

13th Postal Economics Conference on E-commerce,
Digital Economics and Delivery Services

INTERTWINED NETWORK EFFECTS: THEORY AND EVIDENCE

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Joint Research Centre, European Commission

Toulouse, France
April 16-17, 2026

MOTIVATION

AGGREGATOR PLATFORM



phone



Todo Imágenes **Shopping** Noticias Vídeos Vídeos cortos Web Más ▾



Samsung

Menos de 500 €

De segunda mano

Nokia

Apple

LG

Con descuento

ASUS

Fnac



Samsung Galaxy A16

139,00 € y más precios

MediaMarkt y más

En tienda

Devoluciones durante...

4.8 ★★★★★ (12 mil)



Xiaomi Redmi 14C

108,97 € 117 €

y más precios

Amazon.co... y más

Otras ofertas cercanas

4.8 ★★★★★ (16 mil)



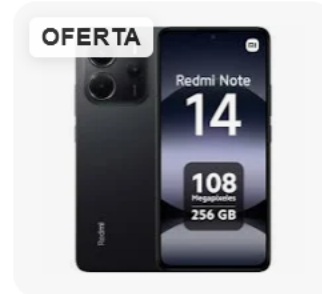
Samsung Galaxy S25 Ultra 5G

1449,00 € y más

samsung.co... y más

Devoluciones durante...

4.8 ★★★★★ (50 mil)



Xiaomi Redmi Note 14

1100 € 179 €

y más precios

Amazon.co... y más

Otras ofertas cercanas

4.9 ★★★★★ (7,8 mil)



Apple iPhone 16

829,00 € y más precios

MediaMarkt y más

En tienda

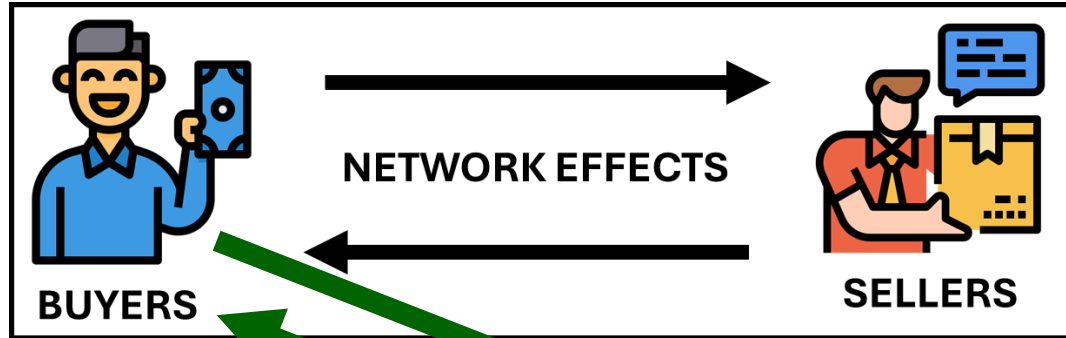
Devoluciones durante...

4.4 ★★★★★ (3,9 mil)

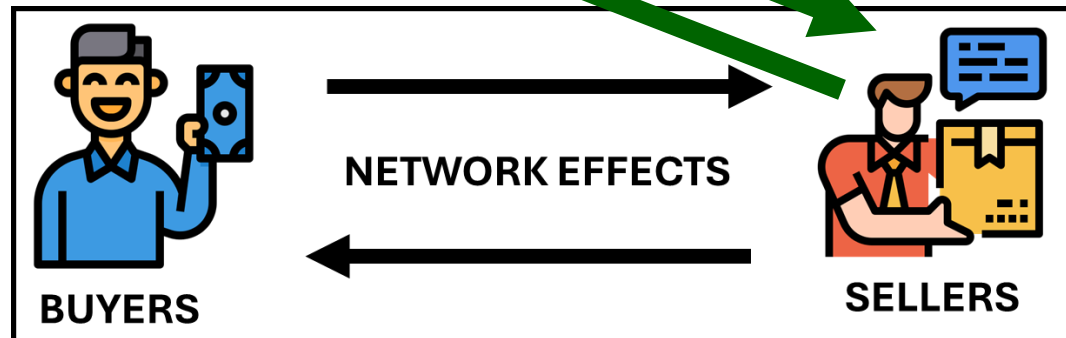
COMPETING PLATFORMS

SELLER

AGGREGATOR PLATFORM (e.g., Google Shopping)



INTERTWINED NETWORK EFFECTS



SOURCE PLATFORM

(e.g., Amazon Marketplace)

Fnac-Darty in Carrefour

Store-in-store

Boulangier in Auchan

Real estate websites aggregating brick-and-mortar real estate agencies' and landlords' listings



Real estate



Walmart



Online marketplaces

FNAC DARTY



Travel metasearch engines

**INTERTWINED NETWORK EFFECTS
(INDEPENDENT PLATFORMS)**

idealo



Price comparison



Microsoft Bing

trademe
PROPERTY NZ

coches.net



LOGIC
-IMMO



etraveli
group

Adevinta Gumtree

seek asia JobStreet
by SEEK

INTERTWINED NETWORK EFFECTS
(POST-MERGER)

MANY ARE HORIZONTALLY
DIFFERENTIATED



WEDDING PLANNER



viagogo

ebay



RESEARCH QUESTIONS



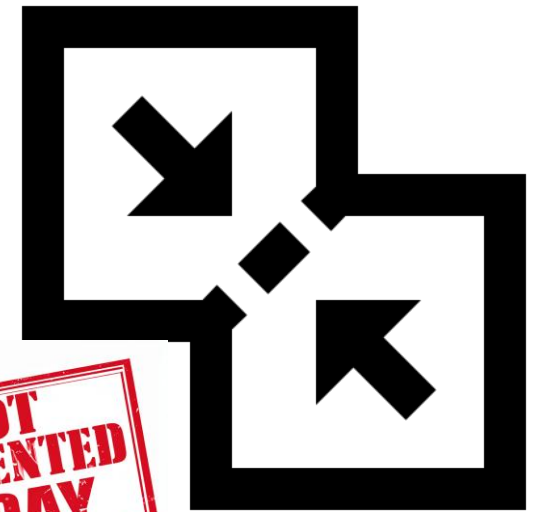
Why do competing platforms set-up intertwined network effects (INE)?

- Competition softening?



What is the effect of INE between **independent** firms on **welfare**?

