Bricks or Clicks?
The Efficiency of Alternative Retail Channels

by

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Abstract

We examine the 10k reports for 122 of the largest US "retail" firms, and analyze the impacts on their operating costs and factor usage of what venues they use to sell their goods: traditional stores that they operate, internet sales, and wholesaling to other stores. We find that the firm profit rates (EBITA) are largely unaffected by the share of sales done through these three venues. However, the use of labor and space (real estate) significantly decreases as the Internet venue share increases. On the other hand a residual category of "costs", which we attribute to shipping, increases sufficiently with the internet venue share to offset the advantage from greater labor and space productivity. In the end, firms using the internet venue appear able to deliver goods to consumer doorsteps for roughly the same cost that firms using traditional stores deliver goods to their shelves. However, consumers must incur an additional 22% of their average purchase price collecting goods from shelves. With this more comprehensive accounting the internet venue is seen to be more efficient.

I. Introduction

There is widespread recognition that the retail sector is undergoing a significant transformation [Hortascu and Syverson, 2015]. Rather than have stores act as the intermediary between consumers and producers, Web-based platforms together with efficient destination-based delivery services are providing a viable and thriving alternative. The latter model has been hailed as giving consumers far greater shopping choice and also creating more transparent and competitive prices. In this paper we examine an additional possible advantage of "etailing" over "retailing" – that of operational efficiency. We study the annual financial (10k) reports of 122 firms that represent this full range of alternatives between pure-play internet delivery (Amazon, Land's End, 1-800Flowers), to traditional pure Brick and Mortar stores (Dollar Stores, Auto Zone) to mixed formats that use both models (Best Buy, J. Crew). We obtain the Gross Profit of each enterprise (Sales Revenue minus Cost-of-Goods) as well as factor inputs (employment, store and distribution space). The question posed is how the various components of a firm's operating expenses are impacted by the share of its sales that are derived through stores, as opposed to the internet. If internet based "e-tailing" can operate more efficiently, then in addition to providing a broader range of goods, sooner or later it will also provide those goods at lower prices. In this case the winner in the war between bricks and click will be obvious [Bedetti, 2017].

Studies suggest that the "path of goods" generally involves three stages following the actual creation or production of goods. The first is purchase and shipment (often through a distributor). This constitutes the retailer's "Cost of Goods." Second, once the retailer takes possession, goods move through is its own internal distribution-display system to get either onto store shelves or to the web page of a final "fulfilment center." Third, the "last mile" involves either a trip to the store by consumers or a delivery to the consumer by truck. The value added of these three stages has been estimated to be 20% of GDP for developed countries [Bronnenberg and Ellickson, 2105]. In this study we focus on mainly on the middle stage – how the cost structure of retailing evolves as a larger share of goods are purchased on the internet and delivered to consumers. But delivery to consumers is not the same as delivery to store shelves so we also provide estimates of how final last mile costs evolve as well.

II.10K Information: Revenue, Sales channels, Factor usage

The information contained in annual 10K reports includes income and expense data as well as balance sheet items. Originally, this study started with the reports of the largest 223 US retailers (based on Sales). Many of these had international operations, and while all reported US and Foreign sales, expenses were not always divided accordingly. The sample was reduced to 122 firms wherein there was complete data on US sales (by channel) as well as various expenses and profit, In the 2017 data, virtually all "retail" firms (based on NAICS code) also identified total sales or revenue by one of 2 channels: stores sales and sales done on the internet. The sum of these, however, is sometimes less than separately reported total sales creating a question of what

constitutes the residual. Contacts with several companies revealed that this residual is most often a form of business to business (B-to-B) sales as opposed to the business to consumer (B-to-C) sales that occur in the other two channels. Some clothing retail companies (e.g. Ralph Lauren) not only have store sales under its own name, and an active web-based sales operation, but also sell their goods to other retailers (e.g. Macy's), who then record the ultimate sale to consumers. In this respect some "retailers" effectively "wholesale" some of their goods to other retailers.

