Cross-channel competition and complementarities in US retail*

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Abstract

We estimate how the spatial assortment of offline stores near a consumer affects their online spending. Our data on US business locations and internet usage permits a comparison of this relationship across retailers and product categories that is informative about the relative sizes of business-stealing effects, cross-channel complementarities, and showrooming effects. We find that a consumer's spending at a multichannel retailer's online store falls (1.1–5.2%, on average) when a rival adds a nearby storefront but rises (12.5–57.9%) when the retailer opens its own storefront. Offline stores often boost Amazon's sales, especially in categories in which showrooming effects are likely relevant.

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1 Introduction

Contemporary retail markets feature competition between retailers that operate exclusively offline, exclusively online, and through both offline and online channels. The effects of the spatial assortment of offline stores on online shopping behaviour partly determine the merits of retailers' channel choices, the extent to which online and offline retail constitute a common market, and the role of offline stores in the digital age. The relationship between offline stores and online sales is multi-dimensional: offline stores could present heterogeneous benefits and harms to online stores across different pairs of offline and online retailers and across different types of products.

The literature on the connection between online and offline retail has hitherto focused on the relationship between offline stores and retailer sales for a particular retailer or on the aggregate relationship between offline stores and online sales. Our study expands this literature by characterizing the relationship between offline stores and online spending across different retailers and retailing categories. This relationship has several components that vary across retailers and categories. First consider the relationship between a particular retailer's offline stores and that retailer's online sales. The retailer's offline store may lower that retailer's online sales on account of *cannibalization*. This weakens the retailer's incentive to open brick-and-mortar stores. But effects that we term *cross-channel complementarities* may offset cannibalization. First, an offline store may boost consumer awareness of and tastes for the retailer. An offline store may also complement the retailer's online store by offering in-person customer service, product pick-ups, and returns.

Rival offline stores may also affect a retailer's online sales. This effect may be negative due to standard *competitive effects*, but rival offline stores may also boost a retailer's online sales on account of *showrooming effects*, i.e., benefits that a retailer derives from informative or promotional services offered by rival retailers. To illustrate, a bookstore may invest in informative services by installing product displays and allowing visitors to read unpurchased books in the store. These investments may benefit online book retailers; online retailers offering minimal informative services may freeride on an offline store's information provision, which discourages the offline retailer from offering informative services. Showrooming is differentially relevant across product categories. It is likely to be especially relevant in categories wherein multiple competing retailers sell a common set of products about which offline stores provide information. The empirical relevance of showrooming has implications for retail strategy and policy. Showrooming encourages retailers to develop exclusive product lines for which they can provide informative services that do not apply to products sold by potential freeriders. Showrooming also motivates minimum resale price maintenance, wherein a manufacturer prohibits resale of its products below a certain price and thereby encourages retailers to invest in informative services without fear of being undercut on price.

To assess the relationship between offline stores and online spending, we combine a panel of online transactions by US consumers in 2007–2008 with data on store locations. Unobservable consumer tastes may induce spurious correlations between the presence of offline stores and online spending, a concern that we call the *location-taste problem.* Bookstores, e.g., may choose to open near avid readers who like buying books both online and offline. Our approach to overcoming the location-taste problem involves controlling for a rich set of consumer and neighbourhood characteristics that proxy for unobserved tastes. These characteristics include descriptors of consumer web browsing behaviour. When these control variables imperfectly proxy for unobserved tastes, using these variables reduces but does not eliminate endogeneity bias. There is, however, a strong argument that our approach significantly abates bias. We often estimate positive relationship between rival retailers' offline stores and a given retailer's online sales when we do not include our controls. This is to be expected given the location-taste problem. When we introduce our controls, we typically estimate negative effects of rival offline stores on a multichannel retailer's online sales, indicating that we have stripped estimates of bias. For expositional simplicity, we often use causal language in discussing our estimates. Readers who do not accept the assumption that our controls solve the endogeneity problem may consider our evidence as suggestive. Whether or not the empirical relationships between offline stores and nearby consumers' online shopping that we study are causal relationships, our article is the first to document how these relationships vary across product categories and online/offline retailer pairs. We propose our characterization of these relationships as the article's primary contribution to readers irrespective of their beliefs regarding our identifying assumptions.