- Consumer surplus
- Seller surplus

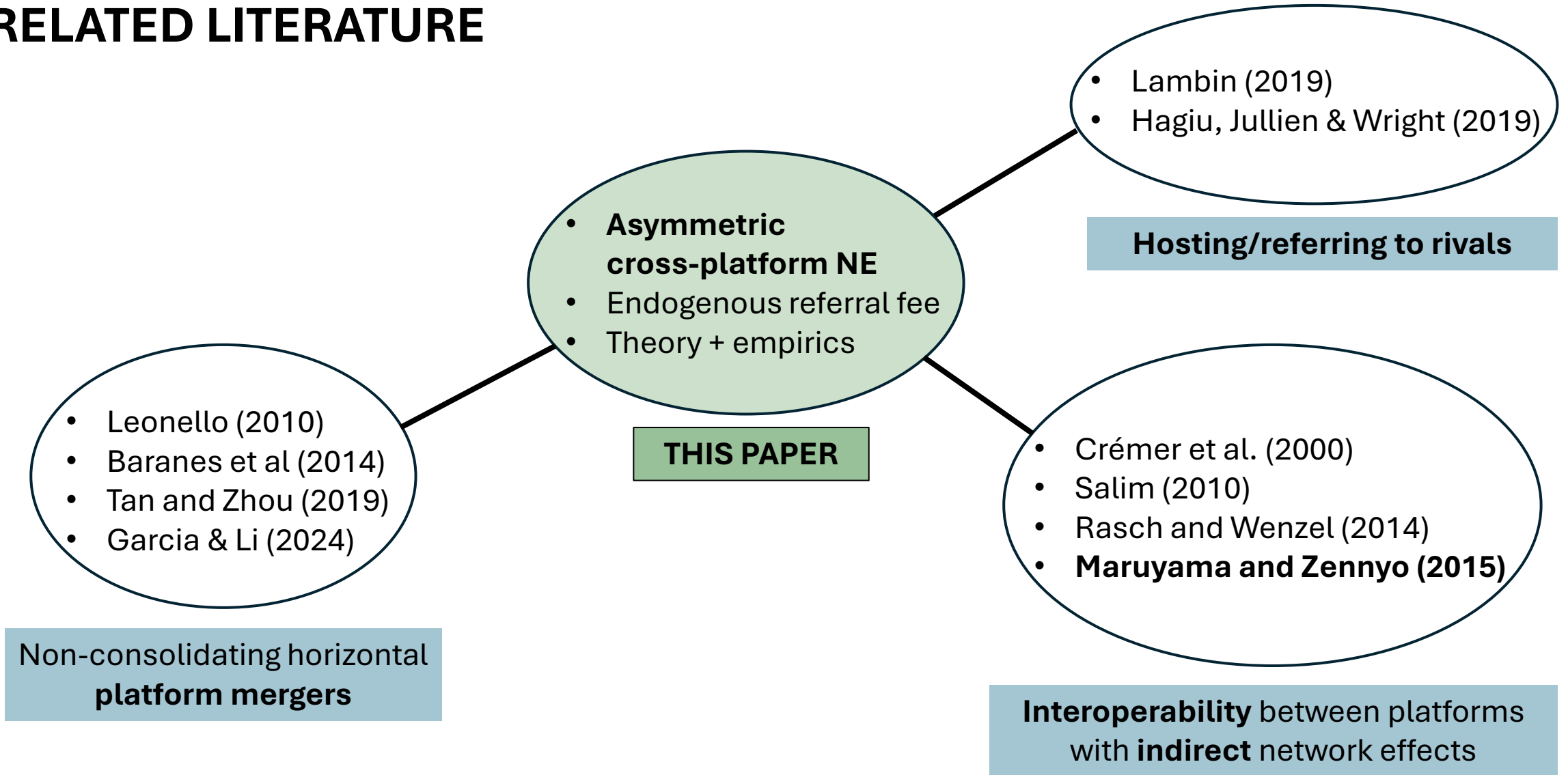


What is the effect of INE + a **merger** on **welfare**?

- Consumer surplus
- Seller surplus

RELATED LITERATURE

RELATED LITERATURE

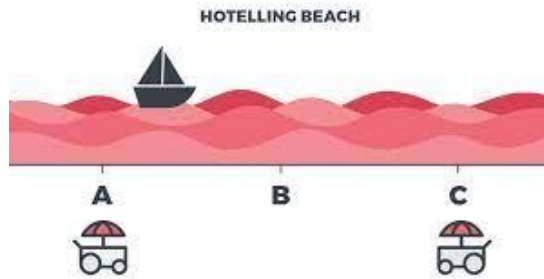


THE MODEL

THE MODEL: MAIN FEATURES



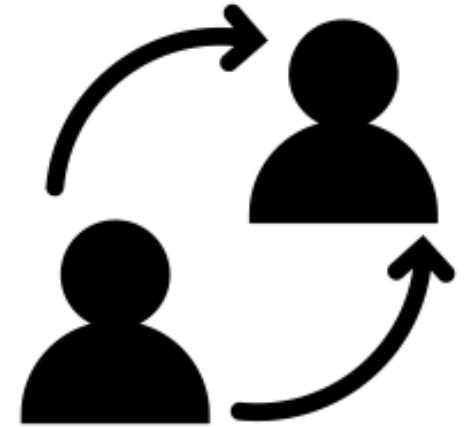
**COMPETITIVE
BOTTLENECK**



**HORIZONTAL
DIFFERENTIATION**



**PER-TRANSACTION PRICE
CHARGED TO SELLERS**



**ENDOGENEOUS
REFERRAL FEE**

Platform 0 = aggregator
 Platform 1 = source platform

THE MODEL

INTERTWINED NETWORK EFFECTS

Buyers $U_i^{bINE} := \begin{cases} v^b + \alpha^b (n_0^s(\cdot) + n_1^s(\cdot)) - \tau^b |0 - x| & \text{if } i = 0 \\ v^b + \alpha^b n_1^s(\cdot) - \tau^b |1 - x| & \text{if } i = 1 \end{cases}$

Sellers $U_i^{sINE} := \begin{cases} n_0^b(\cdot) (\alpha^s - p_0^s) - \tau^s |0 - x| & \text{if } i = 0 \\ (n_0^b(\cdot) + n_1^b(\cdot)) (\alpha^s - p_1^s) - \tau^s |1 - x| & \text{if } i = 1 \end{cases}$

Platforms $\Pi_i^{INE} := \begin{cases} n_0^b(\cdot) n_0^s(\cdot) p_0^s + n_0^b(\cdot) n_1^s(\cdot) f & \text{if } i = 0 \\ n_1^b(\cdot) n_1^s(\cdot) p_1^s + n_0^b(\cdot) n_1^s(\cdot) (p_1^s - f) & \text{if } i = 1 \end{cases}$

REFERRAL FEE

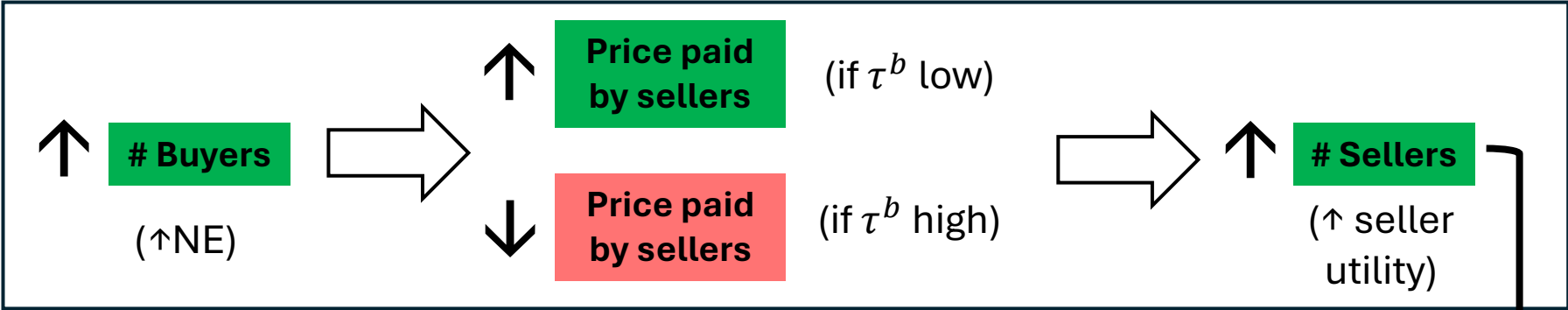
TIMING

1. Platform 0 sets the referral fee f
2. Platforms 0 and 1 simultaneously set the prices charged to sellers (p_0^s, p_1^s)
3. Consumers and sellers simultaneously choose which platform(s) to join

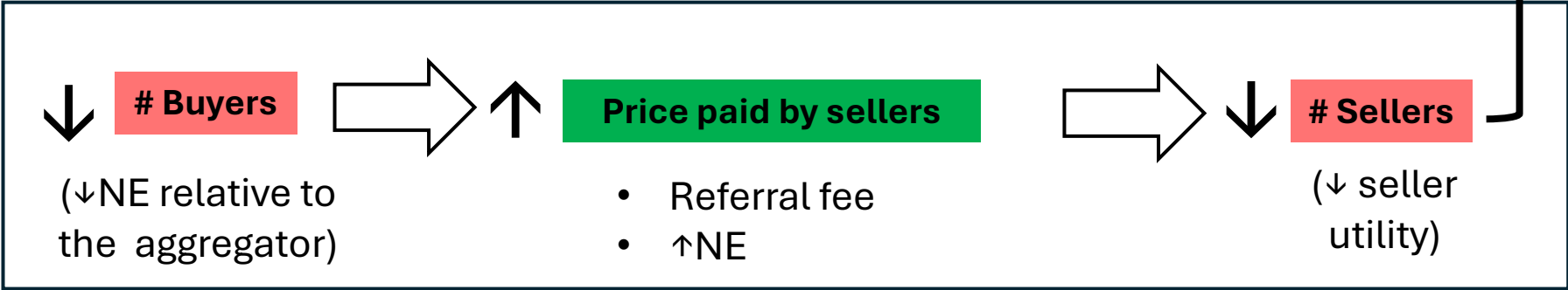
THEORETICAL RESULTS

EFFECT OF INE (VS A NO-INE BENCHMARK)

AGGREGATOR PLATFORM



SOURCE PLATFORM



(if τ^b very high
 ↑ multihoming)

