The Recent Evolution of Physical Retail Markets: Online Retailing, Big Box Stores, and the Rise of Restaurants*

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Abstract

We examine changes in the retail sector in the US over the period 1999 to 2017, a period during which new technologies and forms of competition have been associated with what has been dubbed a "retail apocalypse" in the trade press and beyond. Consistent with this notion of "retail apocalypse," we begin by confirming a sizable decline in the number of establishments in the retail sector defined per the currently used NAICS classification scheme. We further document a strong increase in e-commerce sales from nonstore retailers, and find suggestive evidence that sectors experiencing greater penetration of e-commerce exhibited larger relative decline in sales, number of physical stores, employment, and total payroll. However, the growth of Big Box stores (NAICS 45291), the second main factor often blamed for the reduction in number of retail establishments, flattened starkly after 2009, and we find that changes in other retail activity in a county is, on average, positively correlated with increases in the presence of Big Box stores. Moreover, despite the documented lower number of physical stores in 2017 compared to the start of the period, we find that both employment levels, real sales, real value added and real payroll of brick and mortar retailers had recovered to their pre-Great Recession peaks by 2017. Interestingly, we document that including restaurants (NAICS 722) as part of the retail industry – per the earlier Standard Industrial Classification (SIC) and consistent with the notion that these types of businesses use similar labor and real estate inputs – yields much stronger physical retail activity in terms of aggregate establishments, employment, sales, value added and payroll throughout the period, propelled by remarkably strong growth in the restaurant sector. This growth in number of restaurants is widespread, both across the country (across counties at different income quintiles), and in terms of format (full service and limited service). We examine two channels for the rise of restaurants: we find no evidence for the first, i.e. the idea that this growth was propelled by a reduction in costs induced by the decline of other physical retail. Instead, we find suggestive evidence that two-thirds (one-half) of the growth in restaurant establishments (employment) can be attributed to the relative increase in consumer expenditure share for restaurant food. We briefly summarize emerging trends, and significant venture capital funding for delivery and other services that may complement traditional physical retail stores.

1. Introduction

Much has been written in recent years, in both the trade press and the academic literature, about the decline of US retailing, or the "retail apocalypse."[1] This decline has typically been traced back to changes in

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[1] This notion of "retail apocalypse" has become so ingrained in the U.S. that it has its own Wikipedia entry which provides a long list of over 50 references to related media stories.

technology, including the advent of UPC codes and scanner technology, and the creation of radio-frequency identification (RFID), whose adoption improved logistical and warehousing capabilities, which together spurred the growth of large General Merchandise retail chains such as Walmart and Target, as well as the advent and growth of the internet and resulting online retailing capabilities, themselves also supported by more efficient warehousing, logistics and transportation operations (see Hortaçsu and Syverson, 2015, Basker, 2016, various chapters and citations within those). To a large extent, then, the technologies that are associated with changing the face of the retail sector are not technologies developed by or necessarily for this sector, but rather the consequences of technological change occurring in other parts of the economy (e.g. Warehousing and Transportation, NAICS 48-49) that have had substantial implications for retailing.

In this paper, we argue, using comprehensive data for the 1999 to 2017 period from the US Census, that the widely reported "retail apocalypse", illustrated by poignant stories of the exit of prominent chains (e.g., Borders, Circuit City, the Limited), presents an exaggerated picture of the health of the brick and mortar retail sector in the aggregate. An important measurement issue (discussed in detail in Section 2) plays a major role in explaining this discrepancy. Specifically, the definition of retail used by the Census does not fully account for the overall set of businesses that rely on the types of labor and real estate typically associated with the retail sector. This was not true in the days of the old Standard Industrial Classification (SIC) system, which included restaurants in its definition. The newer NAICS (North American Industrial Classification System) classification scheme has separated restaurants from the retail sector, moving them to a sector comprised of Accommodations and Food Services (NAICS 72). Thus, the changing face of Main Street in many communities, where small retail stores are seemingly being replaced by a growing number of service oriented businesses, including more restaurants, would imply a decrease in the official NAICS based statistics about retailing. However, from an employment and usage of real estate perspective, and we would argue from a "(wo)man on the street" perspective, it is not clear that the "apocalypse" is an appropriate characterization of the transformation that we are witnessing.

We document that the restaurant sector in particular has shown remarkably strong growth, in terms of sales, employment and number of establishments, over the period in question.[2] Once restaurants are included, aggregate real sales, employment and number of establishments in the broader retail sector bounced back and now exceed their pre-great recession peak achieved in 2006.

In addition, and importantly when trying to gauge the effect of technology in this sector, we find that even excluding the restaurant sector, employment and real sales of brick and mortar retail stores have recovered significantly from the depths of the recession in 2009. On the other hand, the number of non-restaurant retail establishments has not recovered from the decline that started in 2008, and still shows about a 3% decline from the levels in 1999 and about 4% below the peak level in 2007. These patterns suggest that the manner in which the technological factors emphasized in the trade press, namely the growth of both online and Big Box stores, have affected the brick and mortar retail sector is more complex than one might imagine. Indeed, the current trade press makes much of the complementarities between brick and mortar and online sales, and the importance of maintaining or developing physical locations for retail businesses.[3]

The paper is organized as follows. In the next section, we discuss our data sources and a number of definitional and measurement challenges that arise in trying to capture the evolution of the retail sector. In

[2] This strong growth in the restaurant sector was noted in an article in The Atlantic by Thompson (2017), who documented the strength of sales in food services relative to the rest of the retail sector (and termed this "restaurant renaissance"). However, the strong performance in this sector has otherwise been underreported in the media. In a long and comprehensive report, on Bloomberg.com, Townsend, Suran, Orr and Cannon (2017) present a number of figures on retail employment using Bureau of Labor Statistics (BLS) data which relies on the NAICS classification, and thereby excludes restaurants (https://www.bls.gov/iag/tgs/iag44-45.htm). Following the NAICS definition, the BLS also classifies restaurants separately from retail, under the leisure and hospitality supersector (https://www.bls.gov/iag/tgs/iag70.htm).

[3] See for example Kercheval, (2014), Santa Cruz (2019).

Section 3, we document some of the trends we see in the retail sector. We then turn, in Section 4, to an analysis of potential drivers for the above data patterns. We conclude that the traditional brick and mortar store has been negatively affected by the growth in e-commerce in general, but that there are indications that brick and mortar stores are increasingly viewed as important complements to online retailing. In addition, we consider possible drivers of the growth in the restaurant sector. We find no evidence that it is the result of the decline in number of retail stores, as might be the case if such decline led to lower real estate and labor costs. Instead, we find evidence that the strong growth in this sector is more likely due to shifts in consumption patterns towards more food consumed away from home.

2. Definitions, Data Sources, and Measurement Challenges

2.1. Defining the retail sector

The current industry classification scheme used by the US Census and other government statistical agencies, the North American Industry Classification System (NAICS), implemented for the Economic Census of 1997, defines retail to include fourteen subcategories that encompass different goods retailing activities across two broad two digit codes (NAICS 44 and 45). This is the definition used in a number of recent research studies of the retail sector (e.g., Hortaçsu and Syverson, JEP 2015), as well as in many media stories on the widely reported "retail apocalypse" (e.g., Townsend, Surane, Orr and Cannon, 2017; Richter 2018).

However, the earlier Standard Industrial Classification (SIC), last revised in 1987, included what we term for brevity "restaurants", but is more precisely described as "Eating and Drinking Places" (SIC 58), within the broad retail sector (SIC codes 52-59). An important change made under the NAICS scheme was to move restaurants to a different major sector, NAICS 72 "Accommodation and Food Services," encompassing what we term for brevity as "hotels" (NAICS 721, Accommodation) and restaurants (NAICS 722, Food Services and Drinking Places).

We believe including restaurants into the broader definition of retail can yield interesting insights, as consumers who see a shop replaced by a restaurant in their local town need not view this as a sign of crisis for what they view as retail. Relatedly, there is strong overlap in the inputs used by restaurants and the traditional NAICS retail sectors. In particular, a number of recent media articles contain anecdotal reports of restaurants taking over retail space from other traditional retail categories (e.g., Morris, 2016; Takahashi 2018), and arguably there is significant overlap in labor markets as well.

Another important subsector worth examining separately, given the importance of e-commerce retailing, is the category of nonstore retailers (NAICS 454), which includes online and catalog retailing, neither of which has traditionally included physical retail stores. Accordingly, in this paper, we use the following breakdowns of retail industry aggregates:

- Traditional Retail, which will include retail per NAICS (NAICS 44-45), as well as restaurants (NAICS 722)
- Traditional Physical Retail, which is Traditional Retail as defined above, but excluding Nonstore retailers (NAICS 454)
- Restaurants (NAICS 722)
- Traditional Non-Restaurant Physical Retail, which is traditional physical retail as defined above, but also excluding Restaurants (NAICS 722); in other words, this is NAICS 44-45 excluding 454.

2.2. Data sources

For our work, we rely mainly on three sources of data:

(i) Annual Retail Trade Survey (ARTS): This data source from the US Census Bureau provides annual sales data for retail subcategories. It also provides data on e-commerce activity levels. E-commerce activity data for the "Electronic Shopping and Mail-Order Houses" (NAICS 451) or ESMOH, are provided separately, and split by Merchandise line (see discussion in Section 2.4 below). We accessed historical tables from the US Census Bureau websites; these tables help address some of the re-classification challenges discussed in Section 2.4 below, as they provide consistent time series by classification codes (suitably adjusting historical data).

