

Stores Going Online: Market Expanding or Self Cannibalizing?

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Introduction

- ▶ Research question: when the chain/brand opens an online store, what will happen to the existing offline stores?
- ▶ **Cannibalization effect (-)**: online sales channel decreases the sales of B&M store.
 - ▶ Consumers typically incur lower shopping (transportation) costs and search costs in online sales channels (Bakos, 1997; Forman et al., 2009; Huang and Bronnenberg, 2022).
 - ▶ Showrooming (Bell et al., 2018).
- ▶ **Informative (market expanding) effect (+)**: online sales channel increases B&M store sales.
 - ▶ The online sales channel carries advertisement or promotion information (Zhang, 2009; Pauwels et al., 2011; Lewis and Reiley, 2014).
 - ▶ Webrooming. Consumers obtain quality information, which may increase the expected utility of visiting the offline store (Li et al., 2019).

Literature

Multichannel (omnichannel) retailing and interaction between online and offline sales channels

- ▶ Opening online store \Rightarrow offline sales
 - ▶ supermarket (Pozzi, 2013), newspaper (Deleersnyder et al., 2002), music CD (Biyalogorsky and Naik, 2003) ...
 - ▶ In general, adding an online sales channel cannibalizes offline sales but increases the overall sales (Timoumi et al., 2022).
- ▶ Opening offline store \Rightarrow online sales
 - ▶ Mixture of substitution (cannibalization) and complementarity (informative) effects (Wang and Goldfarb, 2017; Bell et al., 2018; Avery et al., 2009)
- ▶ Heterogeneity
 - ▶ Online and offline shopping costs vary in product and consumer types (Chintagunta et al., 2012; Pauwels et al., 2011).
 - ▶ Mainstream vs. niche products (Choi and Bell, 2011; Brynjolfsson et al., 2009)

What We Do

- ▶ A unique data set matching 308 B&M stores in a large shopping mall and their corresponding online sales channels.
 - ▶ **Daily sales** and detailed information of all B&M stores.
 - ▶ **Online store opening events** and promotional events.
- ▶ We **separately identify** these two effects using offline exclusive and online exclusive demand shocks.
 1. Cannibalization effect: rain and Covid;
 2. Informative effect: online shopping festivals and live streaming;

What We Find

- ▶ Results:
 1. For **anchor stores**, both effects are larger; net effect is more negative than local stores.
 2. **Amusement and Personal care** categories are not affected much (both effects are small).
 3. **Home, Clothing, Cosmetics and Jewelry** categories lose the most (large cannibalization effect and small informative effect).
- ▶ **Discounted price difference, online store quality and consumer online shopping habits** are the main effects behind the heterogeneous effects across stores.

Contribution

- ▶ Core contribution: solid causal evidence for cannibalization and informative effects.
 - ▶ Novel identification strategy: exogenous variation of offline shopping costs.
- ▶ Many researchers have studied the interaction between online sales and offline sales, but few empirical works have separately quantified the positive and negative impacts.
- ▶ Find heterogeneous effects for stores from different categories as well as the mechanisms behind. These findings are rare in the existing literature and have important managerial implications to B&M store and shopping mall.

Data

The data consists of three parts:

1. Administrative data of a large shopping mall in Ningbo, China, including the daily revenue and the monthly rents of 308 B&M stores operating in the mall from Oct 2016 to Nov 2020.
2. Matching B&M stores to their corresponding online stores on Taobao, the largest e-commerce platform in China. Opening date, promotional events, product rating and sales.
3. A survey of all store managers (or owners) in the shopping mall on February 13, 2021. We received 205 responses.
4. Online and offline product assortment data collecting
5. Survey to identify the inspection need for different products.

Shopping Mall Figure



Data

- ▶ 80% stores belong to certain chains or franchises. For chain stores, the central management team makes the decision to open up an online sales channel, not the B&M store managers. Thus, opening online sales channel is exogenous to B&M stores.