 ↑ **# Sellers**

 Both platforms

 ↓ **# Sellers**

 (otherwise
 ↓ multihoming)

EFFECT OF INE (VS A NO-INE BENCHMARK)

If enough sellers switch from multi-homing to single-homing in the aggregator (more consumers; higher net utility), SS increases

AGGREGATOR PLATFORM

↑ # Buyers (↑NE)

- Consumers in the aggregator gain access to **both** platforms' sellers

↑ # Sellers (↑ seller utility)

• Consumers in the source platform lose interactions with **some** of the platform's sellers

SOURCE PLATFORM

↓ # Buyers (↓NE relative to the aggregator)

↑ Price paid by sellers

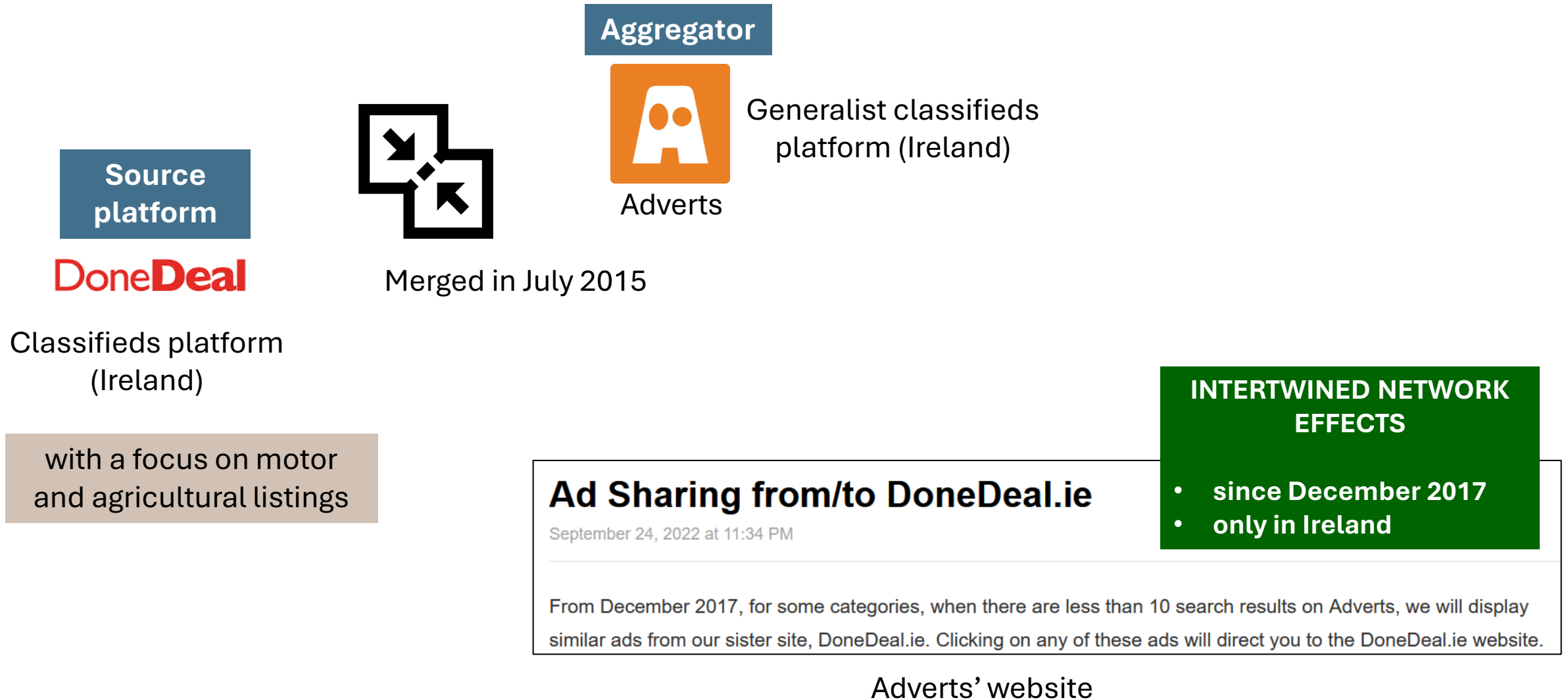
↓ # Sellers (↓ seller utility)

↑ CS

↑ SS (if τ^s low)
↓ SS (otherwise)

EMPIRICAL RESULTS

CASE 1: ADVERTS & DONEDEAL



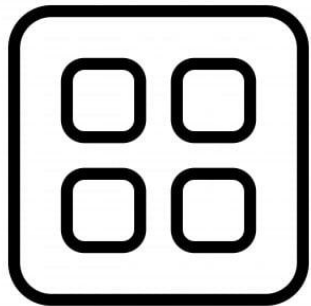
THE DATA (BUYERS + SELLERS)

AN EXTENSIVE MARGIN METRIC OF BUYER+SELLER PARTICIPATION



- Smartphones and tablets
- Android and iOS
- October 2015 to today

AN **OBSERVATION** IS A UNIQUE COMBINATION OF



APP

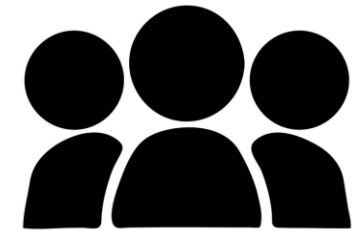


COUNTRY



WEEK

OUTCOME VARIABLE



WEEKLY ACTIVE USERS

No distinction between business (sellers) and end (buyers) users

THE DATA (SELLERS)

AN INTENSIVE MARGIN METRIC OF SELLER PARTICIPATION



stores snapshots of websites over time



Ads Jobs Motors

Buy and sell your things

Place ad

Sign up

Log In

Browse categories

Search in Ads...

All



Home > Search

I scraped the **total number of listings** (proxy of seller participation) once a week

All 688,034 listings

All Categories (688,034)

- Antiques & Collecta... (26,532)
- Art & Crafts (10,102)
- Baby & Nursery (55,056)
- Books & Magazines (22,755)
- Business & Office (4,209)
- Cars, Motorbikes &... (72,179)
- Clothes, Shoes & ... (191,979)
- Computers (19,399)

All Items

Shops

Private Sellers

Quick Sale

Sort by: Most Recent



Couch for sale

pa_Cunningham | Newcastle West, Limerick

good as new2 seater couch..Been recently recovered..it's in perfect condition and really comfortable..open to offers

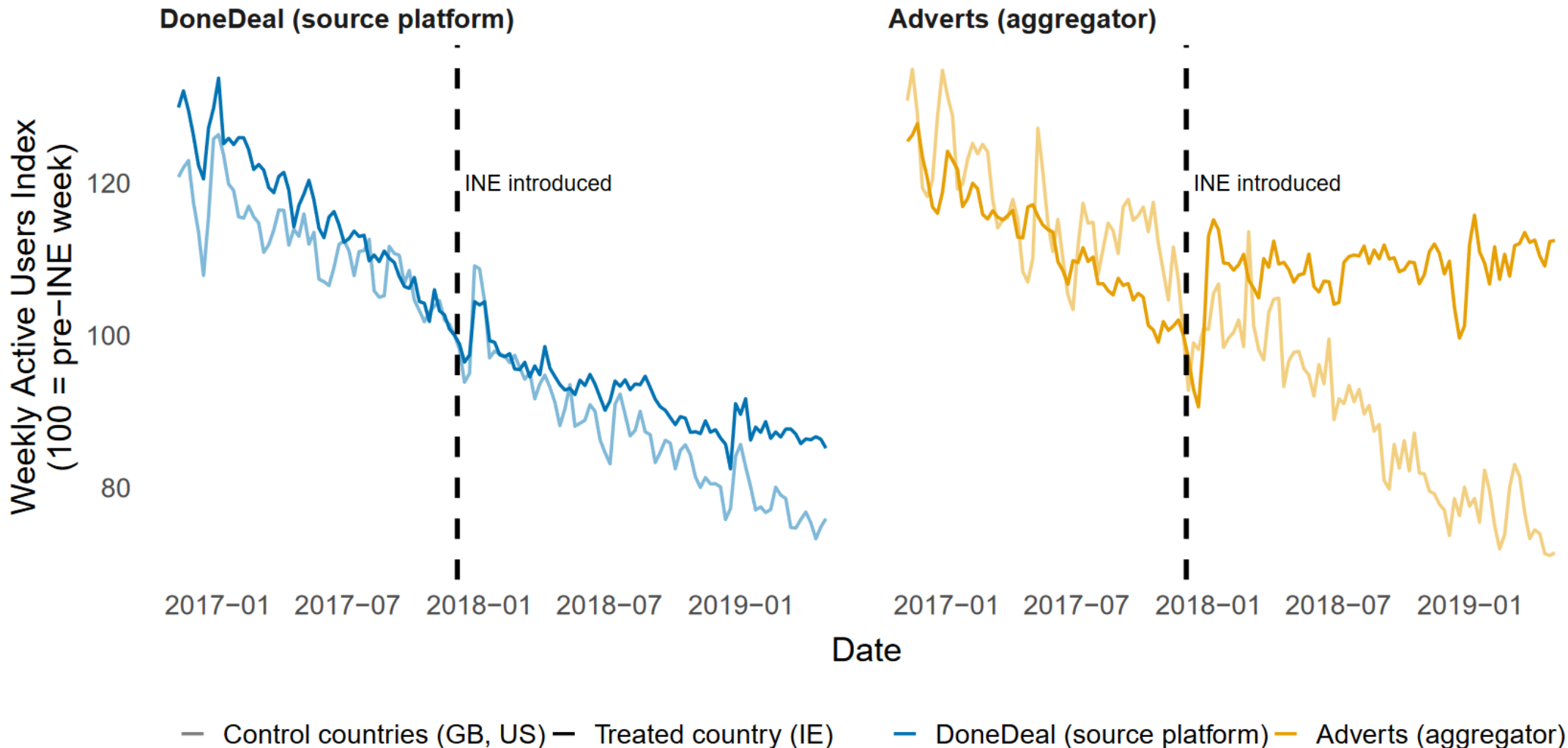
Sofas & Suites | 3 minutes ago | 13 comments