(ii) County Business Patterns (CBP): These data, also provided by the US Census Bureau, include information on the number of establishments, employment, and payroll by NAICS, in each county. One important limitation for employment data is that a significant proportion of these are suppressed (and reported as zero). We use a combination of interpolation and extrapolation within industry-county cells, along with the available employment range information (in the employment flag variable) to impute missing employment data. Note that in these data, employment is defined as all full- and part-time employees who were on the payroll during the pay period that includes March 12.[4] Because the extent of use of part-time employment could vary across sectors, caution must be exercised when comparing employment numbers. In part for this reason, in our analyses, we pay attention also to other outcome variables; in particular value added (aggregated data available from BEA, discussed in point iii below) and payroll (both aggregate and per employee) provide checks that are not affected by the variation in usage of part-time workers.

(iii) BEA Data: We use two BEA tables, one with a breakdown of Personal Consumption expenditures (Table 2.3.5) and one with a breakdown of value added by industry (Table U), downloaded from the BEA websites. We also obtained county-level population and personal income per capita data from the BEAs regional economic accounts datasets available on the web.

(iv) Yelp public-use micro data: We use the Yelp dataset[5] to construct an aggregate annual measure of restaurant variety and quality (as discussed Section 5.3). The Yelp dataset includes information about local businesses in 10 metropolitan areas across 2 countries. We undertake a number of steps to clean the data including: (a) restricting attention to businesses with address information, review information and time-series data, (b) restricting to restaurant businesses by matching a list of keywords in the "category" string, and (c) retaining only states in the US.

(v) Crunchbase: Crunchbase is an online platform that tracks data on companies, and is an increasingly popular source for comprehensive data on venture capital investments. We identify firms in retail-related activity during our study period (1999 to 2017), to provide some information on emerging technologies (in Section 6). Related to the challenge of measuring innovation in the retail sector (discussed in Section 2.6 below), we note a similar caveat about our measurement of start-up retail activity using Crunchbase data, that arises from other large start-ups undertaking activity in retail-related activity. E.g., Uber has a delivery service company (Uber Eats), and Alphabet is investing significantly in autonomous vehicles that has labor saving implications for the retail sector. A large number of technology companies are also investing in warehouse, logistics, and ecommerce platforms that impact online retailing, and hence affects the retail sector as well.

2.3. Heterogeneity within retail – Auto dealerships and Nonstore retailers

While one might expect that retail activities are relatively similar for different types of goods, there are a number of challenges in comparing activity levels across retail sectors, including the following:

[4] See e.g., definition of total employment provided online here: https://www.census.gov/quickfacts/fact/note/US/BZA110217

[5] We thank Alexander Oettl for pointing us to this data source. We accessed the data from: https://www.yelp.com/dataset/challenge

Auto stores have significant sales but small establishment/employment footprint: The automobile retailing (NAICS 441, Motor Vehicles and Parts Dealers) sector accounts for a large portion of retail sales that is not really representative of the level of economic activity in these dealerships because of the exceptionally high wholesale and unit prices in this sector compared to almost all other retail goods. In other words, this sector plays a less prominent role in terms of retail value added, employment and number of establishments. Appendix Figures A1 and A2 illustrate this point. They show that retail sales activity can be disproportionately affected by the fortunes of the automotive sector (e.g., the steep decline in the sector sales during the Great Recession had a significant impact of total retail sales), but the sector has a smaller role to play in explaining fluctuations in retail employment and number of establishments. Specifically, Figure A1 shows that the share of stores and employment of the auto sector relative to total retail are both low (less than 10%) and much more stable than their sales levels. In contrast, per Appendix Figure A2, the sales share of restaurants understates the sector's contribution in terms of value added, employment and number of establishments.

Nonstore/Online retailers have significant activities in other sectors: Another note of caution, for any analysis we undertake about nonstore retailers, is that a significant amount of labor input driving the sales levels achieved by the online retailers who form the main part of the nonstore category would appear in the transportation and warehousing (48-49) industry classifications. Similarly, while technically categorized as "nonstore", these retailers do have retail establishments (and this physical presence has been growing over time). However, the count of establishments in this sector would not include the warehouses and storage facilities owned by nonstore retailers such as Amazon; these would appear in transportation and warehousing again. To the extent that general merchandise and other stores that are in the Traditional Physical Retail Sector are also holding inventories within their stores, comparisons of their numbers of stores to the number of establishments associated with nonstore retailers in retail data are not comparing like to like.[6] Accordingly, sales or value added per employee or per establishment would need to be interpreted with caution, as we discuss again later in section 5 below.

2.4. Other Measurement Challenges

In addition to the issues above that are specific to the measurement of economic activity in the retail sector and subsectors, there are additional measurement issues that are important to keep in mind as we proceed with our analyses below. In particular:

Measuring innovation: As discussed above, transportation and warehousing, as well as the information technology sector, and related technologies supporting these, provide vital inputs for the successful operations of online (and even physical) retail businesses. This means that measuring innovation in the broad retail sector using traditional measures such as patenting is particularly challenging. For example, patents filed by online retailers like Amazon, or even technological innovations by traditional retailers like Walmart, are likely to be classified under patent classification codes related to the technology sector rather than retail activity. Accordingly, a measure of patent counts in codes specifically linked to retail as a fraction of total patents files in the US shows a miniscule level of patenting activity in this sector.[7] Appendix Figure A3 shows that while patent counts have been going up in the retail sector, measured patenting in this sector constitutes less than 1.1% of total patents filed in the US. We believe that this measure significantly understates innovation in the sector, even in terms of patent counts. Because innovation affecting this sector, moreover, comes from other sectors, and some of the innovation is related to changes in organizational structures as

[6] We thank Ben Jones for raising this point at the pre-conference meeting. In particular, he noted that to the extent the rise of online commerce is essentially shifting inventories from general merchandise and other physical retail stores to warehouses (and delivery using transportation workers rather than pickups by customers), the measured productivity benefits from the rise of online commerce would be lower than one may infer from the reduction of input use within the retail sector.

[7] We thank Nathan Goldschlag for sharing USPTO patent count data by NAICS 4 digit sectors, which he and co-authors put together in connection with their work on patent concordances in Goldschlag, Lybbert and Zolas (2019).

well, a patent-based measure for innovation in this sector simply would not capture much of the relevant innovative activity. For that reason, we do not pursue avenues to explain trends in this sector using such measures of technological change.

Changes to industry classifications and related loss of data (apparently correlated with the extent of reduction in activity): Another challenge in studying the retail sector is that changes in the amount of economic activity in various sectors and subsectors have prompted several revisions to the NAICS, many of which have affected the retail sector in particular.[8] This classification, which was implemented with the Economic Census of 1997, was revised in 2002, 2007 and 2012. Two major changes impacting our analyses were: (i) the codes for major subcategories of restaurant (full service and limited service restaurants) were changed in 2007, and (ii) the code for Warehouse Clubs and Supercenters (which we term "Big Box" stores) was changed from NAICS 45291 (under the 2002 and 2007 NAICS versions) to NAICS 42311 in the 2012 revision. While these changes call for extra care in collating the data, which we address below, some other changes are more difficult or infeasible to fully reverse. In particular, certain subcategories get folded into other more aggregate categories, likely because of a decline in economic activity in the subcategory. For example, up to the 2007 version of the NAICS, music stores (NAICS 45211 Prerecorded Tape, Compact Disc, and Record Stores) were tracked within the broader category of NAICS 4512 (Book, Periodical, and Music Stores); this music stores subcategory was abandoned (was no longer tracked) from 2012 onward, as the NAICS 2012 revision does not have a category for these stores. Similarly, Camera and Photographic Supplies Stores (NAICS 44313) and Computer and Software Stores (44312) were tracked under Electronics and Appliance Stores (443), but in the NAICS 2012 revision, these subcategories were eliminated. These classification changes, and our desire to study trends over a relatively long time frame (1999 to 2017) requires us in many cases to use data aggregated at the 3-digit NAICS code level, so that we can construct a comparable continuous data series for the period in question.

Imputing E-commerce Data to retail sectors: A related classification challenge arises from the fact that E-commerce activity by online retailers is tracked in the ARTS based on product codes that do not directly relate to the NAICS classification scheme. We manually imputed NAICS 2012 codes to each of the merchandise lines, as documented in Appendix Table A1.[9]

3. Trends in Retail Sector Activity: A Decline in Brick and Mortar Goods Retailing and a Rise of Restaurants

In this section, we present data patterns for all of Traditional Physical Retail (as defined in Section 2.1 above), and breaking that down by Restaurants and Non-Restaurant Physical Retail.

3.1. Trends in Number of Establishments

The most visible element of retail are storefronts, with media stories focusing on closed store fronts and retail vacancies (e.g. Field, 2018, Kestenbaum, 2017, Kilgannon, 2018). We examine if anecdotal media stories of stores, and chain stores, closures reflect a broad decline in the number of brick and mortar stores in the U.S., using data from the US Census County Business Patterns.

[8] For a historical perspective on the development of the NAICS, and more information about changes implemented over time, see https://www.census.gov/eos/www/naics/history/history.html

[9] One of the ARTS tables reports ESMOH data separated into NAICS categories. However, we did not use this for two reasons. First, and as a practical limitation, we were unable to find this data series for the full 1999 to 2017 period; the two separate tables that we found covered data only from 2011 to 2017. Second, and importantly for our purposes, this table allocates most of the ESMOH sales into the NAICS 454 Nonstore retailer category (in 2017, the proportion allocated to nonstores was 67.8%, or $269.4 billion of the total $397.5 bn). Because our goal is to find a good measure of the extent of penetration by online retailers in traditional categories, this very partial allocation of sales towards traditional physical sales sectors means these tables have very limited utility for us.