Our first main finding is that spending at a retailer's online store is lower in areas with more rival offline stores. We summarize the relationship between rival offline stores and a retailer's online sales using measures defined as the average percentage change in spending at the retailer's store when a rival store opens within 20km of the consumer. These measures range from 2.8% to -3.3% across categories when Amazon is included in the average and from -1.1% to -5.2% when Amazon is excluded. In general, rival offline stores less negatively affect Amazon's sales than they affect multichannel retailers' online sales. This suggests showrooming effects: Amazon sells products at prices below those of its multichannel rivals, which could reflect a cost advantage from not offering offline informative services, while freeriding on these services. Offline stores could thereby boost Amazon's sales. This effect does not apply to other multichannel retailers if they do not charge lower prices for online purchases than for in-store purchases. We find that offline bookstores are especially positively correlated with Amazon's book sales, which aligns with our expectation that the books category is prone to showrooming.

A robust finding is that a multichannel retailer has greater online sales in the vicinity of its own offline stores: an additional offline store raises sales at the multichannel retailer's online store among nearby consumers by, across categories, 12.5–57.99%. We additionally run the analysis on data from 2017–2018; our results for this time period are qualitatively similar to those for 2007–2008, but they are less precise in part because of the decreased coverage of our data in the 2017–2018 time period.[1]

[1] The results for the 2017–2018 time period are available upon request.

1.1 Related literature

We join a literature analyzing the relationship between offline retail and online sales. Earlier studies on cross-channel competition (e.g., Goolsbee 2001, Sinai and Waldfogel 2004, Forman et al. 2009, Brynjolfsson et al. 2009) document evidence for channel substitution while not distinguishing multichannel retailers from single-channel retailers.[2] More recent papers study substitution between a particular retailer's online and offline retail channels in the context of apparel and home furnishings (Avery et al. 2012, Wang and Goldfarb 2017, Shriver and Bollinger 2022), eyewear (Bell et al. 2018), and groceries (Chintagunta et al. 2012, Pozzi 2013). Our study complements those listed above by analyzing heterogeneity across retailers and product categories. To the best of our knowledge, our work is the first to empirically document heterogeneous relationships between offline stores and the sales of own and rival online stores. Our study also complements studies about the effect of online channel on offline sales (e.g., Pozzi 2013, Huang et al. 2023) or on local retail employment (e.g., Chun et al. 2023). In terms of econometric specification, our study is related to the previous studies on shopping and preference externalities in the local environment (Koster et al. 2019, Waldfogel 2008).

Our study also relates to a wider literature on the rise of e-commerce; see, e.g., Hortaçsu and Syverson 2015, Dolfen et al. 2019, Quan and Williams 2018, and Edgel et al. 2023. Another literature to which our article relates is that on showrooming (e.g., Shin [2007]). Studies on showrooming including Jing [2018], Kuksov and Liao [2018], and Mehra et al. [2018] emphasize the effect of showrooming on offline stores' profits rather than on online sales. Carlton and Chevalier [2001] find that manufacturers internalize freeriding by online retailers in their distribution and pricing strategies. More recently, Goetz et al. [2020] find that bookstore closures in Germany in the 2010s were associated with decreases in overall book sales. Our study complements Goetz et al. [2020] by comparing showrooming effects across categories. See MacKay and Smith [2014] for a discussion of minimum

[2] Prince [2007] measures the elasticity of demand for computers at online retailers with respect to the offline price and argues that the cross-price elasticity increased following the rise in multichannel operations.

resale price maintenance, which is often rationalized by appeal to showrooming, and for empirical evidence on the effects of resale price maintenance.

2 Description of data

2.1 Data sources

Our primary data sources are the Comscore Web Behavior Database and the Data Axle business locations database. Comscore provides online browsing and transactions records for a panel of US web users in 2007–2008 and 2017–2018. Because there is limited overlap in the dataset's web users across years, we define a panelist as an individual/year pair. The data feature 147,852 panelists in 2007–2008, the time period that we study.[3] Variables include panelist characteristics, descriptors of website visits, and descriptors of online transactions.[4]

We limit attention to large cross-category retailers and specialized retailing categories that are well represented in the sample. The cross-category retailers that we study are Walmart, Costco, Target, and Amazon, and the specialized categories we analyze are books, office supplies, and electronics. Within each category, we focus on a few large retailers: Barnes & Noble, Books-A-Million, Waldenbooks, and Borders for books; Staples, Office Depot, and Office Max for office supplies; and Best Buy, Circuit City, Radio Shack, and Apple for electronics.[5] We analyze other offline stores as a grouping of "other" stores within each specialized category. The online stores included in our analysis are Amazon and the online stores associated with each large offline retailer. We only include sales within the product category in question in our analysis. Table 1 describes our category-specific transactions data.