€200



BUYERS + SELLERS : DESCRIPTIVES

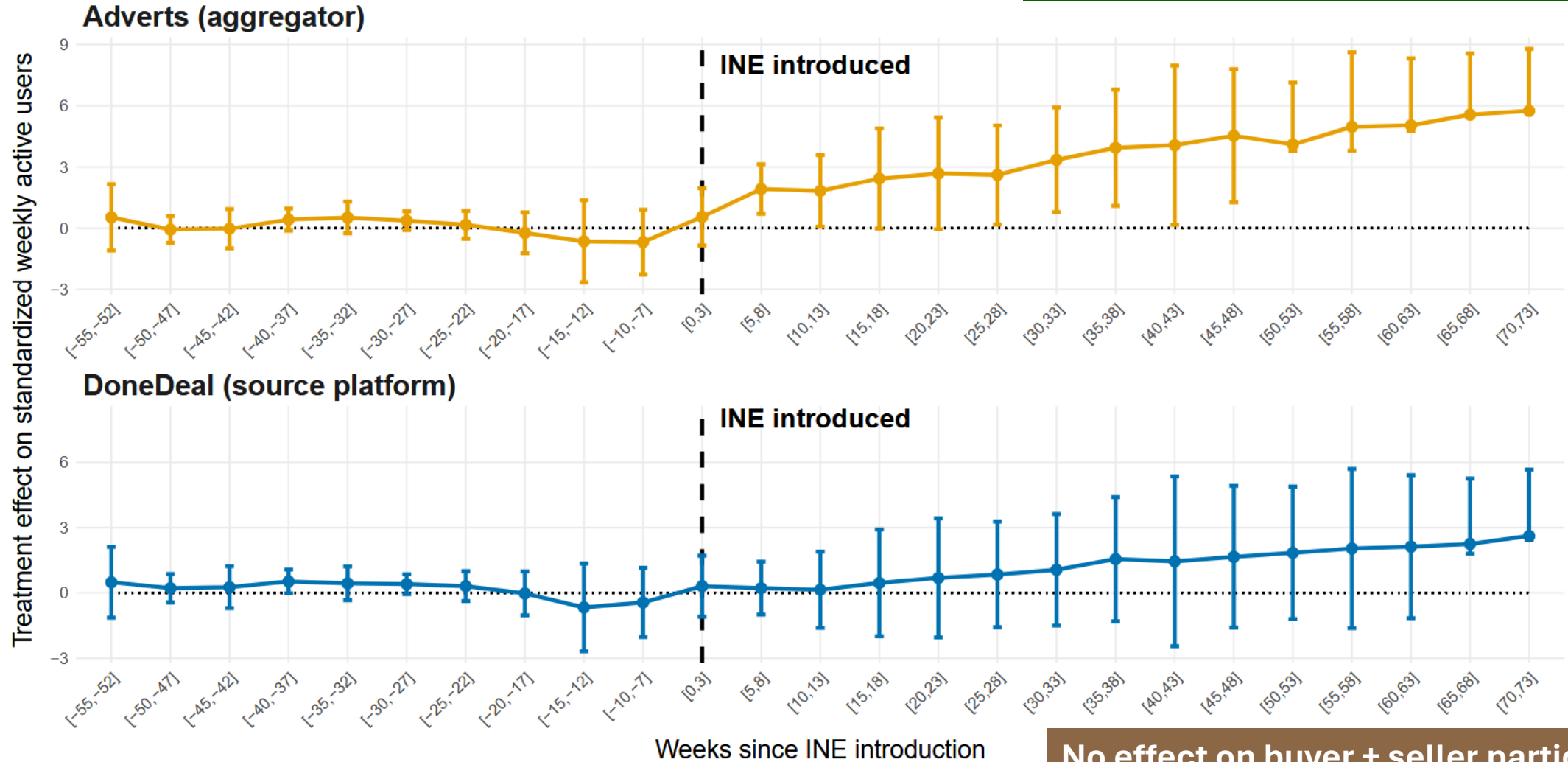
Testable prediction 1: #buyers and #sellers increase in Adverts (aggregator) post-INE



Testable prediction 2: #buyers and #sellers decrease in DoneDeal (source platform) post-INE

BUYERS + SELLERS : EVENT STUDY

Adverts' buyer + seller participation increased post-INE

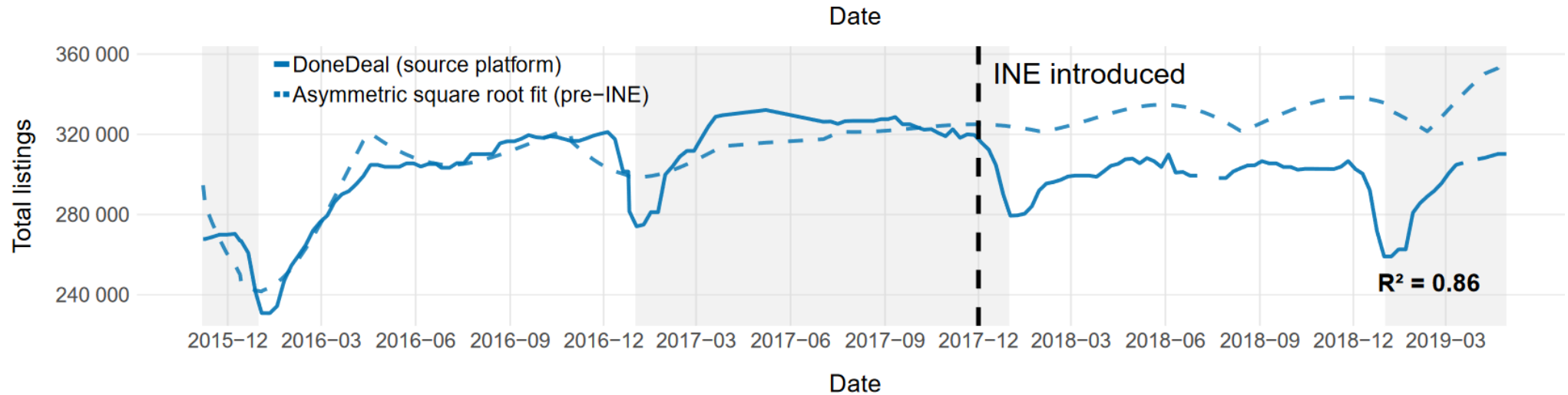
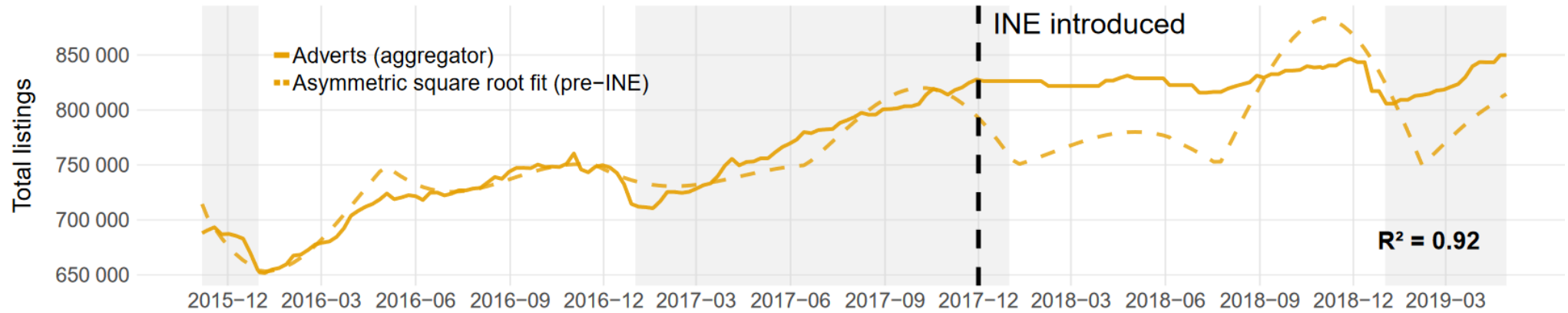