Figures 1a, 1b and 1c present trends in aggregate numbers of stores for Traditional Non-Restaurant Physical Retail, Restaurants and Traditional Physical Retail respectively. Consistent with the extensive media coverage of the "retail apocalypse", we show, in Figure 1a, that there was a sizable decline in the total number of establishments in the Traditional Non-Restaurant Physical Retail sector, from about 1.07 million establishments in 2007 down to 0.98 million in 2017, so a near 10% reduction, with the bulk of the decline coincident with the time of the Great Recession (2008 and 2009). However, in Figure 1b, we find that there has been a secular trend of strong growth in the number of restaurant establishments; despite a slowdown around the great recession, restaurant numbers have increased from about 475 thousand establishments in 1999 to 650 thousand establishments in 2017. This increase in restaurants more than offsets the decline in number of establishments in other physical retail, so that in Figure 1c, the total number of traditional physical retail stores had bounced back almost all the way by 2017, from a peak of about 1.64 million in 2007 to a trough of about 1.59 million in 2010, and back to about 1.63 million in 2017.

The interpretation of the decline in number of establishments in Figure 1a, and of the trends in Figures 1b and 1c, however, requires paying close attention to the vertical axes used. Figure 1d instead shows trends in percentage terms, by normalizing the 1999 level to 100 for each of the categories. This figure shows more clearly that the observed decline in Figure 1a translates to somewhat less than 10% decline in relative terms. Moreover, the stabilization from 2012 to 2016 is reassuring, though the further dip in 2017 may portend a further shakeout in the sector. Finally, the rise of the restaurant sector is evident in this figure as well, and we see that by 2017, the overall number of establishments in Traditional Physical Retail, as defined in this paper, was about 5% above its 1999 equivalent.

3.2. Trends in Employment

Figure 2a presents normalized trends in employment for retail categories, similar to Figure 1d for establishments. We find a very similar pattern in employment, except that retail employment levels even within the Traditional Physical Retail sector excluding restaurants bounce back to the pre-Great recession peak levels by 2016 (though there is again a notable dip in 2017). The restaurant employment shows a remarkably strong recovery from a decline coincident with the great recession, and this impetus from restaurants pushes employment in the overall Traditional Physical Retail sector to well above the pre-Great Recession levels. Even after the dip in 2017, aggregate physical retail employment is about 21% above the 1999 levels.

Figure 2b examines trends in retail employment as a share of aggregate US employment. Consistent with Figure 2a, this shows a small decline in share of Non-Restaurant Traditional Physical Retail from about 11% in 1999 to about 10% in 2017. Again, the rise of restaurants (from about 6% share in 1999 to about 8% in 2017) offsets this decline, so that Traditional Physical Retail shows an overall increase in its share of aggregate employment.[10]

[10] One caveat we want to note is that (as discussed in Section 2.3), the employment variable in the CBP includes part-time employment. Because we are concerned, based on low average annual payroll per employee (see discussion in Section 5.1.3), that the restaurant sector may have more than the typical – even relative to other retail - amount of part-time employment, we want to acknowledge that the total employment contribution from the restaurant sector to the retail sector corresponds to jobs with lower annual payroll per job than in other retail sectors. Nevertheless, as the analysis in Section 3.3 shows, the restaurant sector experienced significant growth in value added and overall payroll, and this contribution helped both real value added and real payroll growth in a substantial manner (see figure 3).

3.3. Trends in Sales, Value Added, and Total Payroll

Figure 3a shows the normalized trends for (real, in 1999 dollars) sales. Here, as for employment, we see that for the Non-Restaurant Traditional Physical Retail Sector, there was a full recovery in sales to pre-Great Recession levels by 2017 (unlike the pattern for establishments in this sector). There is strong growth in restaurants, but the impact of this growth on total Traditional Physical Retail sales is more modest. This is in line with Figure A2 and related discussion in section 2.3, which show that the sales share of restaurants in aggregate retail activity is considerably lower than their share in employment and establishments (implying lower sales per employee in the restaurant sector). We come back to this issue further below, in Section 6. However, in terms of both aggregate real value added (Figure 3b) and aggregate real payroll (Figure 3c), we find that restaurants make a sizable contribution to the overall Traditional Physical retail sector. This is in line also with the larger value added and payroll share of total retail for Restaurants in Figure A2. In particular, Figure 3b shows that excluding restaurants, the traditional physical retail sector recovered only to a little below the 2007 peak in value added and total payroll, while including retail pushes the aggregate trend to above the 2007 indexed level. For both value added and payroll, the addition of restaurants leads to an increase of about 15 percent in the indices for Traditional Physical Retail in 2017.

4. Slowdown of Non-Restaurant Traditional Physical Retail Activity: The role of Online Retailing and Big Box Stores

Two main factors have been mentioned in the trade press and the academic literature (e.g., Hortacsu and Syverson 2015) as main drivers of the decline in brick and mortar retail establishments or what we term Non-Restaurant Traditional Physical Retail: first, the development and growth of online retailing and, second, the growth of large general merchandise retail chains, in particular "Big Box" stores. In particular, by "Big Box", we mean chains of supercenters like Walmart and Target, as well as warehouse clubs such as Costco and Sam's Club. Both online retailing and the success of "Big Box" arguably have been made possible by the development of new technologies permitting more efficient and better tracking of items as they move from manufacturers all the way to consumers, including better inventory management, along with more efficient use of warehouse and transportation assets. In other words, exogenous technological innovation has allowed for growing scale economies that have benefitted national chains of very large general merchandise outlets, and, for online retailing, efficient transportation to and from large warehouses and distribution centers, which in turn have reduced demand for the products sold in Non-Restaurant Traditional Physical Retail stores (see Basker, 2016, which contains several chapters dedicated to technological and organizational changes in the goods retail sectors of the economy).

In this section, we examine in more detail the extent to which both sales by online retailers and Big Box stores have disrupted the retail sector. Figure 4 provides a summary by presenting how sales from these two sources have increased in terms of their share of the Traditional Retail Sector (i.e. NAICS 44-45 plus NAICS 722).[11] This figure shows that in the first half of our study period, i.e., from 1999 to about 2010, the growth of big box stores was a more powerful trend, increasing share from about 4% of the market to nearly 9%, whereas in the same period online retailing grew from about 0.5% to 3.5%. However, in the latter half of our period, between 2009 and 2017, roles were reversed. In particular, there is a striking flattening of the share of Big Box stores starting in 2009, with their share actually declining slightly from about 8.5% in 2009 to 8% by 2017. In contrast, over that same time frame, online retailer ecommerce sales accelerated, increasing share

[11] Figure 4 plots the aggregate share of ESMOH-Ecommerce that is Ecommerce sales by firms in the NAICS 4541 (Electronic Shopping and Mail-order Houses) category, which includes online and catalog retailers and hence we believe includes Amazon and other big online retailers. We do not separate out ecommerce sales by retailers that operate mostly via brick and mortar stores. While this is also increasing as a share of total category sales, these are likely complementary activities for physical retailers (e.g., ordering from websites of clothing stores with returns processed by physical stores, online orders from physical restaurants). Our analysis suggests that Restaurants (722), Clothing (448), Miscellaneous Stores (453), Motor Vehicles (441) and Sporting Goods (451) are the top categories in terms of direct ecommerce (i.e. ecommerce by physical retailers) share of category sales.

from about 3.5% to 7%. Thus, it appears that the competition from Big Box stores has stabilized while ecommerce competition shows no signs of slowing down.

In Sections 4.1 and 4.2, we take a closer look at the trends for online retail and Big Box stores, and undertake additional analysis to see if competition from these sources explains variation in the decline of physical retail (excluding restaurants) over time and across US counties.

4.1. Nonstore Online Sales

The Census Bureau collects data on sales by nonstore retailers, under the NAICS code 454. This industry encompasses "establishments primarily engaged in retailing all types of merchandise using nonstore means, such as catalogs, toll free telephone numbers, or electronic media, such as interactive television or the Internet." It is a subcategory within NAICS 44-45, which, as mentioned earlier, comprises all product retailing.

Appendix Figure A4 shows how the level of retail sales achieved by retailers with no brick and mortar presence, as identified by the Census, has grown with the advent of the internet. It also shows that, as a percentage of total traditional retail (i.e., NAICS 44-45 plus restaurants (NAICS 722)), non-store retailing was a very minor component of retail in the late 1990s, at about 0.3%. This share increased (as seen earlier in Figure 4) to about 7% of total traditional retail sales, representing about $397.5 billion in sales in 2017.

This rise in ecommerce sales by online retailers has involved differential trends across retail subsectors, as illustrated in Figure 5.[12] In particular, and in line with reports in the trade press (e.g. anecdotal explanations for the bankruptcy of chains such as Circuit City and Radio Shack), the data suggest that Electronic Stores (NAICS 443) faced the most intense competition from online sales, with the share of online retailers increasing from around 7% in 1999 to close to 50% in 2017. Sporting Goods (which also includes book stores) was the category with the next highest penetration of online retailing, with shares increasing from below 5% in 1999 to about 37% in 2017. Somewhat surprisingly (given likely high per item shipping costs), furniture stores are the next highest in terms of nonstore ecommerce share in 2017 (at 30%). Clothing stores are next, with about 22% in 2017, but then there is a sizable drop off to the next category (Health and Personal Stores (NAICS 446) at just below 10%. The data yield no imputed ecommerce competition for Restaurants (722), Gasoline Stations (447), Building materials (444) and Motor Vehicles (441).[13]

In Figure 6 and corresponding Table 1, we explore the correlation between the change in ESMOH ecommerce share between 1999 and 2016 for eleven traditional physical retail NAICS 3 digit sectors, and the decline in retail activity.[14] We find that, despite potentially significant measurement error in the imputed ecommerce sales shares, there is a strong negative correlation between increases in ecommerce penetration and the level of retail activity by traditional retailers, as measured by number of establishments, employment, sales, and payroll. Despite the small number of observations available, in Table 1, we confirm the statistical

[12] See the last paragraph of Section 2.3 for a discussion of how we imputed ESMOH data on ecommerce sales to retail sub-categories.