[3] We focus on 2007–2008 because—as documented by Online Appendix O.1—the panel's coverage of transactions is higher for this earlier period. Coverage may have fallen because internet usage shifted from personal computers, which Comscore tracks, to other devices. Our findings for 2017–2018 are qualitatively similar to but less precise than those for 2007–2008.

[4] See Online Appendix O.1 for a discussion of the Comscore dataset's representativeness.

[5] We chose these retailers based on a consideration of national store counts. See Online Appendix O.1 for details.

Table 1: Summary of consumer panel

Category	Store	Avg. spend (all)	Positive spending (%)	Avg. spend (pos.)
Cross-category	Amazon	18.51	14.32	129
	Costco	3.27	0.54	607
	Target	3.84	3.47	111
	Walmart	7.16	6.07	118
Bookstores	Amazon	6.90	8.28	83
	Barnes & Noble	1.08	1.83	59
	Books-a-Million	0.07	0.13	55
Electronics	Amazon	4.12	1.83	226
	apple.com	2.82	0.68	416
	Best Buy	2.75	0.88	311
	Circuit City	2.47	0.76	323
	Radioshack	0.10	0.11	95
Office supplies	Amazon	0.08	0.10	83
	Office Depot	4.36	0.57	768
	Office Max	0.39	0.11	350
	Staples	5.47	0.84	653

Note: "Avg. spend (all)" reports the mean amount spent. "Positive spending (%)" reports the share of panelists who spend a positive amount. "Avg. spend (pos.)" reports the mean amount spent among panelists who make a purchase. In the books category, we do not analyze online stores for Borders and Waldenbooks because our data include no online sales for these retailers in 2007.

We construct variables describing web browsing for use as controls. These variables provide the number of times that the panelist visits a website in each of several categories, including: adult, advert, career, dating, directory, downloads, finance, gaming, government, information, internet/wireless services, malware, media, news, portal, retail, social media, sports, travel, video, weather, and web service.[6] We control for panelist characteristics, including household size and indicators for: household income exceeding $75,000; children in the household; broadband internet access; head-of-household's race (white, black, and other); Hispanic identity; educational attainment (having graduated from college); being under 40 years old; and being between 40 and 50 years old. We additionally construct measures of the demographic profiles of the areas surrounding panelists. These measures are averages of the characteristics enumerated above among panelists within 20km of the ZIP code of the panelist in question.

[6] Online Appendix O.1 describes our procedure for categorizing websites.

Our other data source is Data Axle, whose database reports the locations of all US businesses at an annual frequency. We use these data to compute, for each panelist and retailer, the number of retailer locations within 20km of the panelist. Table 2 describes these variables.

Table 2: Description of offline retail presence variables

Category	Store	# stores (20km)		Min. distance		# stores
		Mean	Median	Mean	Median	(2007)
Cross-category	Costco	2.34	0	75.13	25.77	374
Cross-category	Target	7.48	4	33.41	7.44	1446
Cross-category	Walmart	8.33	6	8.66	5.34	3411
Books	Barnes	5.66	2	26.37	11.10	832
Books	Books-a-Million	0.51	0	474.97	134.02	178
Books	Borders	4.35	2	45.23	14.29	660
Books	Waldenbooks	1.73	1	53.92	23.64	464
Electronics	Apple	1.46	0	86.19	36.70	169
Electronics	Best Buy	4.95	2	23.75	9.59	851
Electronics	Circuit City	4.16	2	33.75	10.79	685
Electronics	Radio Shack	24.41	12	7.01	3.27	5095
Office Supplies	Office Depot	7.11	4	26.09	9.31	1262
Office Supplies	Office Max	4.73	2	29.18	12.19	982
Office Supplies	Staples	10.63	2	41.76	9.05	1486