In Table 1, we can see that this "wholesale" sales channel average about 7% of sales revenue across the 122 reported firms, ranging from zero to as high as 49%. The share of sales done over the internet has a simple average of 14% while sales done through stores are 79%. Both of the latter categories range across the firms from zero to a complete 100%.

Table 1: 2017 10K Accounting Entries (US operations only)

Item	Mean	S.Deviation	Min.	Max	N
Gross Margin	.374	.115	.120	.685	122
Sales/worker(M)	.209	.137	.055	.976	122
Sales/sqft(M)	.398	.310	.088	1.593	122
EBITA/sales	.050	.083	-.228	.424	122
Dn. space %	.244	.219	.000	1.000	122
Ecommerce %	.144	.210	.000	1.000	122
B-to-B %	.069	.117	.000	.494	122

III. 10K Retailer expenses: Cost-of-Goods, labor, space and other expenses

Within the sample of 122 firms, Cost-of-Goods (COG) was accounted for, which in comparison with total sales was most often reported as "gross margin". Gross margins tend to be highest for low volume luxury items, and lowest for high volume discount goods. Further reported are figures for total numbers of employees (full and part time) as well as total store space and distribution space (whether rented or owned). Hence, calculating total sales/worker and total sales per sqft (store plus distribution) was straightforward. Worker and space productivity measures exhibited wide variation across the sample firms (Table 1). As expected, there was also wide variation in the share of space that a firm occupied in stores as opposed to distribution facilities. Finally, reported EBITA profit was also available for the 122 firms. Sample statistics are again shown in Table 1. In Table 1, any data originally reported as a raw number, such as EBITA has been converted to a percentage of revenue.

In expression (1) below, we create a simple accounting identity for the data in 10k reports. It divides up sales revenue into cost of goods, labor expenses, space expenses, other operating expenses and of course residual profit or EBITA. Typically, 10K reports provide revenue, cost of goods, total employees, space (stores and warehouses separately), and EBITA. To calculate any estimate of other expenses as a residual (e.g. shipping, advertising, etc.) we need to convert employment and space usage into dollar factor costs. Only a small set of just 36 firms reported actual total labor compensation. Dividing this by total employees yielded an average yearly wage per worker of $18,185. This low number undoubtedly reflects the inclusion of part time workers

in total employment. None of the firms reported any actual expense for renting and owning the square feet listed under space. Here we relied on national Commercial Brokerage estimates of $10 sqft/year for distribution space and $20 sqft/year for store space, inclusive of both rent and fit-out costs. Note that this economics approach to accounting applies a common annual "shadow" rental rate to space that is both owned by the firm as well as rented. With these estimates we were always left with some residual operating expenses. On average this was a share of revenue comparable to either estimated space or labor costs. In effect, we estimated labor and space expenses with reliable data on factor usage, but a common average set of unit factor prices. We then divided all items by sales to get an identity which separates each dollar of sales into 5 components: (1) Cost of Goods (COG), which is the equivalent of 1-gross margin, (2) estimated labor costs based on worker sales productivity, (3) estimated space costs based on space sales productivity, (4) EBITA, and (5) other expenses as a residual. The sample statistics of these component are again included in Table 1. What we propose to do next is examine how each of these components is impacted by the relative usage of the different sales channels.

$$\boldsymbol{P - COG - WxE - RxS - OE = \pi} \qquad \textbf{(1)}$$

$$\mathbf{1} = \frac{\boldsymbol{COG}}{\boldsymbol{P}} + \frac{\boldsymbol{W}}{\left(\frac{\boldsymbol{P}}{\boldsymbol{E}}\right)} + \frac{\boldsymbol{R}}{\left(\frac{\boldsymbol{P}}{\boldsymbol{S}}\right)} + \frac{\boldsymbol{OE}}{\boldsymbol{P}} + \frac{\boldsymbol{\pi}}{\boldsymbol{P}}$$