[13] Some of this is likely due to one important source of measurement error, arising from a large unallocated "Other merchandise" category within the list of ESMOH merchandise lines, which had about $62.8 bn dollars in ecommerce sales accounting for 16.13% of the total ESMOH ecommerce sales of $397.5 bn in 2017. The notes to the ARTS table describe this category as including "other merchandise such as collectibles, souvenirs, auto parts and accessories, hardware, and lawn and garden equipment and supplies"; hence it is likely that the imputed zero for building materials category (NAICS 444, which includes lawn and garden equipment and supplies stores) and Motor Vehicles (NAICS 441, which includes 4413, Automotive Parts, Accessories, and Tire Stores) are underestimates as they should include at least a portion of what is currently attributed sales to the "Other merchandise" category.

[14] We chose 2016 as the end year of comparison, as the 2017 figures are the latest available and may be subject to revisions. In any case, there is only a modest difference in aggregate figures between 2016 and 2017 (see e.g., Figure 3)

significance of the negative correlation for two of our four measures of retail activity, namely sales and total payroll (at the 5% level for sales and at the 10% level for total payroll).

Data limitations prevent a more granular investigation of the impact of online sales on physical retail activity. Nevertheless, the patterns in Figure 6 suggest solid support for several persuasive accounts from the trade press (e.g., Evangelista, 2015) of the closure of physical stores (e.g., book stores and electronic stores) that specifically refer to increased competition from online retailing as a trigger. With the overall and sector specific trends for online ecommerce (in Figures 4 and 5) showing no signs of a slowdown, pressure from online sales could continue to dampen physical activity in the most ecommerce prone retail sectors of electronics, furniture, sporting goods and clothing.

4.2. The Role of General Merchandise Stores

In their overview paper on the evolution of U.S. retail, Hortaçsu and Syverson (2015) used data up to 2012 to highlight the remarkable surge in the share of Big Box stores in retailing. The growth of this category was reflected also in Figure 4, discussed above. Appendix Figure A5 presents trends for big box and other general merchandise stores in dollar terms (on the left) and as a share of total traditional retail (i.e., NAICS 44-45 and Restaurants 722). The figures show that Big Box stores have grown from about a third of the general merchandise category to well above 50% of sales. While the left panel of Figure A5 shows that nominal sales continued to grow for big box stores through the entire 1999 to 2017 period, their growth slowed starting around 2008, as seen in a dramatic flattening of the trend in terms of share of retail sales (in the right panel of Figure A5, just as in Figure 4 above). The right panel also reveals that the non-Big Box stores in this category experienced considerable decline in their share of retail, so that the aggregate general merchandise category (452) shrunk from a peak of about 14.5% of retail sales (in 2009) to less than 12% in 2017. These trends suggest some challenges for the general merchandise stores category, especially for non-big box general merchandise stores.[15]

These figures also confirm that while Hortaçsu and Syverson were correct to highlight the importance of the rise of Big Box stores up to the late 2000s as potentially more impactful than the rise of ecommerce in the same period, the rise of Big Box stores now has stalled, so that since 2009, and going forward, it seems likely that the continuing rise of ecommerce will be the prominent driver of changes in the physical retail sector. Having said that, with brick and mortar retailers' increased involvement in online sales, and signs that ecommerce firms are finding their way into developing some brick and mortar presence, the lines between Traditional and online retailing will likely be blurred to an increasing degree as well, making it difficult to identify which is affecting which (see discussion in Section 6 below).

Despite the slowdown in Big Box share of retail starting in 2009, over the 1999 to 2016 time frame this sector did see very significant growth. Did this growth reduce demand for other physical retail, especially since these supercenters and warehouse stores often carry a wide range of products that compete with almost every other retail store category? To investigate this in more granular detail, we use US Census Bureau CBP data and regress the 1999 to 2016 growth in measures of physical non-restaurant retail (i.e., NAICS 44-45 excluding nonstore retailers (454)) activity (specifically number of establishments and employment, with growth defined as $\frac{Y_{2016}-Y_{1999}}{Y_{1999}}$) on the growth in Big Box establishments in the county. Results are reported in Table 2. We examine the effect of both a continuous measure of Big Box growth (in odd numbered columns) as well as a more flexible specification using dummy variables for different ranges of growth in the number of Big Box stores (in even numbered columns). In columns 5 to 7, we include variables to control for growth in county population and growth in county personal income. While we would not want to impute a causal interpretation to these regression results, these long-difference specifications are akin to using county fixed-effect regressions, and hence they control for omitted variable bias that would arise from omitted fixed

[15] In Section 6 below, we discuss new approaches that physical retailers like Walmart are adopting, greater investments in online retailing, curbside pickups and grocery home deliveries from stores, to defend and grow their market share.

county-specific characteristics (so long as they have static effects on the number of establishments and employment in the Non-Restaurant Traditional Physical Retail sector). Across all specifications, we find a strong *positive* correlation between growth of traditional retail activity and the growth of big box store. As expected, population growth and income growth are also strongly positively correlated with growth in physical retail activity, but even in specifications controlling for these variables, we still find significant positive correlation between increases in big box presence and growth of the physical retail sector.

The results in Table 2 contradict a narrative where the growth of big box stores is associated with a decline in other retail physical activity; instead these results suggest that places that saw increases in big box presence also saw a relative strengthening of other (non-restaurant) retail activity, even conditioning on income and population growth. We surmise that this occurs because big box stores expand in places that have a more than usual (over and above what is predicted from population and income growth) conducive environment for retail activity in general, rather than into less hospitable places where they try and replace other physical retail activity. Moreover, their presence in some locations might drive other, potentially complementary, retailers to want to operate nearby.[16]

5. Potential explanations for, and closer look at, the rise of restaurants

In this section, we explore two broad (potentially complementary) explanations for the rise in number of and economic activity in restaurants: (i) a supply side explanation, where the increase in restaurants is induced by a reduction in retail real estate prices and retail wages,[17] and/or (ii) a demand side explanation, that the growth in the restaurant sector may have been propelled by a shift in expenditures/preferences away from other consumption, including home cooking, and towards restaurant food.

To explore explanation (i), in Section 5.1, we examine data on real estate prices (Section 5.1.1) and we examine (in Section 5.1.2) whether restaurant growth is directly negatively correlated with other physical retail growth, which would be the case if vacancies and displacement of workers from other physical retail activity played a role in the rise of restaurants. In Section 5.2, we examine evidence for a shift in preferences towards restaurant food and explore a simple quantification of the impact of such a shift on restaurant activity. In Section 5.3, we delve deeper into the expansion of restaurants to examine whether most of the growth was concentrated within a certain type of restaurants (in particular, limited service, or fast-food, versus full service restaurants) and the demographics of counties where the growth occurred.

5.1. Supply Side Factors and the Rise of Restaurants

5.1.1. Trends in Retail Real Estate Vacancies and prices

The growth in online retailing and the growth of Big Box stores described above both would suggest an important reduction in the demand for traditional retail space. Figure 7a shows the vacancy rate, at the national level, for retail (and other types) of commercial real estate. Figure 7b shows how the price of retail real estate has evolved over time. Both figures illustrate the large impact of the great recession in 2008-09 on retail real estate. The effect on price is particularly pronounced, with the price index reaching about 175 right before the great recession (from 100 in 2000), and falling back down to almost 100 at the end of 2009. However, from that point on, the price recovers, reaching about 175 again in 2016.

[16] For several years, Burger King was known to systematically locate its restaurants near McDonald's restaurants on the presumption that these were high demand areas for fast-food, and that the differentiation between the two chains in terms of products would allow them to capture some of that demand. Eaton and Lipsey (1982) argued that economics of scale and scope arising from multipurpose shopping trips lead to benefits from retail agglomeration that can be higher than the costs of locating close to competitors. See also Page (2007) for a theoretical paper that suggests that chains beget chains, based on a similar argument.

[17] In simple, homogenous firm models, it is easy to show that a pure reduction in fixed costs, or pure reduction in variable costs, would lead to a higher equilibrium number of firms in the market.

Looking more closely at vacancies, in Figure 7a, there is a sizable increase in the proportion of vacant retail space starting with the Great Recession, from a rate lower than 8% to a maximum of about 11% a few years later, in 2010-2011. The vacancy rate then decreases gradually, settling at 9.9% in 2016. This post-financial crisis rate is well above the rate of about 7% observed prior to the great depression, in 2005-2007.

While the data about vacancy rate and the price index for retail real estate clearly show the effect of the financial crisis of 2008-09 on this market, an effect that was also very visible in Figures 1 and 3 for retail and restaurants, the evidence about a continued retail apocalypse way beyond the financial crisis is much less clear from these data. Instead, there is evidence of recovery from the great recession, with vacancy rates stabilizing, though at a higher level than before the recession, and the price index fully recovering by 2016.