2.2 Description of proxies for unobserved tastes

Recall that we use a proxy approach to address the endogeneity of retailer location choices. Here, we describe the control variables underlying the approach. The first set of controls are the browsing variables described in Section 2.1. Visited webpages reveal aspects of consumers' interests and personalities. To fix ideas, consider the endogeneity problem that arises when bookstores open in areas with intellectually inclined populations. Intellectual inclination is a component of unobserved tastes that may reflect itself in web browsing behaviour, e.g., through visits to informational websites. Thus, controlling for variables characterizing internet usage at least partially controls for unobserved tastes including intellectual inclination, thereby allaying the endogeneity problem. To assess the scope for internet usage variables to mitigate bias, we regress indicators for whether a panelist bought a book online on the number of offline bookstores within 20km and the internet usage variables. Table 3 provides the results. The internet usage variables predict online book spending in reasonable ways: visits to websites in the information and news categories predict online book shopping. Further, omitting browsing variables leads to a large positive shift in the estimated coefficient for the number of stores, which suggests that including internet usage variables removes upward bias from this coefficient estimate.

Table 3: Regression of online book shopping on nearby stores and internet usage

		Controls included		Controls excluded	
Variable type	Note	Estimate	t-statistic	Estimate	t-statistic
N. stores (log-transformed)		-0.18	-3.30	0.10	1.73
N. visits	Adult	-1.10	-10.98		
N. visits	Advert	-1.17	-7.72		
N. visits	Career	-1.19	-3.01		
N. visits	Finance	2.30	19.64		
N. visits	Gaming	-0.44	-7.45		
N. visits	Government	1.03	4.10		
N. visits	Info	4.86	28.33		
N. visits	Malware	-0.33	-7.82		
N. visits	Media	0.39	4.22		
N. visits	Other	0.02	4.50		
N. visits	Portal	0.21	16.97		
N. visits	Retail	3.02	48.43		
N. visits	Social Media	-0.11	-3.61		
N. visits	Video	-0.70	-6.59		
N. visits	Weather	0.14	1.92		
N. visits	Webservice	-0.50	-8.88		
N. visits	Dating	-0.20	-0.95		
N. visits	Internet Wireless	0.50	6.57		
N. visits	News	1.16	13.91		
N. visits	Sports	-0.22	-1.86		
N. visits	Travel	5.53	18.05		
N. visits	Downloads	-0.55	-4.75		
N. visits	Directory	10.14	2.46		
	R^2	0.080		0.011	

Note: The dependent variable is an indicator for whether the panelist purchased a book online. "N. stores (log-transformed)" is the number of stores within 20km transformed by $x \mapsto \log(x+1)$. "N. visits" is the number of visits to a website in the category (in hundreds). The regressions include panelist characteristics and year fixed effects.

Our second set of controls are characteristics of consumers' neighbourhoods. Neighbourhood demographics may correlate with consumers' socio-economic class and with their interests: conditional on the consumer's own income, e.g., a consumer in a high-income neighbourhood may differ from a consumer in a low-income area in terms of socioeconomic status and consequently shopping tastes. Local demographics may also influence retailers' location choices, thus giving rise to a location-taste problem.[7] We proxy for unobserved tastes that correlate with neighbourhood demographics by controlling for the average value of our demographic variables in the region within 20km of the consumer as well as the log of the population within 20km ("population density.")

3 Estimation

The estimating equation is

$$y_i = \alpha' h(n_i) + z_i' \beta + q_i' \gamma + \rho^{\text{FE}}_{R(i)} + w'_{r(i)} \phi + \varepsilon_i, \tag{1}$$

where $\rho^{\text{FE}}_{R(i)}$ is a fixed effect for census region $R(i)$ and $h(n_i)$ is a vector of counts of retailers' locations within 20km of consumer i transformed by $x \mapsto \log(x+1)$. The outcomes y_i are annual online spending at various retailers and in various categories. Next, z_i includes the panelist characteristics enumerated in Section 2 and population density. In the regressions for specialized retailing categories, we also control for log-transformed counts of Walmart, Target, and Costco stores within 20km. Additionally, q_i includes the internet usage controls, whereas $w_{r(i)}$ includes local demographics. We additionally include year fixed effects. The unobservable ε_i captures disturbances to spending that do not relate to persistent tastes — e.g., the timing of consumption needs or transient liquidity shocks. We estimate (1) by ordinary least squares after trimming observations in which the spending outcome exceeds its 98th percentile conditional on positive spending.

