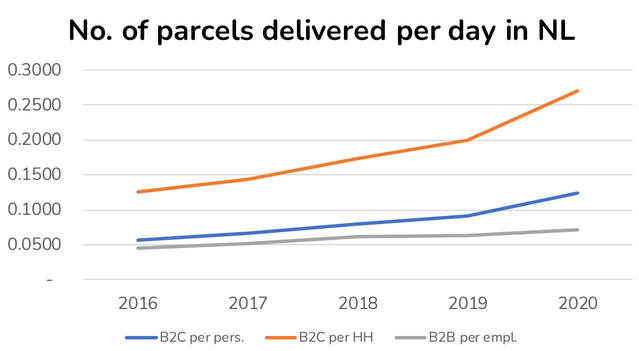
- Ordered logit model, an ordinal regression model
  - Both independent and dependent variables are ordinal
- Explanatory variables are personal characteristics known on zonal (aggregate) level
- Independent variable y is number of ordered e-commerce parcels in three months (in n categories)
- Underlying distribution: $y' = \vec{x}\vec{\beta} + \varepsilon$
- Next to $\vec{\beta}$ we estimate n-1 threshold coefficients μ
- For each category i: $\mu_{i-1} < y'_i \leq \mu_i$

Parameter estimates

	Variable level	Explanation	N	Estimate	Sig.
μ_1	Nongr0	0 parcels	2555	-1.487	0
μ_2	Nongr1	1 parcels	902	-0.872	0
μ_3	Nongr2	2 parcels	794	-0.33	0
μ_4	Nongr3	3 parcels	611	0.136	0.028
μ_5	Nongr4	4 parcels	438	0.516	0
μ_6	Nongr5	5 to 9 parcels	1094	2.189	0
μ_7	Nongr10	10 to 14 parcels	228	3.298	0
μ_8	Nongr15	15-19 parcels	83	4.362	0
	Nongr20	20+ parcels	40	-	
	Income1	<40,000 EUR	2833	-0.23	0
	Income2	40,000 to <67,000 EUR	1881	0	.
	Income3	≥67,000 EUR	991	0.355	0
	Age3	12-24 years old	432	-0.586	0
	Age4	25-39 years old	1494	0	.
	Age5	40-49 years old	825	-0.285	0
	Age6	50-59 years old	962	-0.957	0
	Age7	60-69 years old	982	-1.347	0
	Age8	70-79 years old	725	-1.736	0
	Age9	80 years old and older	161	-2.417	0
	Gender1	Male	3057	-0.105	0.032
	Gender2	Female	3688	0	.

Calibration

- Market size data from ACM



Estimation data

- MPN 2017, extra questions on shopping behaviour
- „How often have you bought [product] online / in a brick-and-mortar shop in the past 3 months?“

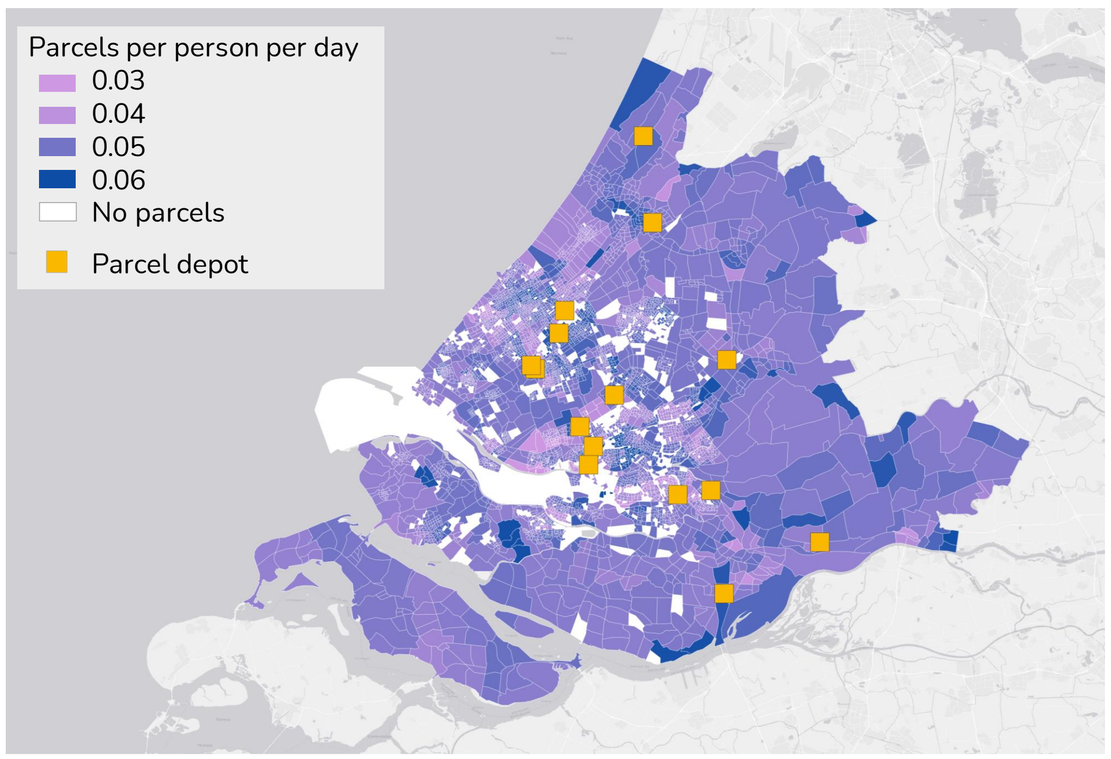
0x	1x	2x	3x	4x	≥5x

Books, electronics, whitegoods, shoes/clothes, household items, personal care, furniture, sport/hobby, toys, groceries

Shopping frequency	Groceries		Non-groceries	
In the past 3 months...	N		N	
Not bought	1149	17%	410	6.1%
Only bought in B&M shop	5094	75.5%	2108	31.3%
Only bought online	158	2.3%	440	6.5%
Bought both in B&M shop and online	344	5.1%	3787	56.1%
Total	6745		6745	

Results

- With the model we can calculate (daily) parcel rates for the population of the zones in our study area
- Income, age and gender as explanatory variables
  - Higher income, age 25-39 and women order more
- Urbanisation level not significant for non-groceries



Discussion

- Next step: interaction with shopping trips
- New data (e.g., as part of national travel survey)
- Include delivery type choice (lockers, pick-up points, home delivery)

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