Control groups: same platform in GB and US
 Fixed effects for platform-country and week ✓

No effect on buyer + seller participation for DoneDeal (extensive margin)

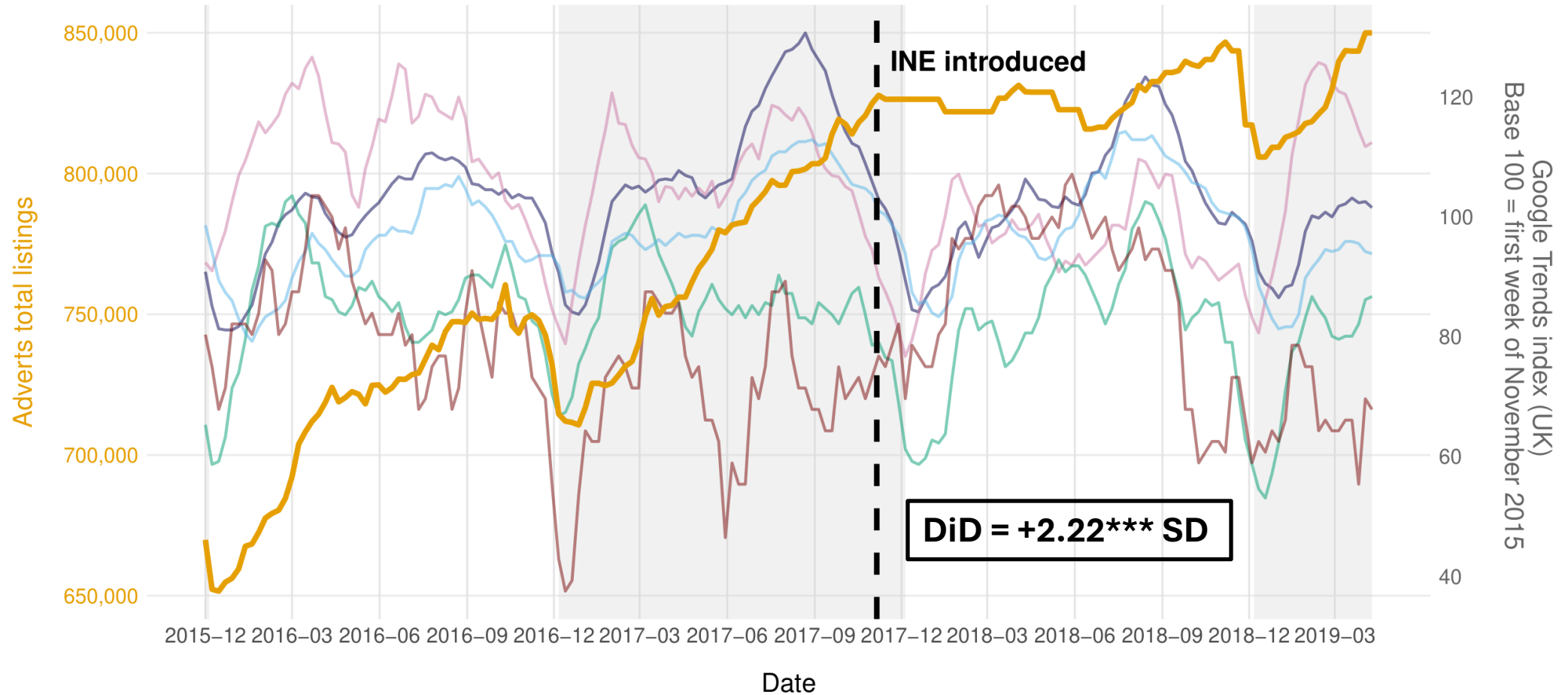
SELLERS: DESCRIPTIVES

Testable prediction 3: #sellers increases in Adverts (aggregator) and decreases in DoneDeal (source platform) post-INE



ADVERTS' SELLERS: DiD

Testable prediction 3: #sellers increases in Adverts (aggregator) and decreases in DoneDeal (source platform) post-INE



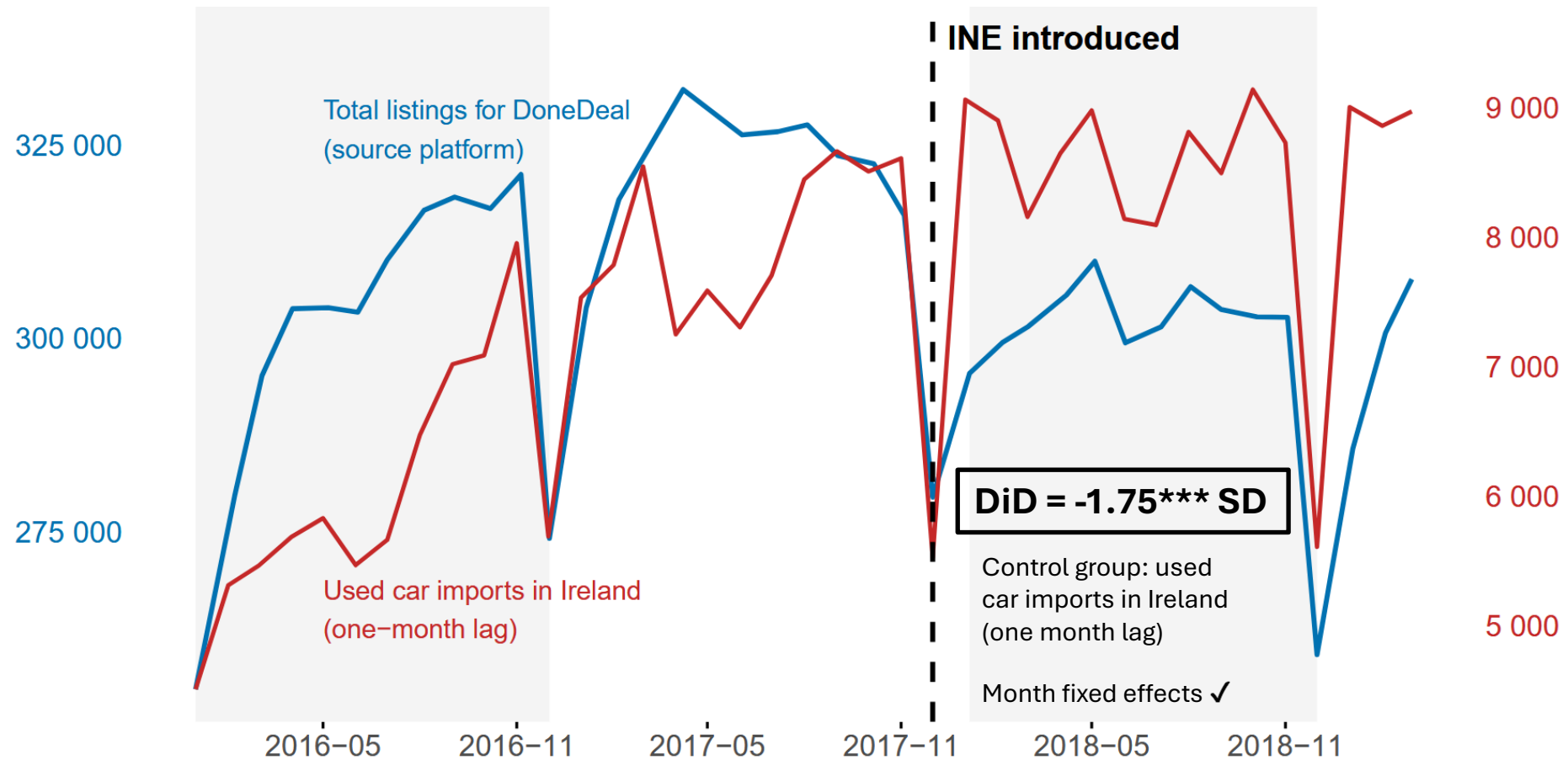
Google Trends (7-day MA, 14-day shift) — Moving home (MA) — Sell books (MA) — Sell dress (MA) — Sell stuff (MA) — Sell used car (MA)