Sources of conditional variation in store counts. Conditional on our controls, variation in offline store counts reflects frictions in real estate markets, including the variety of

[7] Online Appendix Table O.5 provides evidence that, conditional on their own income class, consumers in higher-income areas spend significantly more at Costco's online store, moderately more at Target's, and less at Walmart's. This is consistent with Costco (Walmart) appealing to consumers of higher (lower) socioeconomic status, who are more likely to live in high-income areas. Online Appendix Table O.6 additionally establishes that counts of nearby offline stores of each cross-category retailer correlate with the local high income share (cf. Waldfogel 2008).

properties contemporaneously listed for sale to prospective residents and store-owners as well as prospective buyers' and sellers' bargaining strategies. We assume that these frictions are independent of consumer tastes for online shopping. If so, a reliance on these sources of variation does not introduce an endogeneity problem. Plausibly exogenous tastes for neighbourhoods also induce variation in proximity to stores conditional on our controls. Consider, e.g., two consumers with the same tastes for online shopping, but who desire to live in different neighbourhoods because of differences in locations of family. These factors provide variation in tastes for neighbourhoods even conditional on our controls.

Fixed effects approaches. One solution to the location-taste problem is to specify fixed effects for small geographical regions. But this approach limits our capacity to use cross-region variation and thus limits estimation precision. Also, if measurement error accounts for a large portion of time-series variation in store counts, then relying on this variation significantly biases estimates of offline stores' effects. Measurement error may explain much year-to-year variation as local store counts typically do not change much year-to-year and aggregation to the year level introduces measurement error.[8] The possibility of bias from measurement error underlies a common argument against the fixed effects approach to production function estimation (see, e.g., Ackerberg et al. 2007).

3.1 Measures of rival effects and cross-channel complementarities

To facilitate interpretation of our results, we compute scale-free measures of offline stores' effects.[9] The first measure, θ_{js}, is the percentage change in expected spending at online store s when the number of retailer j's nearby offline stores rises from its mean $\bar{n}_j$ to $\bar{n}_j + 1$, conditional on the mean values of the controls. We also define a store-specific

[8] Basker [2005] estimates the effects of Walmart entry on local prices of various consumer goods, addressing the measurement error in imputed quarterly Walmart entry by constructing an instrument based on planned entry. Such an approach is difficult to implement in our multiple-retailer setting.

[9] We refer to these quantities as "effects" rather than online-offline "relationships" for simplicity. Our terminology is justified if our regression approach yields the causal effects of offline stores on online sales. Similarly, we will often refer to the regression coefficients on store counts as "effects."

rival effect θ_s^{rival} as the average of θ_{js} across rival multichannel retailers j, weighting each j by that retailer's total number of storefronts. Taking a further average of θ_s^{rival} across online retailers s within each category (weighting retailers by their total online sales) yields the category-specific average rival effect $\bar{\theta}^{\text{rival}}$. Section 4 reports estimates of the average rival effect when Amazon's store-specific rival effect is included in and excluded from the average. Last, we define an average own effect as the average of θ_{ss} across multichannel retailers s, weighting each retailer by its total online sales. Online Appendix O.3 provides further details of these measures.

4 Results

This section presents results. Table 4 summarizes results for regressions with overall (rather than store-specific) spending as outcomes, whereas Table 5 reports measures of average rival and own effects as described by Section 3.1.

Table 4: Overall spending regressions

	Cross-category retailers (1)	Bookstores (2)	Electronics (3)	Office supplies (4)
N. Stores: Total	−10.493	0.914	2.792	1.603
	(2.820)	(0.205)	(1.228)	(0.835)
Mean dep. var.	187.35	9.14	47.37	12.91
Observations	145,345	146,506	146,404	146,765

Note: This table presents estimated coefficients from regressions of the overall spending on offline store counts. The "Mean dep. var" row presents the averages of the dependent variable (expenditures in dollars). Heteroskedasticity-robust standard errors in parentheses.

Cross-category retailers. We first study large cross-category retailers. Column (1) of Table 4 provides the result for regressions of overall spending on the total number of stores operated by all retailers. Offline stores are negatively associated with online spending, suggesting substitutability between the online and offline channels.

