

HOW INTERNET PENETRATION AFFECTS LOCAL B&M RETAILERS

JOSÉ-DOMINGO MORA, PH.D., *University of Massachusetts Dartmouth*

Is Internet a blessing or a curse for local bricks-and-mortar (B&M) retail? The present research studies the effects of Internet penetration on two metrics of industry structure of B&M retailers, namely intensity per capita and diversity of retail establishments, over 149 retail formats in 64 counties in New England. These data enter a system of simultaneous equations, where intensity and diversity of retail establishments are endogenous dependent variables. It is found that Internet penetration is a driver of B&M retail diversity, therefore favoring specialists that tend to be smaller and local over generalists that tend to be larger and non-local. Thus, even as Internet access and benefits are available to businesses regardless of size, smaller B&M players seem to be more able to channel those rewards. Furthermore, given recent societal trends, it is possible that consumers are leveraging the Internet to channel their support of local businesses. An important implication of our results is that local governments should promote Internet infrastructure to help support local retailers and benefit consumers through both, broader product arrays and stronger local economies.

INTRODUCTION

Earlier predictions foretold the demise of retailers through the empowerment of producers and consumers, who would be in increasingly more direct contact with each other (Angelides 1997). The economics of intermediation though, i.e., retailers introducing contact efficiency by reducing the costs of matching supply and demand, persists and multiplies in a world with an incremental number of product and service offerings. Thus, intermediation remains a necessity even in electronic marketplaces, as the rise of online retailers such as Amazon illustrates. Furthermore, thirty years into the Internet age consumers have not massively migrated to online, as online sales remained 11.1% of the US retail commerce in 2019 (Statista 2020), even as the recent COVID-19 pandemic may push these numbers further up, and intermediation still rules off-line transactions. The development of the online channel has proven to be more of a supplement than a substitute to bricks-and-mortar (B&M) or physical stores (Biyalogorsky and Naik 2003, Weltevreden and Boschma 2008, Wolk and Skiera 2009, Liu et al., 2018), which is likely valid regardless of the size and location of a retailer. For instance, smaller, local retailers

may make use of multichannel strategies, and in particular the online channel, as it lowers the costs of promoting product and service offerings while expediting commercial transactions (Doherty and Ellis-Chadwick 2010). Larger retailers may enjoy these advantages as well and, additionally, further capitalize on their more advanced logistics to broaden their local offerings even as the products are physically away. As both smaller, local retailers, and larger, likely non-local retailers with national and global scope are capitalizing on the Internet, it is uncertain which players benefit the most. For local B&M retailers, is Internet a blessing or a curse?

This is an important problem because of its potential managerial and policy implications. For instance, if Internet penetration hurts diversity and number of business establishments, then the smaller players that make the marketplace more numerous and diverse are been out-competed by technically sophisticated behemoths, and should develop alternative off-line strategies, e.g., focus on fostering store traffic, developing face-to-face relationships. If, on the contrary, Internet penetration boosts diversity and numerosity of business establishment, it would imply that the performance of smaller players is being disproportionately enhanced as compared to that of larger players. In that scenario, on-line strategies should be viewed as prime tools in strategy-making and tactical implementation.

Policy-wise, local governments would have a better compass to help them decide on efforts to promote and subsidize infrastructure projects.

This problem is addressed by statistically modeling data on Internet penetration and retail sector characteristics, available from the United States Census Bureau (2017) at the county level, specifically for 94 counties in the New England region. Consistent with the narrative on the existence of a *digital divide* further separating haves from have-nots, Census data show that there exists significant variation in the degree of penetration of the Internet over counties. These “digital inequalities” generate enough variability to allow for model estimation. As socio-economic county-level data, such as household income and retail characteristics, are also available from the Census, it is possible to control for their potentially confounding effect on the two retail characteristics of interest. Specifically, the present research empirically models the impact of Internet on the following metrics, which describe the structure of the local retailing industry: a) retail diversity (as entropy) and b) retail intensity (as number of establishments per person), while controlling for potentially confounding variables, and for the mutual effect of those two metrics on each other. Diversity is an entropy measure of the distribution of retailers by class. Smaller diversity of retail formats implies that generalists—likely bigger non-local chains, e.g., supercenters—tend to dominate the local marketplace, whereas larger diversity implies that specialists—likely local businesses, e.g., specialty stores—play a more significant role. The second descriptor of industry structure is retail intensity, the ratio of retail options to demand, which is captured as stores per capita. Higher retail intensity implies better consumer access to offerings and more intense competition—likely from smaller players—on the supply side.