Control groups: Google search queries to sell second-hand items in GB

Week-of-the-year and year fixed effects ✓

DONEDEAL'S SELLERS : DiD

Testable prediction 3: #sellers increases in Adverts (aggregator) and decreases in DoneDeal (source platform) post-INE

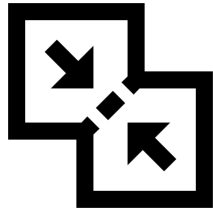


CASE 2: FINN & NETTBIL

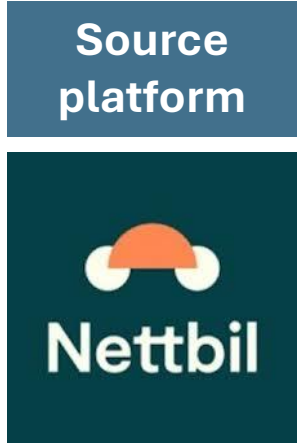
The (car) seller manages the sale directly to private buyers



Norway's main generalist classifieds platform



Merged in December 2019

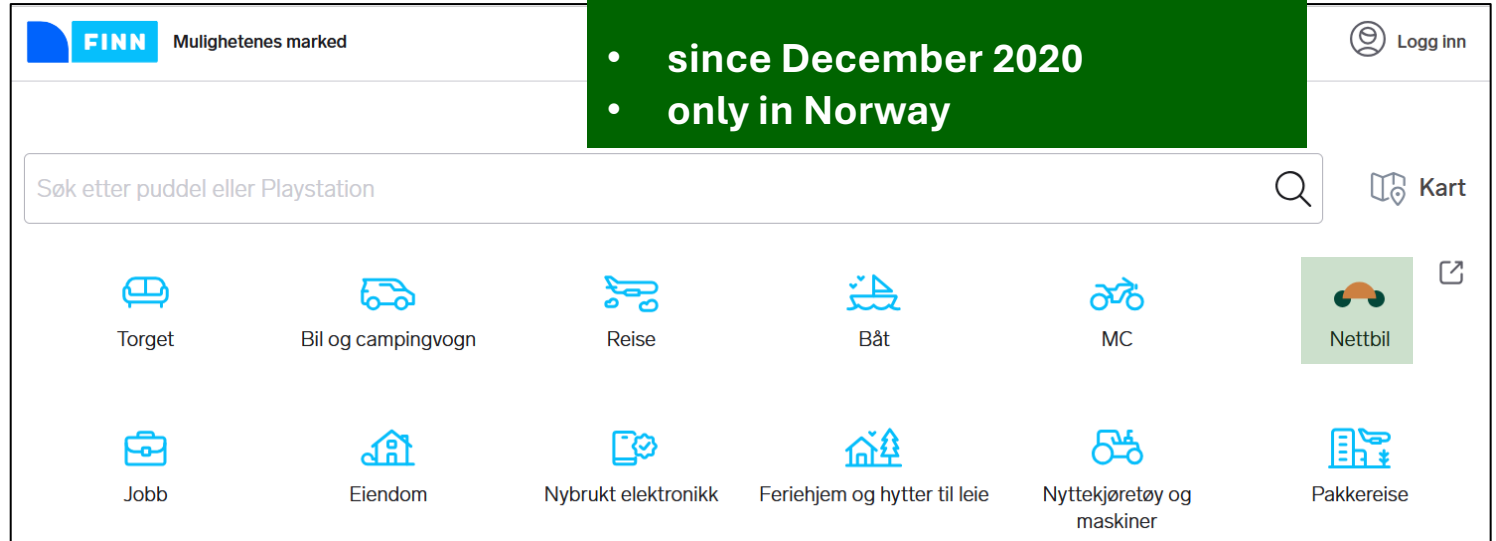


Car sales platform

Nettbil manages the sell via an auction to car dealers

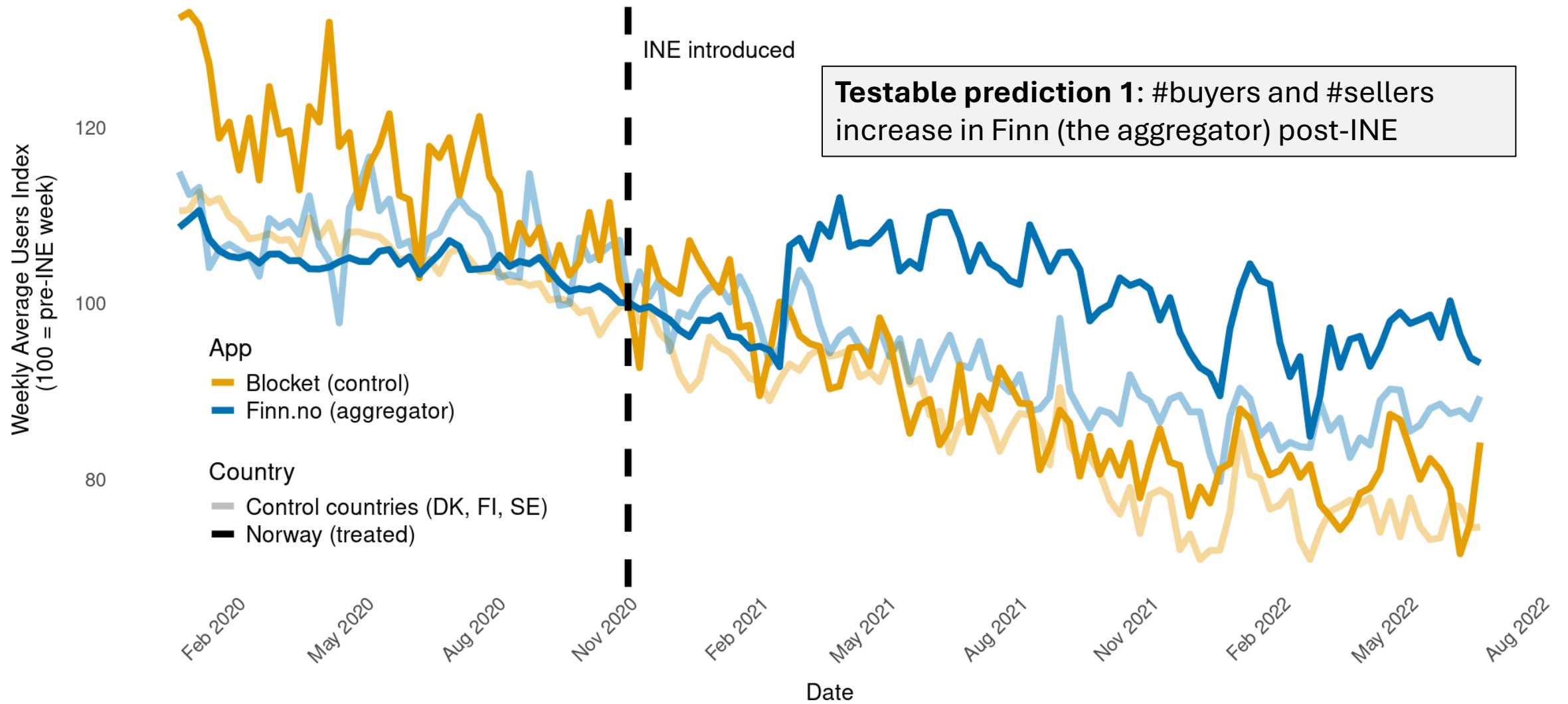
INTERTWINED NETWORK EFFECTS

- since December 2020
- only in Norway

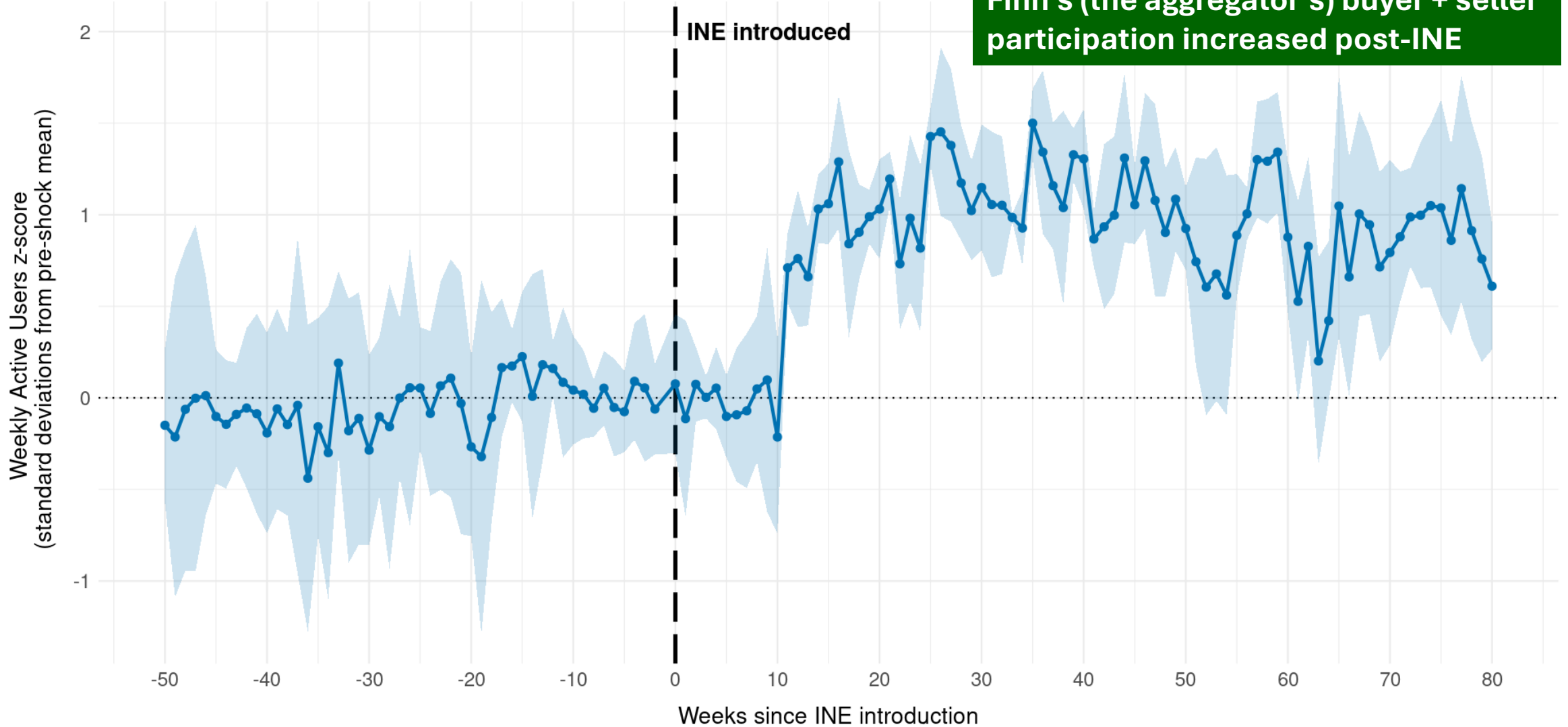


Finn's website

FINN (AGGREGATOR) & BLOCKET (CONTROL): DESCRIPTIVES



FINN'S BUYERS + SELLERS: EVENT STUDY



Control group: Blocket in NO, DK, FI and SE ; Finn in DK, FI and SE

Fixed effects for platform-country and week ✓

Control for COVID restrictions ✓