We conclude that the growth in online retailing and general merchandise stores has been associated with reductions in the number of establishments and employment in the goods retail sector (NAICS 44-45), but that the effect on the retail real estate market has been less dramatic than might be expected in that there is not the kind of secular reduction in the price of retail real estate, nor continued increase in the vacancy rate, that one might predict post the great recession based on the rate of growth in online retailing in particular. This, of course, is consistent with the idea that the demand for retail real estate has not systematically declined over time, or since the great recession. We would argue that this is likely due to the counterbalancing growth in the number of restaurants in the post-financial crisis, as shown in Figure 2 above. In fact, the evolution of the price index in Figure 7 is very similar to the evolution in the total number of establishments (the sum of establishments in NAICS 44-45 and restaurants) in Figure 1d.

5.1.2. Correlation between Restaurant Growth and Traditional Non-Restaurant Physical Retail Growth at the County Level

As a further and more direct test of whether the rise in restaurants was induced by the decline in retail rents and wages, which themselves would be consequences of the collapse/apocalypse in the goods retail sector, we examined the correlation between restaurant growth and growth in number of establishments or employment in such retail at the county level, using the US Census Bureau's County Business Patterns data.

In Table 3, we show long difference regression results where the dependent variable is either the growth in number of restaurants in the county between 1999 and 2016, or the growth in the number of employees in that sector. The main explanatory variables are the growth in the number of establishments in Traditional Non-Restaurant Physical Retail, and growth in average payroll per employee in that sector.[18] In our preferred specifications, we also control for growth in the number of Big Box stores, growth in county population, and growth in per capita income in the county.

In columns 1 and 2 of Table 3, we find that there is a strong *positive* correlation between restaurant growth (both in terms of number of establishments and employment) and growth in the number of establishments in the brick and mortar goods retailing sector (NAICS 44-45 except nonstore retail). In columns 3 and 4, we find, as expected, that the average payroll per worker in the brick and mortar goods retailing sector is a deterrent to restaurant growth. In the remaining specifications, we show that the strong positive correlation between the growth in number of establishments in the brick and mortar goods retailing sector remains after we control for growth in the number of Big Box stores and demographics at the county level. Moreover, here

[18] As mentioned in Section 3 above, we do not have wage data in the County Business Pattern database. We use total payroll in the sector in the county and information about total numbers of employees in the sector to derive a measure of average yearly pay per worker. To the extent that some of the employment is part-time, this measure of average payroll indicates how much the average employee working the average number of hours brings home as compensation on a yearly basis. If all the employees were full-time, or if we knew hours worked, this measure could be further divided by the usual number of hours worked to yield a wage rate. However, we do not have data on hours worked, and we know many of the employees are in fact part time, so we use "average payroll per employee" throughout.

again, as in Table 2, we find that Big Box store growth is positively correlated with restaurant growth, and population and income growth are beneficial for restaurant growth as well.

Figure 8 presents a semi-parametric picture of the relationship between the growth in number of restaurants or restaurant employment and growth in the brick and mortar goods retailing sector. Specifically, the figure reports the mean and the interquartile (p25 to p75) range for the growth rate for restaurants between 1999 and 2017, within 10 (population-weighted) deciles of county bins of growth in Traditional Non-Restaurant Physical Retail.[19] The graphs on the left confirm the results from the regression, that there indeed has been systematically higher growth of restaurants (both in terms of establishments in the top left panel, as well as employment in the bottom left panel) in the counties that experienced relatively lower decline or even positive growth in number of other physical retail establishments. The results in the panels on the right provide more nuance relative to the average negative effects we found in Table 3 with respect to compensation. Specifically, it appears that the growth in restaurants was lower in places with very low as well as very high growth in average payroll per worker in the physical goods retail sector. Thus, restaurant growth was focused on those counties with medium to high growth in the compensation of workers in the Traditional Non-Restaurant Physical Retail sector, not those with the highest but also not those with the lowest such growth.

Overall these results suggest that restaurant growth is in fact stronger in places that experienced relatively less of a decline in other physical retail activity, suggesting that there is not a prominent role for a supply side explanation that relies on the reduction in demand for real estate or labor due to reductions in other physical retail for the rise of restaurants.

5.1.3. Productivity and Compensation

While labor and real estate cost reductions do not seem to have spurred the growth in the restaurant sector, it is possible that costs in this industry might have been reduced, or productivity increased, through some other channel, e.g. some innovation or other cost-side shock. Figures 9 and 10 provide some interesting data in this regard.

In Figure 9, we use data on sales are from the US Census Bureau ARTS, and on employment and establishments from the US Census Bureau County Business Patterns, to calculate and show how both real sales per establishment (top left panel) and employment per establishment (bottom left panel) have grown at a very rapid rate in the restaurant sector since the great recession. In particular, sales per establishment (in 1999 dollars) increased from about 600K in 1999 to about 720K in 2017, with steep increases between 2013 and 2016.

Note that real sales per establishment in part grew as a result of sizable increases in the number of employees per establishment (top right panel) in this sector, so the story on real sales growth is not simply one of increased productivity per employee. Nonetheless, the steep growth in real sales per employee implies increased productivity per worker, which, holding demand constant, could explain some of the observed growth in the number of establishments in this sector. However, the two middle panels in this figure also show very rapid increases in real payroll, per establishment (top middle panel), and per employee (bottom middle panel). The increases in real payroll per worker are large enough, in fact, to lead to overall decline in

[19] The counties are divided into 10 groups with lowest to highest Traditional Physical Retail growth between 1999 and 2016. The x-axis measures the growth, so the top left panel of Figure 8, first bin, has a mean Traditional Physical Retail physical establishments' growth rate of -38%. The population-weighting in the construction of the bins means (as indicated in the notes to the figure) that counties are divided into ten groups with equal populations in each group; because the total US population in 2016 per the BEA data is about 320 million, each group refers to a collection of counties with population of about 32 million people. (The number of counties varies across bins as some bins may have a lot of small populated counties that together only have the population of a single large county in another bin.)

sales per dollar of payroll (bottom right panel). [20] Thus, while there has been labor productivity growth in this sector, the growth in real compensation has more than offset the benefits garnered by firms as a result of this productivity growth.

Figure 10 compares trends in labor productivity and compensation for workers in different retail sectors. It shows in particular that real value added has been very stable throughout the period in all sectors except in nonstore retailing. The latter's growth in value added should be interpreted with caution, because of the measurement error discussed in subsections 2.3 and 2.4, i.e. the idea that some of the labor that support sales in this sector likely appears under Warehousing and Transportation (NAICS 48-49) rather than Nonstore retail.

Figure 10 shows that real value added per worker, and real payroll per employee, are lower for restaurants than for other retail. This point provides a note of caution in interpreting some of the aggregate trends noted above. In particular, while the growth of restaurants has offset the decline in employment in the rest of the physical retail sector, Figure 10 highlights the fact that the payroll per employee as well as contribution to GDP per employee (value added) in this sector are significantly lower than for other sectors. That is, we must be cautious in comparing employment numbers in retail to those in other physical retail sectors because the range of payroll around 10K to 12K per year per employee for restaurants is consistent with much of this work being part time, more so than what occurs in other retail sectors, even though some of them may also have part time worker.

In terms of productivity and compensation, however, the main point with regard to restaurants is that while sales per establishment, and real sales per employee, have gone up dramatically (per Figure 9) over the period we focus on, in reality, real value added per employee has not. At the same time, real payroll per employee has inched up (Figure 9, and Figure 10, right top and especially bottom panel).

5.2. The Demand for Food Away from Home

As our results above suggest that there is not a good supply side explanation for the growth in the number of restaurants, in this subsection, we turn to an examination of potential demand side explanations. A study projecting demand for restaurant food (Stewart, Blisard, Bhuyan and Nayga 2004) noted that increases in household income typically increase demand for restaurant food. The increase in proportion of single-person and no-children-multiple-adults households were also expected by the study authors to increase restaurant demand.

We use BEA data on personal expenditures to derive estimates of expenditures on food. Specifically, the BEA reports spending on Food and Accommodations (consistent with NAICS code 72) in a "Personal Consumption Expenditures by Major Type of Product" table. Comparing the dollar expenditure numbers in the BEA data to sales data for NAICS 72 according to the ARTS data, we find that the ratio of aggregate expenditure to sales in this category are in a tight range between 92% and 98% over the 1999 to 2017 period. Assuming that the same personal expenditure (per BEA) to sale (per ARTS) ratio holds for subcategories within Food and Accommodations, we use the available sales for restaurants to arrive at an estimated personal expenditure on restaurant food (by multiplying restaurant sales by the expenditure-to-sales-ratio for the "Food and Accommodation" aggregate category).[21] The BEA table also separately reports "Food and beverages purchased for off-premises consumption" as a category within non-durable goods, which we characterize as expenditure on "food at home".

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[20] Both increased competition for workers, and changing minimum wage laws in various jurisdictions, are likely to be contributing to the growth in payroll per employee in the restaurant sector.

[21] That is, we estimate personal expenditures on restaurant food $E_r \equiv S_R \times \frac{E_{FA}}{S_{FA}}$ where S_R is total yearly sales in NAICS 722, S_{FA} is yearly data on sales for Food and Accommodations (NAICS 72) which are available from ARTS, and E_{FA} is yearly expenditure on Food and Accommodations (available in the BEA table).