The study findings show that Internet penetration is a driver of B&M retail diversity, and therefore favors smaller, local players. The study finds no effect of Internet penetration on retail intensity (as stores per capita), which points to the limitations of Internet as a tool to overcome structural constraints on local economic growth.

BACKGROUND

Company Adoption of Internet

The extant literature provides consistent evidence linking the adoption of Internet to enhanced firm performance over a broad range of firm characteristics. First, both the speed at which retail firms adopt Internet as a communication channel, and the speed at which they develop electronic commerce alliances have positive effects on firm performance, measured as Tobin’s q (Lee and Grewal 2004). Beyond adoption and speed of adoption, the incorporation of more advanced features in company websites also predicts management’s perception of firm performance (Drennan and McColl-Kennedy 2003). As firms advance toward more comprehensive Internet strategies, measures of self-perceived firm performance (among managers) significantly improve as well (Weltevreden and Boschma 2008). In fast-growing companies, more complex patterns of use of online media positively co-vary with firm revenues (Mora and Barnes 2011). At one rather advanced level of Internet adoption, i.e., as a fully developed distribution channel of digitalized music, the effect on sales is shown to be very positive, whereas cannibalization of the traditional channel by the online channel remains negligible (Biyalogorsky and Naik 2003). In sum, these studies provide clear evidence that adoption, speed of adoption, and degree of sophistication in the implementation of Internet tools positively affects actual or perceived firm performance, measured with a number of validated metrics.

Importantly, the adoption of Internet-based tools and media has become ever more expedite, as technological developments have made progress in addressing the main drivers of such adoption. A study of Internet adoption by retailers conducted in the United Kingdom 17 years ago (Doherty et al. 2003) identified ten factors predicting higher degrees of company website functionality. Among those, the main drivers were management’s strategic readiness, the availability of infrastructure inside the firm, the costs associated to the Internet channel, and the degree of target consumer’s adoption of Internet. The authors of the present study posit that the first three factors have been largely addressed since 2003 by the increasing

availability of web development firms. The number of such firms grew at a 6.6% annually between 2014 and 2019 in the US, to more than 75 thousand (IBIS World 2019). A second enabler of adoption of Internet tools is the increasing availability of server capacity for hosting websites, which has resulted as well in lower costs for companies (Ribeiro 2012). In parallel with these two developments, the number of consumers using the Web has grown dramatically, to 76% in the USA in 2016 (Roser et al. 2020). The main barriers for adoption of Internet identified by Doherty et al. (2003) have been significantly eroded over an interlude of a decade and a half.

Thus, not only Internet provides tangible benefits for the adopting companies, the adoption of Internet-based tools and media has become less costly and less complex. Importantly, these two phenomena seem to benefit firms across the board, although it seems unlikely that every type of company would benefit equally. One interesting divide over which to explore potential differences in Internet adoption is company size, specifically because of the critical role played by small and medium enterprises (SMEs) in developed economies. For instance, in the member countries of the Organization for Economic Cooperation and Development, SMEs constitute 99% of all commercial firms and create more than 50% of the economic value (OECD 2019). It is thus interesting to elucidate the influence of Internet penetration on smaller players as compared to larger ones. Local B&M retailers are a subset of SMEs. Unfortunately, none of the studies cited in this section, nor those found in an extensive literature search, compare the effect of the adoption of Internet, or the degree of sophistication in its use, between smaller and larger firms.