Where: **P = Sales Revenue**
COG = Cost of Goods
W = Wage (assumed $18,185)
E = Employment
R = Rent (assumed $20 sqft for stores, $10 for distribution)
S = Space (stores and distribution sqft)
OE = Other operating expenses
π = Operating profit (EBITA)

IV. Results: Impact of Sales channels

In Table 2, we report a set of simple OLS cross-section regressions of firm accounting items against the fraction of US sales revenue that originates from E-commerce and B-to-B operations. The default, in the first column of Table 2, shows the share from the traditional store sales channel. In the second and third columns is the change in that share as a firm moves to selling 100% over the internet or 100% to other stores. The first three rows are quite informative. The 10k data seems consistent with intuition in reporting that firms with mainly a traditional sales channel also have mostly store space, while those primarily using the internet use mostly distribution space. Most importantly, sales productivity for both space and workers is also far greater for firms with a large share of Ecommerce and/or B-to-B business.

We can also examine how each sales channel impacts the share of revenue going to each of the calculated components of gross profit. Examining the regression results, for a firm that does *only traditional store sales*, its revenue is comprised of the following fractions: COG (63%), estimated labor expenses (11%), estimated space expenses (11%), residual (11%), and profit (5%). These are in the first column of Table 2, labelled "constant".

When we examine the impact of being a firm that sells *exclusively on the internet* we can simply add the coefficients in the "E-commerce" column to those in the first. This yields COG (67%), labor expense (5%), space expense (4%), residual (24%) and profit (1%). For the hypothetical firm that does exclusively B-to-B sales the predicted shares are: COG (32%), labor expense (3%), space expense (-3%), residual (58%) and profit (11%). Of course, the firms that predominately use one channel or another might sell different types of goods, which would partly explain these factor cost differences.

Table 2: Reduced form regressions of sales channel on accounting items
(* indicates significant at 5% confidence)

Dep. Variable	Constant	B-toB %	Ecom. %	R2
Dn. space %	.08*	.59*	.83*	.75
Sales/worker(M)	.16*	.11*	.33*	.26
Sales/sqft(M)	.29*	.65*	.45*	.16
COG/Sales	.63*	- .31*	.04	.11
Est. Labor costs	.11*	- .08*	-.06*	.14
Est. Space costs	.11*	-.14*	-.07*	.23
Est. other costs	.11*	.47*	.13*	.24
EBITA/sales	.05*	.06	-.04	.017

Firms that do most of their sales on the internet, as opposed to using traditional stores, tend to have quite similar Cost-of-Goods as a percent of revenue. In fact, there is no statistical difference. The recorded 2017 profit margins for both types of retailers are also not statistically different. In between these two numbers, however, the nature of the operating expenses for the two types of retailers is quite different. Firms primarily using the internet, have between 2 to 3 times the space and worker productivity (based on sales) relative to firms using store channels. This productivity advantage means that online retailers can spend about half has much per dollar of revenue on comparably priced labor and space. On the other hand, internet sales create other operating expenses that are more than twice as large as traditional store sales. Our speculation is that these additional operating expenses are due in large measure to the shipping costs in the case of internet goods delivery. We have no explanation for why firms doing B-to-B sales have such a huge share of residual expenses. Finally, we note that these additional "other" expenses add $.13 per dollar of revenue for firms using the Internet exclusively, and then move to studying shipping costs more directly.

V. Shipping and Last Mile costs

Traditional retailers ship goods from producer to warehouses to stores. Most of this shipping is internal "bulk" shipping which generally is quite cost efficient. The 10K data does not report any separate estimates of such costs. When consumers purchase through this traditional store channel, the "last mile" shipping costs involves their own time and money expenses of traveling to and from stores. To estimate the average of such shopping trip costs we can rely on the most recent 2017 NHTS survey, which shows that the average household spends 20% of its total VMT on trips whose purpose is "shopping/errands". The average (round trip) distance of these trips is 7.2 miles. This travel covers both local food store trips as well as longer excursions to say regional malls. The NHTS also estimates the full money and time costs of travel at $.80 per mile – suggesting an average shopping trip cost of $5.70. There is little suggestion in any literature on traditional shopping that stores bear the burden of these consumer trips. Hence for traditional shopping, last mile costs must be considered an extra expenditure on top of store shelf prices – and of course on top of the revenue/expenses reported in the 10k data.