This aggregate estimate, however, conceals heterogeneity across retailers. Table O.8a in Online Appendix O.4 displays estimates for regressions of retailer-specific spending on

Table 5: Category-level rival and own effects on expenditures

	Cross-category retailers (1)	Bookstores (2)	Electronics (3)	Office supplies (4)
Rival	-0.052	-0.049	-0.011	-0.027
	(0.017)	(0.019)	(0.013)	(0.024)
Rival	-0.033	0.028	-0.000	-0.026
(incl. amazon)	(0.009)	(0.008)	(0.010)	(0.024)
Own	0.320	0.579	0.125	0.429
	(0.036)	(0.090)	(0.096)	(0.048)

Note: Each column presents the category-level average rival effects and own effects. "Rival (incl. amazon)" shows average rival effects including Amazon.

retailer-specific store counts. The estimated relationship between multichannel retailers' offline store counts and their own online sales are positive and statistically significant across stores. Conversely, the estimated relationship between rival offline stores and a retailer's own online sales is often negative (or positive but statistically insignificant, except the marginally significant positive coefficient on Costco store counts in Amazon's regression). We interpret the negative rival effects as evidence that competitive effects generally outstrip showrooming effects for cross-category retailers. Next, Table O.8b in Online Appendix O.4 presents estimates of scale-free measures of rival and own effects for cross-category retailers. For all retailers, the rival measure is negative and the own measure is positive. Additionally, the rival and own measure are heterogeneous across retailers. One notable finding is that, within each category, the effects of rival offline stores on Amazon's sales are weaker than the effects of such stores on multichannel retailers' online sales. Indeed, Amazon's sales fall by 1.8% lower in response an additional offline rival store whereas Walmart's online sales fall by 3.3% in response to an additional offline rival store. The rival measures are even greater in magnitude for the other multichannel retailers.

The store-level results mentioned above and documented in Online Appendix O.4 yield the main estimates in Column (1) of Table 5: the category-level own effect is positive and the rival effect is negative for multichannel cross-category retailers, and the negative rival effect is mitigated when Amazon is included.

Books. Column (2) of Table 4 presents the result from regressions of overall books spending on the total number of bookstores. The estimated coefficients are positive. Showrooming effects provide one interpretation. Next, Table O.9 in Online Appendix O.4 reports the results of store-level regressions and associated rival and own effects. The results are similar to those for cross-category retailers in suggesting that a multichannel retailer's own offline stores raise its online sales. It is less clear, though, that a retailer's online sales suffer from rival offline stores given that we estimate a positive rival effect for Amazon. This suggests that offline bookstore experiences lead consumers to purchase books online due to showrooming effects. Consequently, bookstores' rival measure is negative (-4.9%) when Amazon is excluded but it is positive (2.8%) when it is included, as shown in Column (2) of Table 5. The own-sales measure is positive and large (57.9%).

Electronics. The overall spending result for electronics appears in Column (3) in Table 4, and the rival and own measures for electronics appear in Column (3) of Table 5 (see Online Appendix O.4 for store-level results). Overall spending again positively relates to the total number of offline stores. The rival and own effects for electronics have the same sign as those for bookstores, although the estimates are imprecise.

Office supplies. Column (4) in Table 4 present results for regressions of overall office supplies spending on the overall counts of office supplies stores. The estimated overall coefficient is positive and marginally statistically significant. We also find strong own-store measures and often negative rival measures at the store level, for multichannel retailers (see Online Appendix O.4). The estimates for Amazon are less precise. These estimates translate to negative associations between rival stores and multichannel retailers' own sales together with relatively strong positive associations between a multichannel retailer's own stores and its online sales; see Table 5.

Robustness checks. In Online Appendix O.5, we present four sets of robustness checks for the main results. Specifically, we show that the qualitative results reported in Tables 4 and 5 remain largely unchanged if we change functional forms (from linear to Poisson), dependent variables (from expenditure levels to positive-spending indicator), the definition of local markets (from 20km distance bands to 50km distance bands), and region fixed effects (from census regions to states).

5 Discussion

Sources of cross-channel complementarities. A robust pattern in the results is that a multichannel retailer's offline stores tend to boost its own online sales and reduce rivals' online sales. The former result reflects cross-channel complementarities that stem from several sources. We identify these sources in part based on archived versions of retailers' websites from 2007. The first such source is the option to return items purchased online in-store. All archived websites that we checked—including those for Walmart, Target, Costco, Barnes & Noble, Staples, Office Max, Best Buy, and Circuit City—indicate the acceptance of in-store returns for online purchases. This service makes online ordering more appealing to consumers near offline stores.