MEASURING FIRMS, BIG AND SMALL

Metrics of industry structure (e.g., number of players, degree of concentration) are useful indicators of how SMEs in general, and local B&M retail in particular, fare in relation to larger companies. The present research looks at two broad descriptors of the structure of the retail industry, which are termed retail intensity and diversity. Retail intensity is the number of retail establishments per one-thousand people at

the county level. It reflects the number of retailers an average consumer “faces” in their county, hence the term intensity. Diversity is the variety of retail formats over a number of NAICS categories or retail formats (e.g., supermarkets, bakeries, meat stores) “faced” by the average consumer in a county. Diversity is conceptually the opposite of industry concentration. A well-known and widely used measure of concentration is the Herfindahl index, which has a relatively simple formulation: it is the summation of the squared shares of market sales by firm, and varies between very close to zero (never gets to zero) and 1, with 1 representing a market with one single player holding 100% of sales. This infinitely concentrated market would have zero diversity. Note that the Herfindahl index could have been used in our research, as it measures the opposite of diversity. The proposed measure of diversity, the Shannon entropy (Shannon 1948) has a number of advantages, though, over the Herfindahl index. It varies between zero and a potentially infinite number, with larger values representing higher diversity. Within its compact formula (see below) this index considers, and increases with, both the number of classes in a system (number of retail formats) and how equitably distributed is the sum total of the elements in the system (number of retail establishments) over those classes (retail formats). These properties of the Shannon index are known in the ecology literature as numerosity and equitability. Thus, a market with 10 retail formats (higher numerosity) is bound to be more diverse than a market with 5 retail formats (lower numerosity). Furthermore, a market with 100 stores uniformly distributed in 10 retail formats (high equitability) is more diverse than a market also with 100 stores and 10 retail formats, but where 2 of the retail formats capitalize 50 of the stores (low equitability).

Thus, larger values of Shannon entropy in the present study are for counties with more retail formats and total number of establishments more evenly distributed over those retail formats. More retail formats imply larger number of specialized stores, e.g., meat stores and bakeries as opposed to only supermarkets.

RESEARCH QUESTIONS

The researchers posit that B&M retailers tend to be local, and that larger retailers, e.g., national store chains, tend to be non-local. In terms of benefiting from the Internet as an innovation, online resources help lower the costs of disseminating information and completing transactions, effectively lowering barriers to entry for smaller competitors, but also providing both larger competitors and smaller competitors with cost advantages. Larger players may further benefit from the Internet as they are able to invest in logistics that help expand their local assortments, e.g., customers ordering online items not kept in stores for in-store pick-up. Should the balance of this complex array of forces favor bigger players, one should expect that Internet penetration hurt both intensity and diversity of retail. Vice versa, if the balance favors smaller players, both intensity and diversity of retail should increase with Internet penetration. As this underlying balance is unknown, it is asked:

- RQ₁:** How does Internet penetration influence diversity of B&M retail establishments in US counties?
- RQ₂:** How does Internet penetration influence intensity of B&M retail in US counties?

MEASURES AND STATISTICAL MODEL

The present research investigates whether the diversity of retail formats (*Diversity_c*) and the intensity of retail outlets (*Intensity_c*) in county *c* are predicted by the penetration of Internet in that county. *Diversity_c* is operationalized as the Shannon entropy (Shannon 1948) over NAICS industry codes, as follows:

$$Diversity_c = - \sum_{k=1}^K p_{ck} \text{Log}(p_{ck}) \quad (1)$$

where *p_{ck}* is the proportion of all retail establishments in county *c* belonging in the *k*-th retail format (5-digit NAICS codes corresponding to store formats, such as supermarkets and meat stores). *Intensity_c* is operationalized as the ratio of total number of retail establishments in the county to the population in the county. Diversity and

intensity are not independent from each other, they positively co-vary (*r* =.74) arguably as a result of a mutual causation relationship. All else being equal, an increase in retail intensity (stores per capita) pushes potential entrants to new corners of the retail landscape, thus increasing diversity. In the opposite causal direction, increasing diversity improves the chances of success for new ventures, thus increasing intensity. For this reason, *Diversity_c* and *Intensity_c* are endogenous variables that need to be modelled simultaneously using a system of equations (Greene 2010).