For internet retailers, there can also be internal "bulk" shipping as goods are moved from producer to say an Amazon fulfilment center [Greasely and Assi, 2012]. This however, tends to be limited to volume goods that the fulfillment center purchases and keeps in inventory. Much of what Amazon sells is not from its own inventory. For these sales there more often is a full shipping cost either directly from producer to consumer or from producer to consumer through a fulfillment center. This "item" based shipping is not as efficient as "bulk" shipping. On the other hand it is directly to the consumer's doorstep and not to the shelf. Regardless of whether shipping is "free" to the purchaser or incorporated into prices, all of these internet delivery costs are billed through the retailer and hence are contained both in their revenue and expenses, even if they are not separately identified in the 10K reports.

Since much internet delivery is currently undertaken by 3rd party delivery service companies (e.g. UPS, USPS, Fedex) it is possible to make a crude estimate of average shipping costs. Take the total revenue of a delivery company (e.g. 2017 UPS: 54 billion) and divide by the total number of parcels delivered (5.1 billion) to arrive at an average full delivery cost per package of around $11. This number surely has wide variance, however, since it includes purely local deliveries (last mile) as well as international "item" shipping – direct from producer to purchaser. A number of consulting firms have estimated the share of this expense that is from the nearest center operated by the delivery company to the purchaser's doorstep [McKinsey, 2016 and 2018]. These estimates range from 30% to 50% of total delivery cost. This places average internet last mile delivery at somewhere between $3 and $5 with an additional $7 on average spent for longer distance shipping. If the last mile estimate seems low, it must be remembered that this involves chained trips wherein 100 or more packages can often be delivered on a single long journey with perhaps less than a mile between stops. Importantly, the above UPS average total shipping cost per delivery is exactly 13% of the $81 average value of an internet order [Statista, 2018]. This share matches the estimated additional "other expense share" for internet companies in Table 2. Estimated "last mile" costs for internet delivery are only around 5% of purchase value.

For tradition store-based shopping the picture changes when last mile costs are measured as a fraction of purchase value. In 2016 the BLS reports average household expenditure on all goods, as approximately $11,500 annually [BLS, 2016]. When spread out over the 450 shopping trips (NHTS) this creates an average purchase value (AOV) of about $25.00. Clearly the mix of goods bought in local stores is not the same as that bought on the internet, nevertheless, in terms of *just last mile expenses*, direct shopping adds a significant 22% to the price of an average package of goods bought in stores as opposed to only 5% for truck delivery with internet shopping.

This discussion illustrates that to truly get goods to consumers through the traditional store channel we have to add roughly 22% to shelf prices to get the final delivered cost of a purchase. The delivered cost of shopping on the internet includes shipping whether separately itemized or "free". While the last mile portion of shipping is a bit less in the case of Internet delivered shipping, shipping costs before the last mile are likely higher than with stores since much is "item" versus "bulk" traffic.

VI. Conclusions

These results seem to provide another argument in favor of the internet channel over traditional stores. Assuming both channels acquire an identical good for the same price from a producer, our analysis of 10k data suggests the cost of putting them on shelves is roughly the same as that of doorstep delivery. The makeup of these costs, however, is quite different. Internet retail is much more efficient in terms of worker and space usage, although this seems roughly offset with additional expenses that we attribute to shipping costs. But doorstep delivery is certainly not the same as shelf delivery. The former saves the consumer a significant travel expense. In this sense, a true comparison of the two channels would add consumer trip costs to the traditional store channel. With this accounting, the internet not only provides greater product choice, but also a lower the *total* cost of putting purchased goods *into consumer hands*. Our rough estimate of this latter savings is a significant 22%. For stores to survive, whatever advantage they have from "direct goods contact" will have to outweigh the Internet's advantage in both delivered cost as well as product choice.

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