Another source of cross-channel complementarities is "buy online, pickup in-store" (BOPIS). Retailers often allow consumers to purchase items online for pickup at an offline store or offer to ship items not carried by an offline store to a store for pickup without charging shipping fees. In March 2007, for instance, Walmart launched its "Site to Store" program—which allows consumers to ship items listed online to offline stores for pickup without paying fees. Loyalty programs applying to both online and offline purchases (e.g., Target's "Red Card" program or the "Staples Rewards" program) also give rise to cross-channel complementarities: consumers may join the programs due to offline store locations, and then shop more from the associated retailers online upon becoming members.

Some retailers limit their online services to consumers living near offline stores. Staples, for example, restricted furniture deliveries placed online to consumers living within 20 miles of an offline Staples location in 2007. Other sources of cross-channel complementarities include offline stores' function as advertisements for their associated retailers and in providing consumers with information about the fit-and-feel characteristics of retailers' exclusive products.

Differences in showrooming across categories. Evidence of showrooming effects is strongest for books, followed by electronics. This finding aligns with the fact that both categories include products sold by multiple retailers that consumers may learn about by visiting offline stores. Also, the extent of product variety can explain why categories with higher shares of e-commerce are expected to be those which enjoy the larger effect of offline stores on online sales. In a category with many products, offline stores may help consumers discover new varieties and thus bolster consumer interest in the category.

Amazon and showrooming. A conspicuous pattern in Table 5 is that excluding Amazon leads to stronger average rival effects. We explain this pattern by appealing to showrooming effects — Amazon charges lower prices than multichannel retailers while freeriding on its multichannel competitors' informative services to achieve higher sales among consumers living nearby these competitors' offline stores. Table O.7 in Appendix O.2 documents price differences between books and electronics stores. For books, the table provides the sales-weighted average ratio of a book's price at Amazon to its price at various multichannel retailers across several best-selling books. The table also provides the same average ratio for electronics products including three versions of the PlayStation 3—the 40, 60, and 80 gigabyte versions—and two models of Apple iPods, the iPod Nano and the iPod Shuffle.[10] Table O.7 shows that Amazon generally offers lower prices than its competitors for PS3s, iPods, and especially for books. Indeed, Barnes & Noble—Amazon's main competitor—offers a price for best-selling books that is on average 23%

[10] We consider these electronic devices because they are frequently purchased in the data, which allows us to reliably infer their prices.

higher than Amazon's. Amazon's lower prices mean that consumers who learn about a product at offline stores can generally save by purchasing the product on Amazon, which implies that a more offline stores around a consumer may especially benefit Amazon. The fact that rival effects (including Amazon) are most positive in the books category, which we argue is especially prone to showrooming effects, further suggests the empirical relevance of showrooming.

Explaining Amazon. Amazon has become the predominant online retailer despite operating almost entirely online and forgoing the benefit of cross-channel complementarities. This raises the questions about the merits of multichannel retailing. But Amazon has benefitted from cost-side economies of scale and scope that have permitted its success despite not realizing cross-channel complementarities; see, e.g., Houde et al. 2022. In addition, Amazon's expansion into brick-and-mortar retail through its acquisition of Whole Foods and its introduction of offline stores (under brands Amazon Go, Fresh, and Style) suggests that it perceives gains from cross-channel complementarities. Bell et al. 2018 notes that eyewear retailer Warby Parker similarly expanded from a primarily online model to a multichannel model and consequently benefitted from cross-channel complementarities.

6 Conclusion

In this article, we estimated relationships between offline stores and online shopping that vary across retailers and retailing categories. The estimated relationships are conditional on a rich set of consumer and local characteristics. Our findings suggest that cross-channel complementarities are more empirically relevant than cannibalization: a retailer's own offline stores are associated with increases in its online sales. The offline stores of a multichannel retailer's rivals are generally associated with reductions in this retailer's online sales, although Amazon boasts greater sales where its multichannel rivals operate more offline stores. This latter finding could be explained by showrooming effects that particularly benefit Amazon due to the fact that it generally charges lower prices than do multichannel retailers.

Although we focus on the effects of offline stores on online sales, the online retail environment also affects offline sales. We leave the study of such effects to future work.

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