The antecedents of *Diversity_c* are presented now. The first one is, as in RQ1, Internet penetration (*Internet_c*). Second, the size of the county's and the state's economies (vector *ECONOMY_c*) which are both expected to positively co-vary with retail format diversity. Third, population density (*Pdensity_c*) should positively co-vary with number of consumer needs and, therefore, with the number of possible market segments, yielding a more diverse retail sector as population density increases. Fourth, average business size per county (*Bsize_c*) should negatively affect the diversity of county retail as larger retail establishments (e.g., department stores, super centers) tend to comprehend increasingly larger arrays of product categories, allowing them to better fight smaller specialists. Fifth, higher levels of consumer resources, as captured by personal income (*Income_c*), should tend to

$$Diversity_c = \beta_0 + Internet_c * \beta_1 + \beta_2' \\ ECONOMY_c + Pdensity_c * \beta_3 + Bsize_c * \\ \beta_4 + Income_c * \beta_5 + \\ Intensity_c * \beta_6 + \epsilon_c \quad (2a)$$

expand consumer needs, therefore having a positive influence on diversity of the retail sector. Lastly, one must consider the fact that the per capita density of retail stores (*Intensity_c*) puts competitive pressure on businesses, which should result in active efforts on the side of firms to differentiate their offerings, thus positively influencing retail diversity. Hence, The antecedents of *Intensity_c* are presented now. RQ₂ asks if *Intensity_c* is affected by Internet

penetration ($Internet_c$). Other possible antecedents of $Intensity_c$ are similar to those in (2a). A larger economy, both county- and state-level ($ECONOMY_c$) should lead to higher retail density. Population density ($Pdensity_c$) should reduce retail intensity. Larger business

$$Intensity_c = \gamma_0 + Internet_c * \gamma_1 + \gamma_2'$$

$$ECONOMY_c + Pdensity_c * \gamma_3 + Bsize_c * \gamma_4 + \quad (2b).$$

$$Income_c * \gamma_5 + Diversity_c * \gamma_6 + u_c$$

establishments ($Bsize_c$) should reduce the density of retail establishments, as larger stores tend to be generalists (i.e., carrying wider assortments). Also, more resourceful consumers (higher income, $Income_c$) should be able to demand more diverse items and thus positively affect $Intensity_c$. Finally, more diverse offerings ($Diversity_c$) should further drive demand and, hence, increase $Intensity_c$. Therefore, Equations (2a) and (2b) form a simultaneous system with two endogenous variables, $Intensity_c$ and $Diversity_c$, where errors e_c and u_c are assumed as normally distributed, and allowed to be correlated. The estimation of the system proceeds via iterated three-stage least squares, using all covariates in both equations as instruments, as in Greene (2010, p. E-508). To make the system identifiable, it is necessary to use an additional instrument for one of the endogenous variables on the right side of either of these equations.

DATA AND SAMPLE

The present study covers the states in the New England region of the United States, namely Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont. Most data were collected from the Census’ online database (United States Census Bureau n.d.), specifically the following:

- a) Number of retail establishments and number of retail employees per county c and retail format k , c . 2017. The number of categories of retail format, K , varies between 5 and 149 NAICS codes (5-digit level) per county, as well. These are the terms that enter the Shannon equation (1).

- b) Population per county c . 2017, or the estimates based on data 2010-2015 (the Census reports these estimates for sparsely populated counties).
- c) Average income per county c . 2017, or the estimates based on data 2010-2015.
- d) Internet penetration per county c . 2017 or 5-yr. estimates based on data 2010-2015.

The remainder of the data, specifically state gross domestic product c . 2017, comes from the Bureau of Economic Analysis, United States Department of Commerce (n.d.). Table 1 presents the correlations between the model variables. An additional variable used as an instrument for diversity by county ($Diversity_c$) in equation (2b) is population size by county,

$Population_c$ ($\rho_{Diversity_c, Population_c} = .63$). As said in the Model section, using this instrument is necessary to make the system identifiable.

The number of counties in New England is 68 but only 64 enter the estimation sample due to lack of data for the counties Essex and Grand Isle in Vermont, and the fact that the Dukes and Nantucket counties in Massachusetts are maritime islands with intense touristic activity and, therefore, atypical retail structures.

RESULTS AND DISCUSSION

Model estimates are shown in Table 2. Model fit improves considerably for retail diversity when Internet penetration enters as a covariate, and remains roughly unchanged for retail intensity. Therefore, model 2 is a better description of the data than model 1.

Model 2 estimates in Table 2 reveal that Internet penetration is a major driver of retail diversity (RQ1), with an estimate that is close to that of business size in terms of absolute value. Thus, the lowering of barriers to entry for smaller businesses, as a result of Internet penetration, outweighs the lowering of costs for big competitors for the same reason. Smaller retailers—mostly local—make use of the Internet to challenge big players and the effect of this strategy is larger than the gains of larger competitors in terms of lower costs.