In Figure 11a, we present the resulting trends in the share of expenditures on "off-premises food" (which we label as "non-restaurant food") versus the share of (imputed) restaurant expenditures. We find that, consistent with a shift in consumer preferences towards restaurant food, there has been a decline in the share of total expenditures on non-restaurant food from 8.2% to 7.2% (right axis), with an almost exactly offsetting increase in the share of restaurant food, from 4.2% to 5% (left axis).

We then undertake a simple quantification exercise to understand the role of this increase in share of expenditure on restaurant food in potentially explaining the observed increase in number of restaurants and employment in restaurants. To do this, we obtain a counterfactual number of restaurants in the absence of expenditure share growth by using the following simple relationship:

Projected number of restaurants in year t = share of restaurants in total personal expenditure in 1999 × observed total personal expenditure in year t × observed sales to expenditure ratio for restaurants in year t / observed sales per restaurant in year t

We project the counterfactual employment using a similar formula. Figure 11b shows the actual and predicted (counterfactual) trends in number of establishments in the left panel, and in employment in the right panel. The left panel shows that without the expenditure shift, the aggregate number of restaurants would have reached only 550,000 instead of the observed 650,000 in 2017 (using the observed sales per establishment each year, which itself grew during this period). Thus, of the roughly 150,000 establishments increase between year 1999 and 2017, about 100,000 (or 2/3rds) could be attributed to the increase in share of restaurant expenditures. Similar calculations for restaurant employment on the right panel suggest that about 2 million of the observed 4 million increase in restaurant employment (from 8 million in 1999 to 12 million in 2017) can be attributed to this shift in expenditures.

Albeit highly simplistic, these estimates suggest an important role for increases in personal expenditure, and particularly for a shift away from expenditures on food at home toward more food consumed away from home, in explaining the rise in the number of, and employment levels in, restaurants.

5.3. What types of restaurants grew and where?

In this section, we take a closer look at the growth in the number of restaurants. In particular, we address two questions: (i) Is the restaurant sector growing by adding high quality restaurants, as suggested by our earlier analyses suggesting increasing establishment size and employee productivity; and (ii) is the growth focused on particular types of customers (i.e. growth in full service vs. limited service restaurants, which might indicate a focus on high or low income customers, or in counties with high or low income levels).

Quality of Restaurants: Figure 9 above presented trends for a number of proxies for quality of restaurant establishments and sales and payroll per worker. Because these all show sizable upward trends in these measures, they suggest an overall increase in the quality of establishments and jobs at these establishments.

In Figure 12, we use data from Yelp to calculate an inverse HHI (Hirshman-Herfindhal Index) measure of restaurants variety, as well as the fraction of restaurants with a rating at or above 4 stars. Though the data are necessarily limited to the small number of US MSAs in the Yelp data, which we combine into a single aggregate time series for both the inverse HHI and ratings data over time, results suggest that consumers now have access to a greater variety of types of restaurants, as well as a greater fraction of highly rated restaurants.[22]

[22] In addition to the limitation that the Yelp data reflect only years 2010 to 2018, and only a few MSAs with significant coverage (more than 5000 restaurant-year observations in the full panel) of just six states (Arizona, North Carolina, Nevada, Ohio, Pennsylvania and Wisconsin), with some limited coverage of two others (Illinois (2861 observations) and

Rich vs Poor Counties, and Fast Food versus Full Service: In Figure 13, analogous to Figure 8, we present a semi parametric analysis to show where the two different categories of restaurants identified in the Economic Census, namely Limited Service restaurants (i.e., restaurants where patrons normally order their food at a counter rather than interacting with a server at their table; this category is often equated with Fast-Food, although it also includes much more than the typical burger restaurant that this nomenclature conjures up) and Full Service restaurants (where patrons are seated and order their food and are served while seated at their table) have grown, in rich versus poor countries. The figure shows strong positive growth across the full range of county income levels for both types of restaurants. In other words, both full service and limited service restaurants have grown in number, across poor and rich counties. Bars, (which form a small third category in the Food Services sector – see Appendix Figure A7a) have achieved slower growth generally, and in particular in poorer counties, both of which are perhaps socially optimal.

6. Emerging trends in retail

In this section, we draw on media news stories, company annual reports, and data from Crunchbase to discuss some emerging trends in the retail sector. As noted earlier, a number of new firms are offering services or technology that complement traditional physical retail; our (admittedly rough) manual classification of the top 25 best funded retail-related startups (in Appendix Table A3) finds that 55% of the funding went to companies that provide complementary services. Specifically DoorDash with about $2.1bn and Instacart with about $1.8 bn in funding are delivery services companies that help physical retail firms provide home delivery for customers.

- Omnichannel strategy – Physical retailers offering online shopping, and the blurring of boundaries: Physical retail firms are investing in their online presence, and realigning their supply chain and distribution to serve customers through a blend of (a) online ordering, packaging at warehouses and delivery to customer homes from warehouses, (b) online ordering, collation of order in physical store, and delivery to customer homes, and (c) online ordering and curbside pickup. Walmart has been an aggressive proponent of this "omnichannel" strategy, with plans "to have grocery pickup available at 3,100 stores and same-day delivery from 1,600 stores, covering about 80% and 50% of the U.S. population, respectively" by end of 2019 (Redman 2019). A prominent investment for Store 8, Walmart's incubation arm, is Walmart InHome Delivery, which aims to deliver groceries not just to the customer's door, but to stock it in the home refrigerator. Arguably, Amazon's acquisition of Whole Foods (in 2017), and the Prime Now service (launched in June 2018), which offers same-day delivery in select locations from Whole Foods stores, is an example of the reverse trend, namely online retailers embracing an omnichannel strategy as well. News reports (e.g., Weise 2019) suggest that Amazon is contemplating a new chain that "would be built for in-store shopping as well as pickup and delivery".
- Independent on-demand delivery firms teaming up with physical retailers: Related to the above, a number of new independent delivery firms are teaming up with physical retailers. For example, emerging grocery delivery firms including Instacart, Shipt, and Burpy, offer on-demand delivery services from local stores, with online ordering and "personal shoppers" picking and putting together the order and delivering it to customer homes. These services could enable physical retailers to provide the comfort and convenience offered by online retailers. DoorDash (the top of our retail

South Carolina (1535 observations), we also note that the definition of restaurant varieties is not systematic. We define varieties by looking for keywords in the "categories" description string variable for nationalities (e.g., Indian, Chinese, Afghan, etc.) or regions (Arabic, Asian, Mediterranean, etc.), as well as food types (deli, diner, halal, sandwich etc.). The full list of restaurant types used is provided in Appendix Table A2.

start-up list in Appendix Table A3) and a number of other start-ups (e.g., GrubHub) provide home delivery services for customers to buy from a range of local restaurants.[23]

- Traditional retailers investing in curbside pickup and BOPIS (Buy Online Pickup in Store or "Click and Collect"): A number of media stories suggest investments by grocery stores, general merchandise stores, and other retailers in allowing shoppers to buy online and pick up curbside or in store (termed "BOPIS" or Buy Online Pick-up in Store). An infographic report on invesp.com cites studies showing that 67% of shoppers in the US have used BOPIS, and that 49% of shoppers using BOPIS report making additional purchases while picking up items in store. The report also mentions that 90% of retailers plan to implement BOPIS by 2021.[24] One of Walmart's investment, JetBlack, is a start-up aimed at Personalized Shopping for time-constrained parents in Manhattan.

- Autonomous vehicles/drone based delivery: Amazon, Dominos and other retailers have announced plans to experiment with delivery using drones. Amazon's Prime Air page highlights the fully autonomous (no human pilot) delivery made on Dec 7, 2016. UPS was recently awarded certification to use drones on medical campuses (New York Times, 2019)[25], but UPS indicated that the possibility of use in urban areas was uncertain. News reports suggest delivery startups such as Postmates are experimenting with delivery robots as well.[26] Per our search of Crunchbase data, there are few start-ups focused specifically on drone or autonomous vehicles delivery for retail; with Nuro developing autonomous vehicles (total funding of $1 billion, and recent test-drive partnership with Walmart[27]), Starship Technologies developing drones(funding of $82.2 million), and Marble focused on land-based courier robots (funding $10 million) being the most prominent. However, autonomous vehicle (AV) development has seen significant investment by other large companies including Alphabet, Uber, Tesla and mainstream car manufacturers (Ford, GM, and if these vehicles reach so called full automation "Level 5" capability, it would be a significant labor saving technology with significant implications for the structure of retail markets; this capability however seems many years away (see e.g., Noonan, 2019).

- Artificial Intelligence (AI) investments to improve stocking, inventory management and customer services: A number of traditional retail companies report investments in AI technologies to reduce costs throughout the supply chain, as well as to respond to and answer customer questions. Examples of investments by physical retailers include the Intelligent Retail Lab investment by Walmart's Store 8, and investments by Dominos in AI-enabled automated phone-ordering[28], Macy's On Call app for assistance in-store, Uniqlo's in-store Kiosks to recommend products, experimental Sam's Club Now store that allows customers to map the most efficient route through the store and leave without the traditional checkout line, Kroger App that makes in-store recommendations, and

[23] One emerging measurement issue is the rise of "virtual restaurants", which are non-store restaurants (including operated from home kitchens, or operated in another name from a physical restaurant) that serve as "online ordering and home delivery only" entities (Isaac and Yaffe-Bellany, NYT 2019). These firms may be difficult to find, and also duplicate employment, space and capital of existing restaurants. E.g., the New York Times news story reports a restauranteur with four operations, only one of which is physical, and the other "three are "virtual restaurants" with no physical storefronts, tables or chairs… [which] exist only inside a mobile app, Uber Eats". https://www.nytimes.com/2019/08/14/technology/uber-eats-ghost-kitchens.html

[24] https://www.invespcro.com/blog/buy-online-pick-up-in-store-bopis/

[25] https://www.nytimes.com/2019/10/02/us/UPS-drone-deliveries.html

[26] https://www.forbes.com/sites/amyfeldman/2019/08/20/starship-technologies-raises-40m-to-expand-its-food-delivery-robots-on-college-campuses/#68b4487b1cec

[27] https://corporate.walmart.com/newsroom/2019/12/10/walmart-to-test-drive-autonomous-grocery-deliveries-with-nuro

[28] https://www.mobilemarketer.com/news/dominos-lets-ai-assistant-dom-handle-incoming-phone-orders/522111/

Starbucks AI-enabled voice ordering.[29].AI technologies are also used by online retailers (e.g., Amazon for product recommendations) so it is unclear whether AI would systematically benefit physical retailers more than ecommerce retailers.