Table: Mall Information

| | |
|-------------------------------------|------------------------------------|
| Open time | 2016 Sept |
| Shopping mall indoor area (m^2) | 100,000 |
| Number of stores (non-restaurants) | 215 |
| Number of restaurants | 93 |
| Market size | 6km |
| Ave. consumption | 100 RMB (14.5 \$) |
| Ave. daily consumer number | 42764.53 |
| Ave. daily car number | 4390.27 |
| Ave. monthly revenue | 54,951,603 RMB (8,001,572.7 \$) |

Table: Market Demographics (2019)

| | |
|-------------------------------------|---------|
| Population | 204,123 |
| Women ratio | 0.50 |
| Age (< 18) Ratio | 0.19 |
| Age (> 60) Ratio | 0.20 |
| Ave. distance to mall (km) | 7.62 |
| Ave. car travel time to mall (mins) | 15 |
| Ave. bus travel time to mall (mins) | 41 |

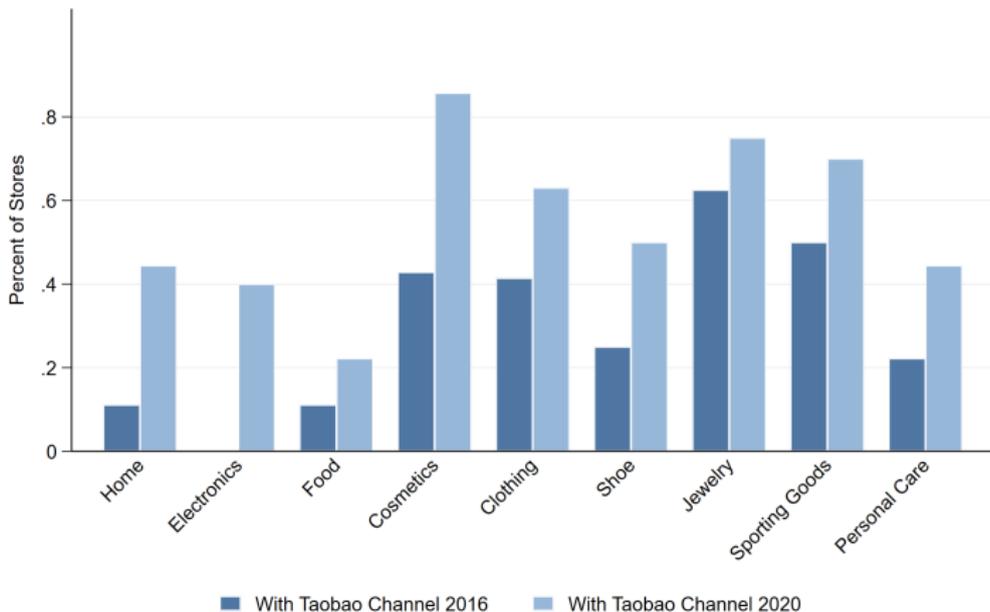
Data

Table: Store-Level Summary Statistics

| Variable name | Obs | Mean | St. Dev. | Min | Median | Max |
|-------------------------------------|-----|---------|-----------|----------|--------|----------|
| Offline Store Characteristics | | | | | | |
| <i>Ave.revenue</i> (RMB) | 215 | 6813.14 | 15226.059 | 90.30 | 3452.6 | 198787.9 |
| <i>Store.area</i> (m ²) | 205 | 242.73 | 726.985 | 8 | 110 | 9190.47 |
| <i>Open.days</i> | 215 | 910.82 | 499.643 | 6 | 895 | 1517 |
| <i>Anchor.store</i> | 215 | 0.21 | 0.408 | 0 | 0 | 1 |
| <i>Taobao</i> | 215 | 0.52 | 0.501 | 0 | 1 | 1 |
| <i>JD</i> | 215 | 0.39 | 0.488 | 0 | 0 | 1 |
| Online Store Characteristics | | | | | | |
| <i>taobao.open.year</i> | 112 | 2013.63 | 3.664 | 2006 | 2013 | 2020 |
| <i>taobao.flagship</i> | 112 | 0.85 | 0.360 | 0 | 1 | 1 |
| <i>taobao.rating</i> | 112 | 4.81 | 0.084 | 4.5 | 4.8 | 5 |
| <i>taobao.fan.num.million</i> | 112 | 2.61 | 5.856 | 5.00e-06 | .307 | 43.053 |
| Demand Estimation | | | | | | |
| <i>Ave.spending</i> (RMB) | 215 | 566.02 | 895.180 | 12 | 107 | 8000 |

Stores Going Online

Figure: B&M Stores with Taobao Channel, 2016 vs. 2020



Note: 31% stores have the Taobao online channels in 2016; 51% stores have Taobao in 2020

Cannibalization Effect

- ▶ To separate the cannibalization effect from the informative effect, we need to use some exogenous offline exclusive demand shocks.
 1. Rainy days
 2. Covid
- ▶ Prediction: B&M stores with online sales channel suffer more revenue losses compare to offline-only stores.