CONCLUSIONS

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Intertwined network effects create surplus

not competition softening

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Intertwined network effects create surplus

not competition softening



... but INE cannot be Pareto-improving

consumers and single-homing sellers in the
source platform are always harmed

CONCLUSIONS



... but INE cannot be Pareto-improving

consumers and single-homing sellers in the source platform are always harmed



Taking INE to policy-making



Intertwined network effects create surplus

not competition softening

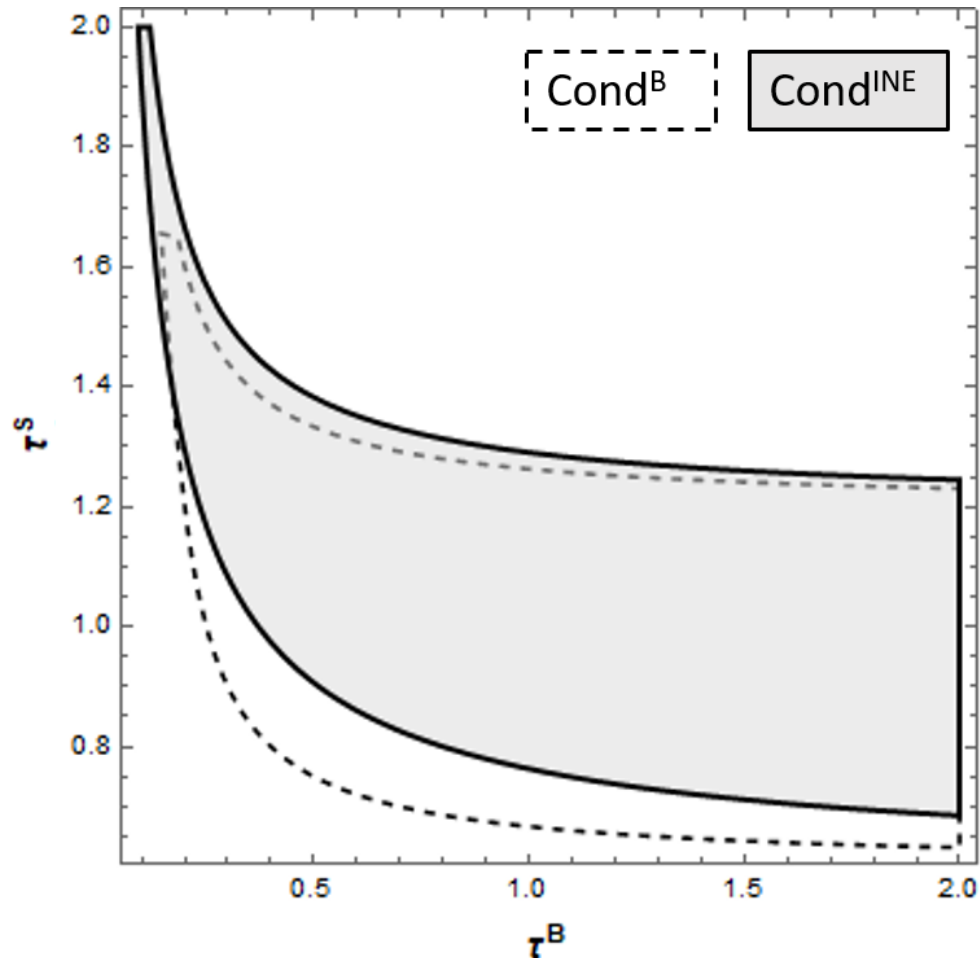
- **Asymmetric interoperability** mandates (e.g., Digital Markets Act) with indirect network effects benefit the two sides overall, but hurt consumers and sellers in the source platform (\neq symmetric interoperability)
- **INE** should be incorporated to merger review when pertinent (\neq from symmetric interoperability) and considered as **remedies**

THANK YOU!