- Other technological innovations in the restaurant sector: In the restaurant sector, operators are looking for technological solutions to address some known pain points. Examples from the casual dining segment include the use of tablets in restaurants, which facilitate interactions with servers (i.e. flagging to get a drink refill or the bill), apps to allow diners to check table times and put their names on wait lists remotely, and General Motors' Marketplace, which allows for food ordering, making reservations, and payment while driving.

7. Conclusion

In this paper, we have discussed how the evidence about the so-called "retail apocalypse" is much less clear, and is in fact contradicted, if we examine sales or employment rather than the number of establishments or storefronts in retail, as the former have bounced back to their pre-great-recession levels at this point, while the number of establishments indeed is still lower today than it was pre-great recession. We note that the changing face of retail in the U.S. is mostly due to innovations that have arisen in other sectors of the economy, namely in the logistics, warehousing and transportation sectors, where cost-saving innovations and the capacity to track goods as they go from manufacturers to consumers have enabled the growth of large chains of general merchandise stores such as Walmart and Target. And of course, the advent and growth of the internet, along with these same innovations in warehousing and logistics, have had a large, and we expect will continue to have a large, effect on many segments of the physical goods retail sector. We also discuss briefly, in Section 6, some innovations that brick and mortar stores are exploring (and even already exploiting) presently to address the needs of consumers.

Most important from our perspective, we also have shown throughout much of the paper how the restaurant sector has grown since 1999, enough so that using what was the Standard Industrial Classification (SIC) version of the retail sector, which included restaurants, we find overall growth in retail over the period of our study. We also show that the number of restaurants has grown in both lower and higher income counties, and across types of restaurants (full versus limited service, variety of food).

We note that while the growth of restaurants has offset the decline in employment in the rest of the physical goods retail sector, Figure 10 highlights that the payroll per employee as well as contribution to GDP per employee in the restaurant sector is significantly lower than for other sectors. The range of 10K to 12K per year for payroll per employee for restaurants also is consistent with much of this work being part time, more so than in other goods retailing sectors (which themselves likely have part time workers). However, there are signs that both worker productivity and pay is increasing in the restaurant industry (Figure 9).

Finally, we find evidence suggesting that this growth in the number and sales and employment in the restaurant sector is related to changing consumer tastes, from less food at home to more food consumed away from home. Exploring the factors that could explain this shift is beyond the scope of the present paper, but many articles in the trade press point to demographic changes along with increased desire for "experiences" outside the home and less focus on purchasing durable goods among younger consumers as factors explaining the increased tendency to consume food outside the home. Moreover, we note that technology is increasingly being used in this sector as well, to relieve some of the pain points for consumers and increase efficiency as well. This, in turn, may lead to yet greater growth in this sector, as well as increases in productivity and employee compensation. We leave further exploration of these issues and other issues explaining the evolution of the retail sector broadly defined as avenues for future research.

[29] https://www.forbes.com/sites/blakemorgan/2019/03/04/the-20-best-examples-of-using-artificial-intelligence-for-retail-experiences/#6ea201574466

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Figure 1a: A Decline in Number of Traditional Non-Restaurant Physical Retail Establishments

Notes: This figure presents the trend in the aggregate number of establishments in Traditional non-Restaurant Physical Retail, which is all retail per the current classification code (i.e., NAICS 44-45) less all nonstore (NAICS 454 which includes ecommerce and catalog) retailer establishments. Data are from the US Census Bureau's County Business Patterns (CBP) dataset.

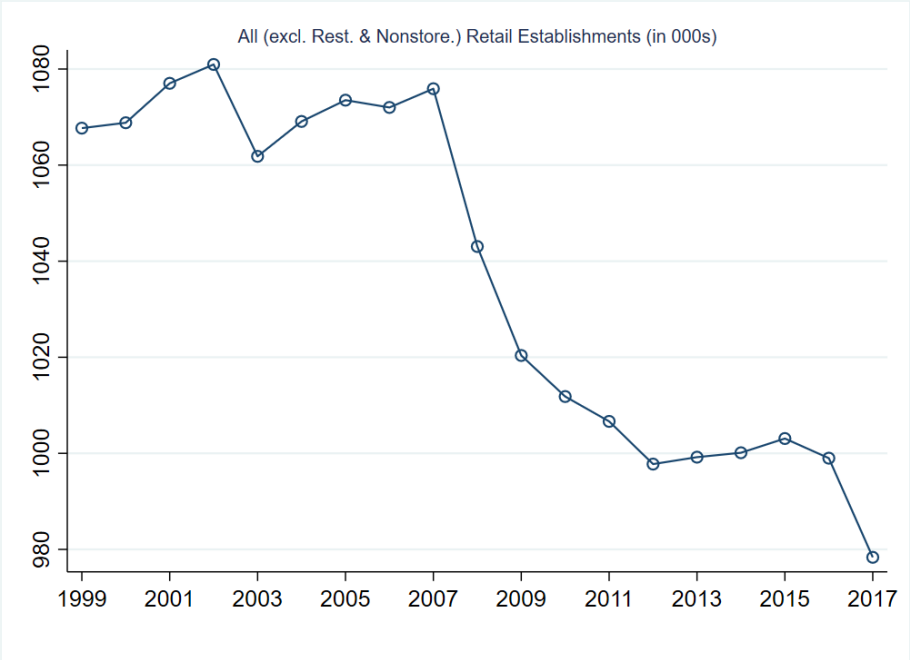


Figure 1b: Strong Growth in Number of Restaurants

Notes: Restaurants is NAICS category 722. Data are from the US Census Bureau's County Business Patterns dataset.

Figure 1c: Traditional Physical Retail (Including Restaurants) Bounces Back After the Great Recession

Notes: This figure presents trends for "Traditional Physical Retail", which refers to all retail establishments (NAICS 44-45) plus restaurants (NAICS 722) but excluding nonstore establishments (454). Data is from the US Census Bureau's County Business Patterns dataset.

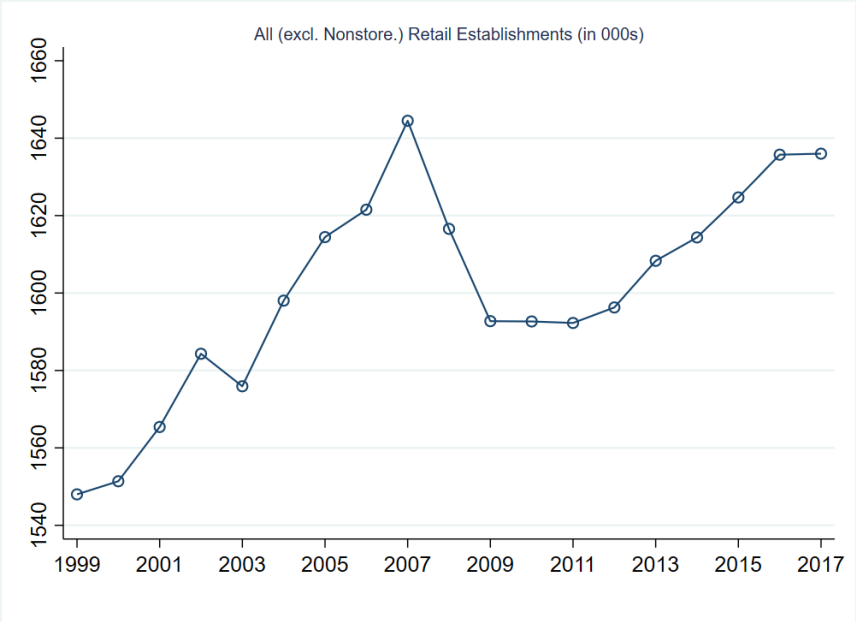


Figure 1d: Numbers of Establishments -- Normalized Trends in Retail Categories

Notes: "Traditional Physical" refers to traditional (per old SIC classification) retail stores excluding nonstore establishments (to exclude establishments of ecommerce and catalog companies) – this is NAICS 44, 45 and 722 excluding Nonstore Retailers (454). "Traditional Non-Rest. Physical" is the "Traditional Physical" excluding restaurants (722). Restaurants refers to NAICS 722. Data on number of establishments are from the US Census County Business Patterns (CBP).