Cannibalization Effect: Rain

- ▶ KNN-PSM DID: for each store in the treatment group (open Taobao channel during the sample period), we chose 5 most similar stores without opening Taobao stores during the sample period as the control groups.

- ▶ Regression (1):

$$R_{jt} = \beta_0 + \beta Rain_t * Taobao_{jt} + \eta_j + \eta_t + \epsilon_{jt}.$$

- ▶ Regression (2) :

$$R_{jt} = \beta_0 + \beta Rain_t * Taobao_{jt} + \beta_1 Rain_t + \beta_2 Taobao_{jt} + \eta_j + \eta_w + \eta_{weekday} + \epsilon_{jt}.$$

Cannibalization Effect: Rain

| | Dependent Variable: Store Daily Revenue | |
|---|---|-------------------------|
| | (1) | (2) |
| <i>Rain_t * Taobao_{jt}</i> | -508.038** (257.382) | -466.392* (261.545) |
| <i>Rain_t</i> | | -339.114** (164.137) |
| <i>Taobao_{jt}</i> | | 706.588 (835.715) |
| Store FE | Yes | Yes |
| Day FE | Yes | No |
| Week FE | No | Yes |
| Weekday FE | No | Yes |
| Observations | 159011 | 159011 |
| R-Squared | 0.587 | 0.561 |
| Δ% Revenue | -5.11% | -4.69% |

Robustness Check

- ▶ Triple DID, before and after Taobao Opening
- ▶ Other short-term Online Exclusive demand shock: air pollution.
- ▶ Other DID methods: Synthetic Control DID (in progress).

Robustness Check 1: Triple DID, before and after Taobao Opening

► Triple DID: Rain Effect before and after Taobao Opening

| Dependent Variable: Store Daily Revenue | | |
|---|------------------------|-----------------------|
| | (1) | (2) |
| | After Taobao Opening | Before Taobao Opening |
| $Rain_t * Taobao_j$ | -682.025* (377.485) | -404.378 (469.203) |
| Store FE | Yes | Yes |
| Day FE | Yes | Yes |
| Observations | 51553 | 56178 |
| R-Squared | 0.587 | 0.741 |
| $\Delta\%$ Revenue | -7.31% | |

Robustness Check 2: Air Pollution

- *Bad.air*: pm10 higher than 100; 7.54 % of days have bad air.

| | Dependent Variable: Store Daily Revenue | |
|--|---|-------------------------|
| | (1) | (2) |
| <i>Bad.air_t * Taobao_{jt}</i> | -851.948*** (325.385) | -738.313* (439.487) |
| <i>Bad.air_t</i> | | -774.963** (316.208) |
| <i>Taobao_{jt}</i> | | 971.076 (2,392.035) |
| Store FE | Yes | Yes |
| Day FE | No | No |
| Week FE | Yes | Yes |
| Weekday FE | Yes | Yes |
| Observations | 162791 | 162791 |
| R-Squared | 0.560 | 0.559 |
| Δ% Revenue | -9.6% | -8.3% |

Cannibalization Effect: Covid

- ▶ Covid is the largest and longest offline demand shock in China.
- ▶ On Jan 28th 2020, the local city government announced Covid restrictions. Everybody should stay home even though there was no positive case in the city.
- ▶ We use the window 2 months before the Covid and 6 months after the Covid outbreak.