Bruno Carballa-Smichowski

www.brunocarballa.com

INE CREATE SURPLUS AND THE PLATFORMS SPLIT IT



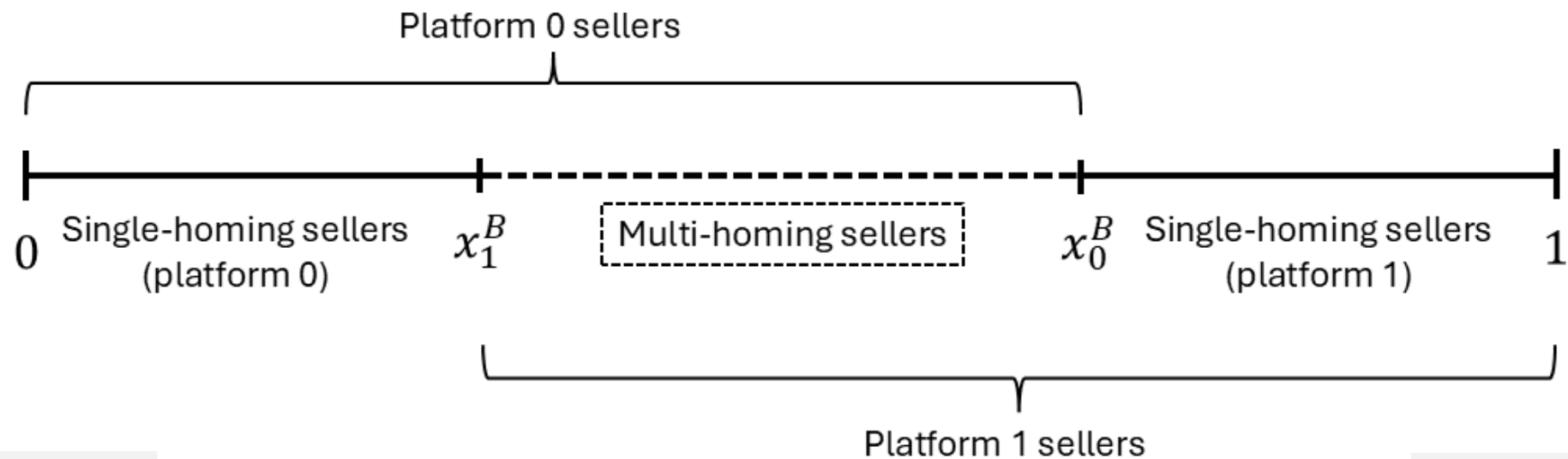
SOURCES OF INE SURPLUS

- **Higher-quality matches**
(no additional transactions)
- **More transactions**
(notably for multi-product platforms)

PLATFORMS' INCENTIVES TO SET-UP INE

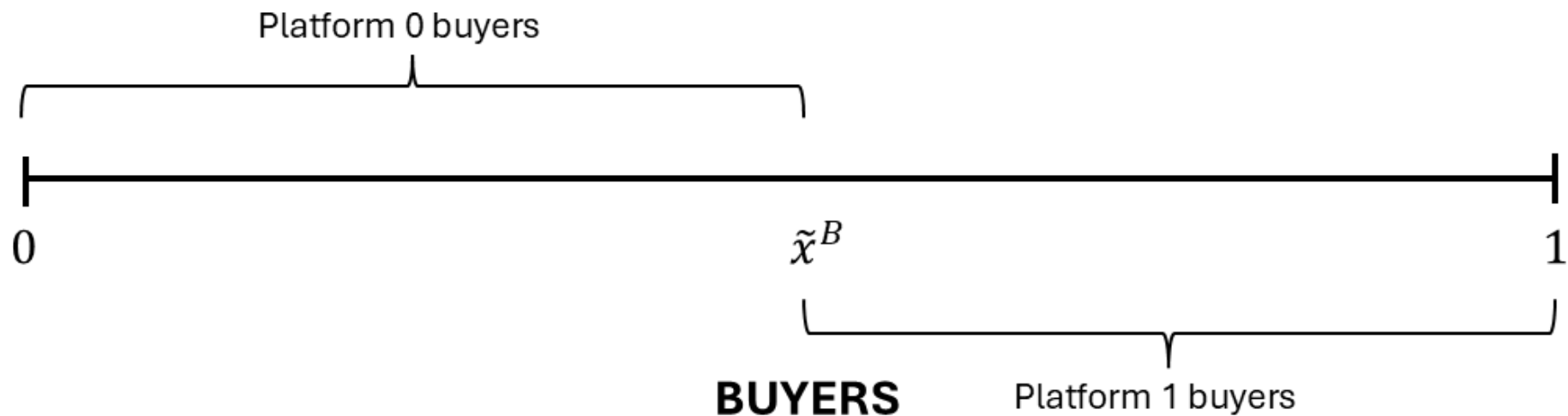
- INE are profitable unless the platforms are too homogeneous
- If profitable, both firms prefer INE to no INE (they share the surplus through the referral fee)

SELLERS



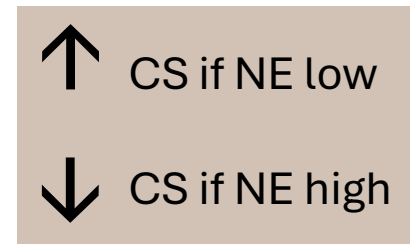
Platform 0
(aggregator)

Platform 1
(source platform)



EFFECT OF A MERGER + INE (VS INE + COMPETITION)

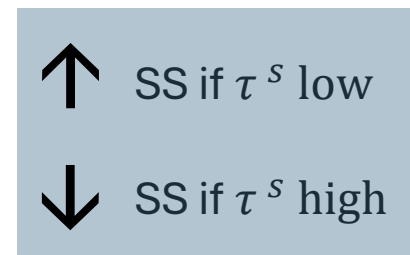
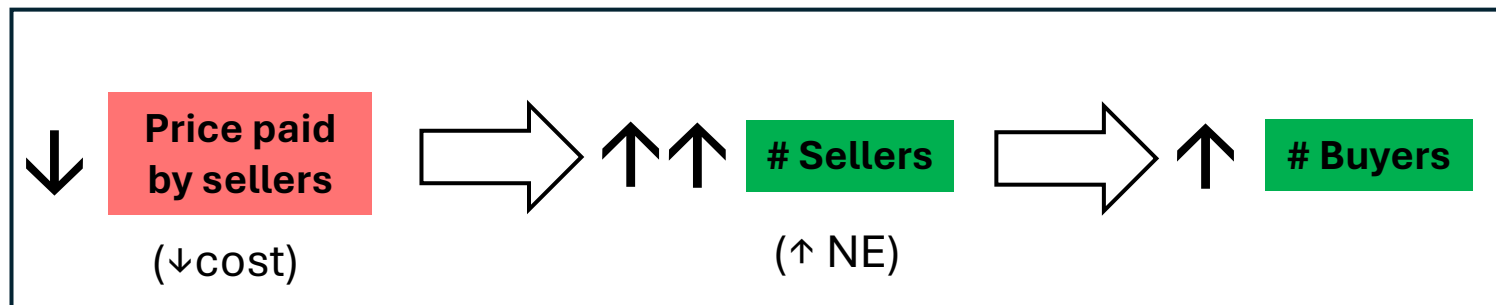
AGGREGATOR PLATFORM



No more referral fee

- More sellers overall increases interactions.
- But the more buyers/sellers go to the source platform, the less interactions overall.

SOURCE PLATFORM



RANDOMIZATION INFERENCE

Permutation-Based Null Distribution

Permutation of intervention timing (“placebo” shock dates) for Adverts/DoneDeal. I generate many hypothetical “placebo” shock timings by shifting the intervention date to different points in time within the study period. This simulates scenarios where the intervention might have happened earlier or later by chance.

Random assignment of treatment status across units (platform-country combinations) for Finn. I randomly reassign the treatment label across platform-country units to generate placebo treatment assignments. This simulates the treatment being allocated to different units by chance, respecting the clustered and panel structure of the data.

For each permutation (regardless of type), I rerun the event study model and compute the test statistics. This builds an empirical null distribution that reflects how the data might look if the intervention had occurred by chance alone. This null distribution replaces theoretical asymptotic distributions and more accurately captures the real randomness in the experiment.

I calculate the p-value by counting how many of the permuted test statistics are as extreme as or more extreme than the observed test statistic. For example, if I do 500 permutations and find that 20 of them have test statistics larger in absolute value than my observed statistic, then my p-value is $20/500 \approx 0.045$.

Confidence Intervals via Binary Search

- To find confidence intervals, I search for the smallest and largest effect sizes that remain consistent with the permutation-based null distribution.
- Using a binary search approach, I iteratively test candidate effect sizes. If the observed statistic is compatible with a candidate null effect, I proceed to test more extreme values; if not, I adjust towards less extreme values.
- This method efficiently homes in on precise confidence bounds without needing exhaustive computations over all effect sizes.