Internet penetration, though, does not affect retail intensity (RQ2) (the negative sign of the

**TABLE 1:
Correlations Among Model Variables**

	Retail diversity	Retail intensity	Internet penetration	Economy size, county	Economy size, state	Population density	Business size	Income
Retail diversity	1.00	0.74	0.64	0.67	0.55	0.31	-0.67	0.08
Retail intensity		1.00	0.20	0.37	0.21	0.13	-0.68	<0.01
Internet penetration			1.00	0.44	0.52	0.22	-0.15	0.03
Economy size, county				1.00	0.64	0.49	-0.29	0.02
Economy size, state					1.00	0.37	-0.26	-0.02
Population density						1.00	-0.15	<0.01
Business size							1.00	0.06
Income								1.00

**TABLE 2:
Model Estimates (standardized)**

DV		Model 1 (Benchmark)		Model 2 (Test)	
		Retail Diversity	Retail Intensity	Retail Diversity	Retail Intensity
R^2		0.801	0.581	0.888	0.581
Adj. R^2		0.784	0.544	0.876	0.536
Internet penetration	% of households			0.398 ***	-0.031
County economy, size	Retail payroll (000\$/yr.)	0.383 ***	1.854 ***	0.312 ***	1.901 ***
State economy, size	Log[GDP]	0.133 +	0.006	-0.015	0.018
Population density	People/ sq mile	-0.025	-0.049	-0.014	-0.051
Business size, average	Employees/ establishment	-0.214 **	-0.681 ***	-0.407 ***	-0.681 ***
Income, average	\$/household-yr	-0.135 +	-0.006	0.015	-0.018
Retail intensity	Establishments/ 000 people	0.492 ***		0.202 ***	
Retail diversity	Shannon entropy ^a		-1.716 ***		-1.754 ***

Legend: + p<.10, * p<.05, ** p<.01, *** p<.001.

Note: All data from the US Census, except for state GDP (US Dept. of Commerce).

^aPopulation size is used as an instrument for Shannon entropy when the latter is an endogenous covariate.

estimate in Table 2 is irrelevant as p=.763). This is possibly due to the limited ability of Internet to help businesses expand demand, a necessary condition for retail intensity to increase. Demand has a number of unobserved

institutional, geographic, and labor constraints that limit the effect of the competitive devices available through the Internet. These unobserved determinants of demand, and hence retail intensity, likely underlie the relatively smaller fit of the retail intensity equation (adj-

$R^2=.536$), as compared to the retail diversity equation ($\text{adj-}R^2=.876$).

The endogenous estimates for intensity and diversity in model 2, Table 2, reveal that even as retail intensity positively drives retail diversity (.202), the effect of the latter on the former has a negative sign and a magnitude that is more than eight times larger in absolute value (-1.754). This implies that a larger local retail sector opens up opportunity for specialists, but specialization—i.e., smaller and more focused retail establishments—tends to reduce to an even larger extent the ability of competitors to grow local demand and, therefore, the size of the local retail sector.

The size of the economy has the expected positive effects in both intensity and diversity of the retail sector, but it is important only at the county level; state-level effects are one or two orders of magnitude smaller and non-significant. These results attest to the critical role that local factors, as stated above, play in shaping the structure of local retail. The size of business establishments has a negative effect on both intensity and diversity, as expected, and consistent with reports in the literature (Crowley and Stainback 2019). Larger retailers are likely reducing the number of establishments as they exclude smaller competitors whose main strategy is specialization (Ficano 2013), e.g., Wal-Mart superstores capture business from grocers, hardware stores, and many other specialists, thus reducing intensity and diversity of retail formats.

The demand-side variables population density and household income have negligible effects on both DVs. Even when the two variables for the size of the economy are dropped from the regression equations (results not shown), population density and household income show no effect on either intensity or diversity. This implies that it is the size of the aggregate population and their aggregate income what drives retail intensity and diversity.