Cannibalization Effect

- ▶ Regression (1):

$$R_{jt} = \beta_0 + \beta Taobao_{jt} * Covid_{jt} + \eta_j + \eta_t + \epsilon_{jt}.$$

- ▶ Regression (2):

$$R_{jt} = \beta_0 + \beta Taobao_{jt} * Covid_{jt} + \beta_1 Covid_t + \beta_2 Taobao_{jt} + \eta_j + \eta_m + \epsilon_{jt}.$$

| | Dependent Variable: Store Daily Revenue | |
|--|---|-------------------------------|
| | (1) | (2) |
| <i>Covid_t * Taobao_{jt}</i> | -9,664.603** (4,397.348) | -9,664.061** (4,391.002) |
| <i>Covid_t</i> | | -19,440.435*** (4,180.722) |
| <i>Taobao_{jt}</i> | | -1,553.261 (3,053.443) |
| Store FE | Yes | Yes |
| Week FE | Yes | No |
| Month FE | No | Yes |
| Observations | 7511 | 7511 |
| R-Squared | 0.656 | 0.644 |
| Ave. Weekly Revenue | 32233.43 | 32233.43 |
| Δ% Revenue | -29.98% | -29.98% |

Informative Effect: Double 11 Festival

- ▶ Double 11 (Nov 11) Festival is the most well-known and influential online shopping festival in China (similar to Cyber Monday).
- ▶ We use 3 weeks before (promotion beginning) and 3 weeks after Nov 11 in 2017, 2018, and 2019 as the time window.
- ▶ B&M stores with online sales channel obtain additional revenue compared to offline-only stores.

Informative Effect: Double 11 Festivals

During Taobao Shopping Festivals

Online coupon



Cannibalization Effect

Online Ads.



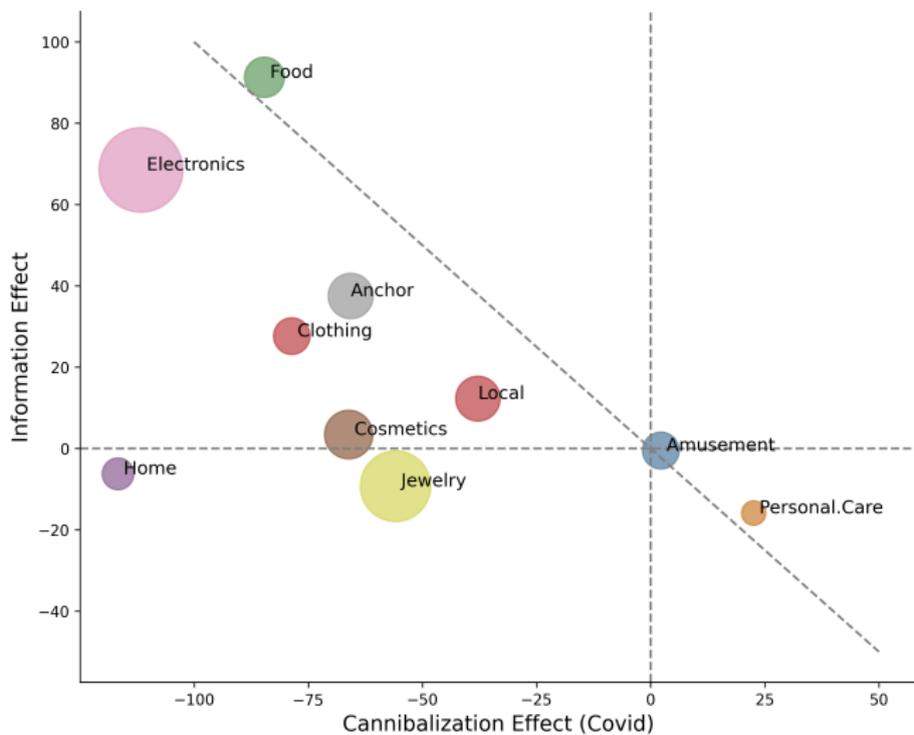
Informative Effect

Informative Effect: Double 11 Festivals

| | Dependent Variable: Store Daily Revenue | |
|--|---|-------------|
| | (1) | (2) |
| <i>Shop.Festival_t * Taobao_{jt}</i> | 1,491.569* | 1,377.289* |
| | (842.111) | (794.230) |
| <i>Shop.Festival_t</i> | | 40.434 |
| | | (472.483) |
| <i>Taobao_{jt}</i> | | -12.352 |
| | | (1,768.240) |
| Store FE | Yes | Yes |
| Weekday FE | Yes | Yes |
| Month FE | Yes | Yes |
| Observations | 78236 | 78236 |
| R-Squared | 0.591 | 0.582 |
| Ave.Daily.Revenue | 9146.618 | 9146.618 |
| $\Delta\%$ Revenue | 16.31% | 15.06% |

Robustness check: using the non-promotion stores from our survey data as the treatment group.