CONCLUSIONS AND IMPLICATIONS

Smaller, likely more specialized B&M retailers benefit from Internet access, arguably because Internet enables both firms and consumers to,

respectively, lower customer acquisition costs and expedite access to a more varied assortment of offerings. Whether this is the result of enhanced e-commerce transactions, enhanced access to information, or both, remains an empirical question to be answered by future research. What seems certain is that the balance of the underlying factors at play, i.e., Internet both reducing costs (which helps both large and small players) and lowering entry barriers (which favors smaller players) tends to disproportionately help smaller, likely local specialists, as compared to larger players. This implies that the value of one-stop-shopping solutions offered by larger players, which deliver a convenience benefit, does not offset the value of accessing a wider variety of offerings stemming from shopping around over a larger set of retailers. Consumers seem willing to spend more of their time and effort as a means to widen their options.

Yet another explanation to consider is that some consumers may proactively support local businesses as a matter of principle, and use the Internet to this aim. Supporting local businesses is a societal trend revealed by commercial researchers both at the country level, i.e., people buying products manufactured in their own country, and the small locality level, i.e., people buying more from local producers and retailers. Globally, 27% of consumers support patronizing local retail outlets (Angus and Westbrook 2020), whereas in the United States a recent survey conducted by Comscore for UPS showed that 93% of consumers said they shopped at local retailers, with 40% citing “support local businesses” as a rationale for this behavior (UPS 2015). Furthermore, service seems to emerge as a potential differentiator favoring small businesses: “Consumers are responding to the unique merchandise, easy-to-shop formats and personal service that come with mom-and-pop retail stores.” (Gustafson 2016)

Another alternative explanation to our findings is that small vs. big retailers may tend to differ in their choice of location, e.g., downtown or the inner city vs. more remote locations. Hence, location would become an unobserved covariate that could potentially bias model estimates. This factor is unlikely to affect the outcome of the models though because the data

are collected at the county level and counties enforce zoning by town or city area. Zoning implies, among other things, forbidding commerce from setting operations outside specific areas; it has grown, among other factors, out of home owners' concern with property value, and it has had an important impact on business: zoning has led to spatial agglomeration (Datta and Sudir 2013). Thus, there tend to be commercial districts in cities and towns all over the USA, which reduce choice of location for retailers, thus increasing the likelihood that small and large operations share locations. Developers of shopping centers tend to choose one or two big retailers as anchor stores, but the remaining tenants occupying the majority of stores may end up being small businesses. For instance, the largest developer of street shopping malls in the USA, Kimco, created in 2012 a program to attract small businesses, consisting of one year of free rent and other incentives; four years later, the program was in place in 19 states (Gustafson 2016).

The implications of our findings for public policy are important. Furthering Internet penetration emerges from this research as a means to foster consumer choice above and beyond what electronic commerce arguably does. Furthermore, Internet penetration seems to have a measurable effect on the ability of local B&M to compete with larger retailers. Thus, states and counties should further stimulate investment in broadband services as a means to both increase consumer welfare and strengthen local economies.

Implications for managers come from several directions. First, indirectly through the actions policy makers may take based on the present study and similar research. Specifically, by stimulating broadband access at the county level, policy-makers would be boosting the competitive capabilities of local and regional firms that have a hard time competing with larger national retailers, which also own brands with considerable equity. Second, managers and owners of local and regional firms should make their case before stakeholders, such as local government and local business associations, to push for expanded access to broadband. Business associations, for instance, could lobby local authorities and Internet

service providers to this aim. Third, local businesses in counties where Internet penetration is already high should become ever more sophisticated users of Internet's commercial capabilities. For instance, by advancing from having a website just as a means to display offerings, to enabling online ordering and record customer feedback. In an increasingly on-line world, competing with big brands demands leveraging advantages, such as being local by fully developing the on-line channel.

LIMITATIONS

A limitation of the present study is that it does not account for the adoption of mobile technologies. It is likely the case that Internet penetration co-varies with penetration of mobile services and applications performing similar functions than Internet-based digital media. This being the case, the estimate for Internet penetration could be biased upward, but it would still capture the impact of information technologies broadly considered on retail diversity. The key finding of the study stands regardless of this limitation; whatever their technological underpinnings, i.e., Internet or mobile technologies, digital media and other virtual capabilities are impacting local B&M retailers in a positive manner.

The study was conducted in counties of the six states in the New England region. It would be beneficial to expand the geographic scope of future studies, not only in the USA but elsewhere in the world.

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