Heterogeneous Analysis: Categories



Possible Mechanisms

Potential stories behind category difference

- ▶ Price difference and Promotion Level Difference.
- ▶ Inventory cost and assortment difference between online and offline stores.
- ▶ The need for goods inspection before purchasing.
- ▶ Online store quality.
- ▶ Consumer composition (age).
- ▶ Others: Taobao store delivery speed (very few variation).

Offline/Online Difference Data Collecting

- ▶ We scraped all the online products of each online store in our sample (137662 products), price and specifications (colors and sizes).
- ▶ The shopping mall management team helped check the product availability (color, size, price) in the offline stores.
- ▶ We survey the online availability of the top 10 best sellers from each offline store.
- ▶ We collect the expected delivery services directly from each online store's customer service.

Measures

Variables are defined such that a larger measure means the online channel is better.

- ▶ *online.availability*: whether an offline top seller is available online. Mean: 0.25.
- ▶ *online.assortment*: online assortment number / offline assortment number. Mean: 2.26.
- ▶ *off/on.price*: offline price / online price. Mean: 1.02.
- ▶ *off/on.discount.price*: offline price after discount / online price after discount. Mean: 1.13.

Other Mechanisms

- ▶ *inspection.need*: the consumer chooses to buy offline even if the offline product is X % more expensive than the online product.
- ▶ *online.rating*: online store rating.
- ▶ *consumer.young.prop*: offline store young citizen consumer (age ≤ 55) proportion.

Ways to Figure out the Main Mechanism

- ▶ Regression significance and Adjusted R square change
- ▶ LASSO and other main factor analysis methods

Regression: Cannibalization Effect Main Mechanisms

| Dependent Variable: Cannibalization Effect | | | | | |
|--|----------------------|----------------------------|----------------------|-------------------|----------------------|
| <i>off/on.discount.price</i> | -4.560*** (0.991) | | | | |
| <i>online.rating</i> | | -2,252.096*** (643.672) | | | |
| <i>consumer.young.prop</i> | | | -49.705* (29.188) | | |
| <i>online.availability</i> | | | | 0.524 (1.216) | |
| <i>online.assortment</i> | | | | -0.086 (0.155) | |
| <i>inspection.need</i> | | | | | 360.438 (303.005) |
| Adjusted R-Squared | 0.410 | 0.090 | 0.020 | -0.013 | 0.005 |

Regression: Informative Effect Main Mechanisms

| Dependent Variable: Cannibalization Effect | | | | | |
|--|----------------------|-----------------------------|----------------------|-------------------|----------------------|
| <i>off/on.discount.price</i> | 22.636*** (5.431) | | | | |
| <i>online.rating</i> | | 5,944.385*** (1,462.435) | | | |
| <i>consumer.young.prop</i> | | | 127.464* (65.582) | | |
| <i>online.availability</i> | | | | 4.605* (2.437) | |
| <i>online.assortment</i> | | | | 0.081 (0.310) | |
| <i>inspection.need</i> | | | | | 492.137 (466.454) |
| Adjusted R-Squared | 0.361 | 0.120 | 0.029 | 0.023 | 0.001 |

Conclusion and Managerial Implications

- ▶ Conclusion
 - ▶ Separately identify the cannibalization and informative effects using rainy days, Covid, and online shopping festivals.
 - ▶ Heterogeneous analysis shows that the two effects vary a lot by anchor/local stores, categories.
 - ▶ We also find that discounted price difference, online store quality and consumer online shopping habits are the main effects behind the heterogeneous effects across stores.
- ▶ For B&M store managers and shopping mall managers:
 - ▶ New definition of “anchor stores” after stores go online.
 - ▶ New composition of categories and after store going online.
 - ▶ Implication on rental contracts.