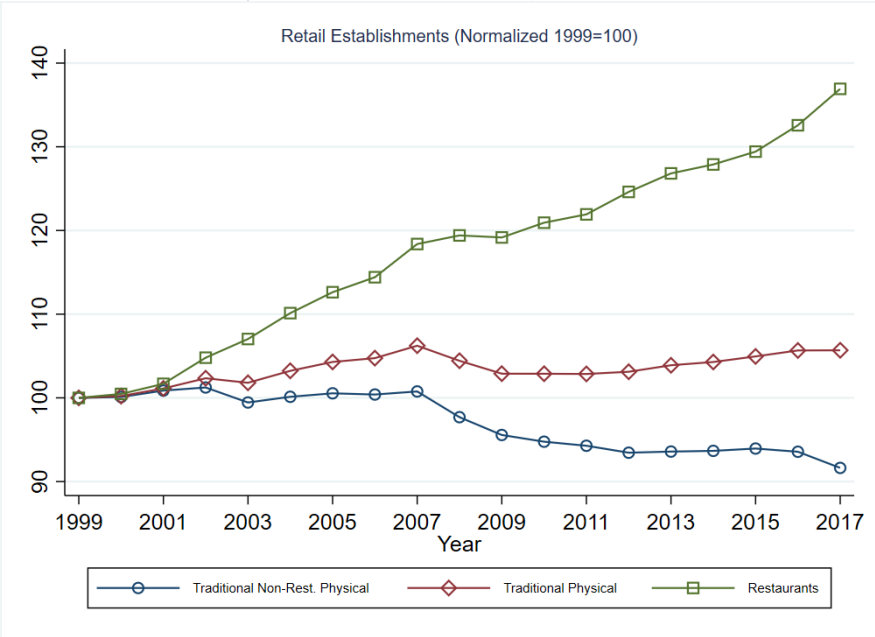


Figure 2a: Employment -- Normalized Trends in Retail Categories

Notes: "Traditional Physical" refers to traditional (per old SIC classification) retail stores excluding nonstore establishments (to exclude establishments of ecommerce and catalog companies) – this is NAICS 44, 45 and 722 excluding Nonstore Retailers (454). "Traditional Non-Rest. Physical" is the "Traditional Physical" excluding restaurants (722). Restaurants refers to NAICS 722. Data on employment are from the US Census County Business Patterns (CBP).

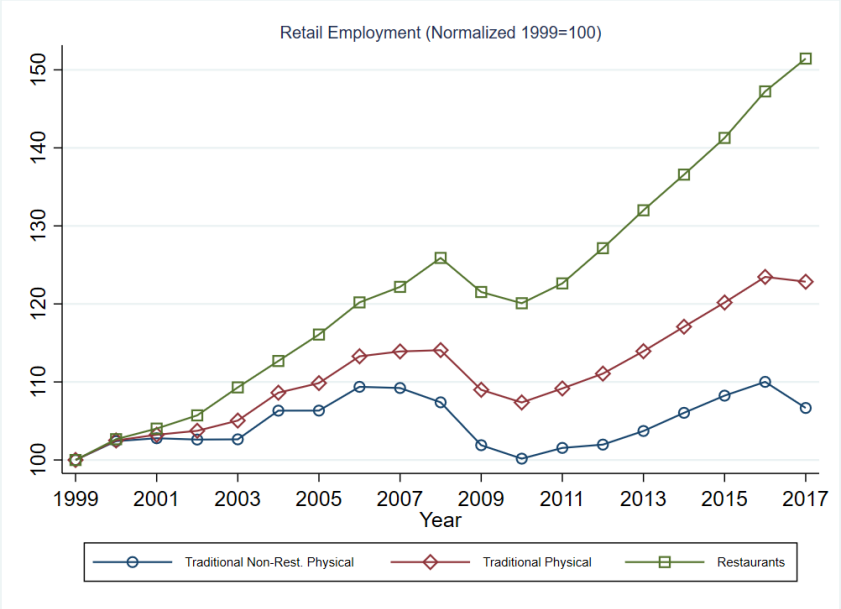


Figure 2b: Employment -- Physical Retail and Restaurant Share of Total Employment

Notes: "Traditional Physical" refers to traditional (per old SIC classification) retail stores excluding nonstore establishments (to exclude establishments of ecommerce and catalog companies) – this is NAICS 44, 45, and 722 excluding Nonstore Retailers (454). "Traditional Non-Rest. Physical" is the "Traditional Physical" excluding restaurants (722). Restaurants refers to NAICS 722. Data on employment are from the US Census County Business Patterns (CBP).

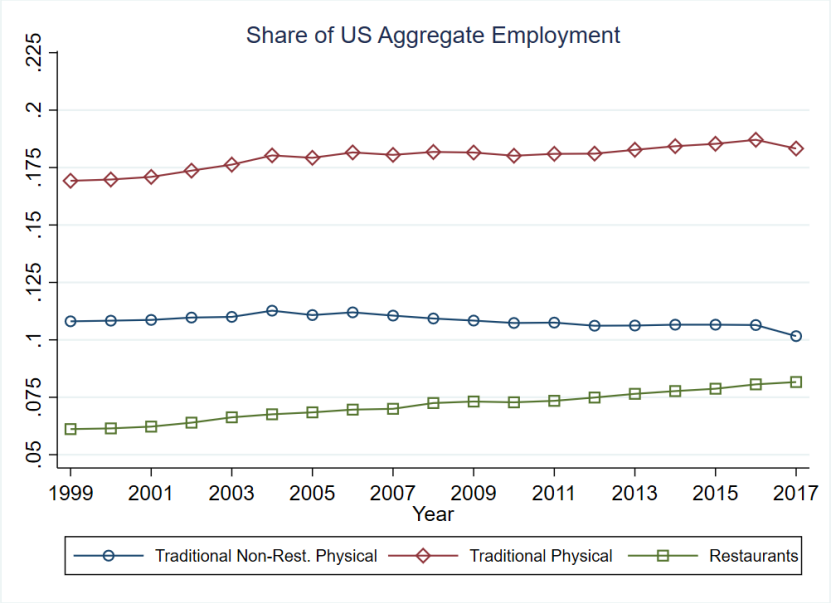


Figure 3: Sales, Value added and Payroll -- Normalized Trends in Retail Categories

Notes: "Traditional Physical" refers to traditional (per old SIC classification) retail stores excluding nonstore establishments (to exclude establishments of ecommerce and catalog companies) – this is NAICS 44, 45, and 722 excluding Nonstore Retailers (454). "Traditional Non-Rest. Physical" is the "Traditional Physical" excluding restaurants (722). Restaurants refers to NAICS 722. Data on employment are from the US Census Annual Retail Trade Survey (ARTS) and its antecedents.

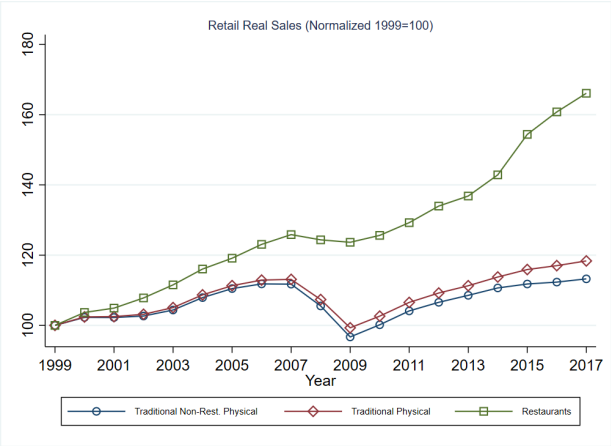


Figure 3a: Sales

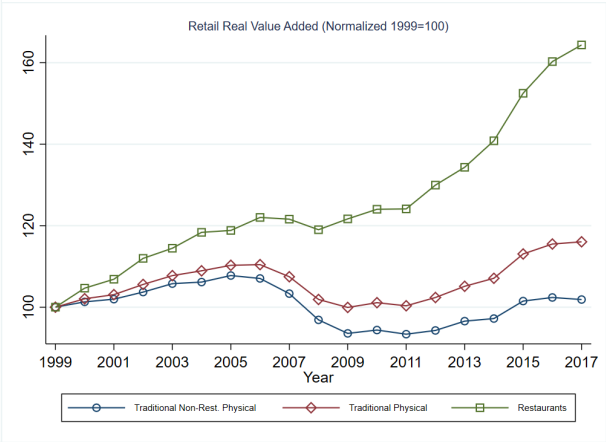


Figure 3: Value Added

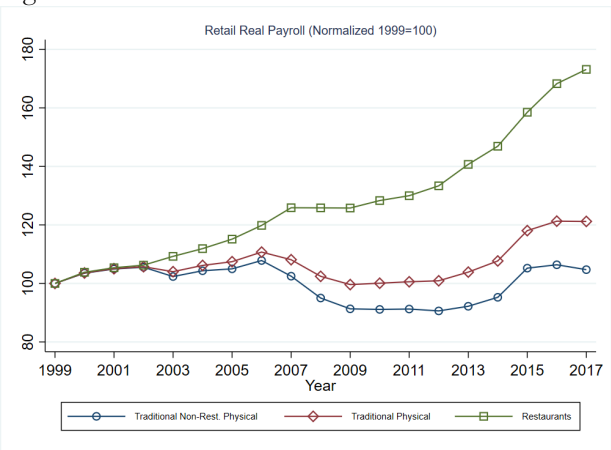


Figure 3c: Payroll

Figure 4: Retail Sales – Trends for Big Box and Non-Store Ecommerce

Notes: Traditional Retail includes all subcategories of NAICS 44, 45 and 722. "Big Box" is the subcategory 45291 (Warehouse Clubs and Supercenters) in the 2012 NAICS. ESMOH-Ecommerce refers to ecommerce by firms in the NAICS 4541 (Electronic Shopping and Mail-order Houses) category, which includes online and catalog retailers. Data are from US Census Bureau's Annual Retail Trade Survey (ARTS) and the Services Annual Survey (SAS) and their antecedents.

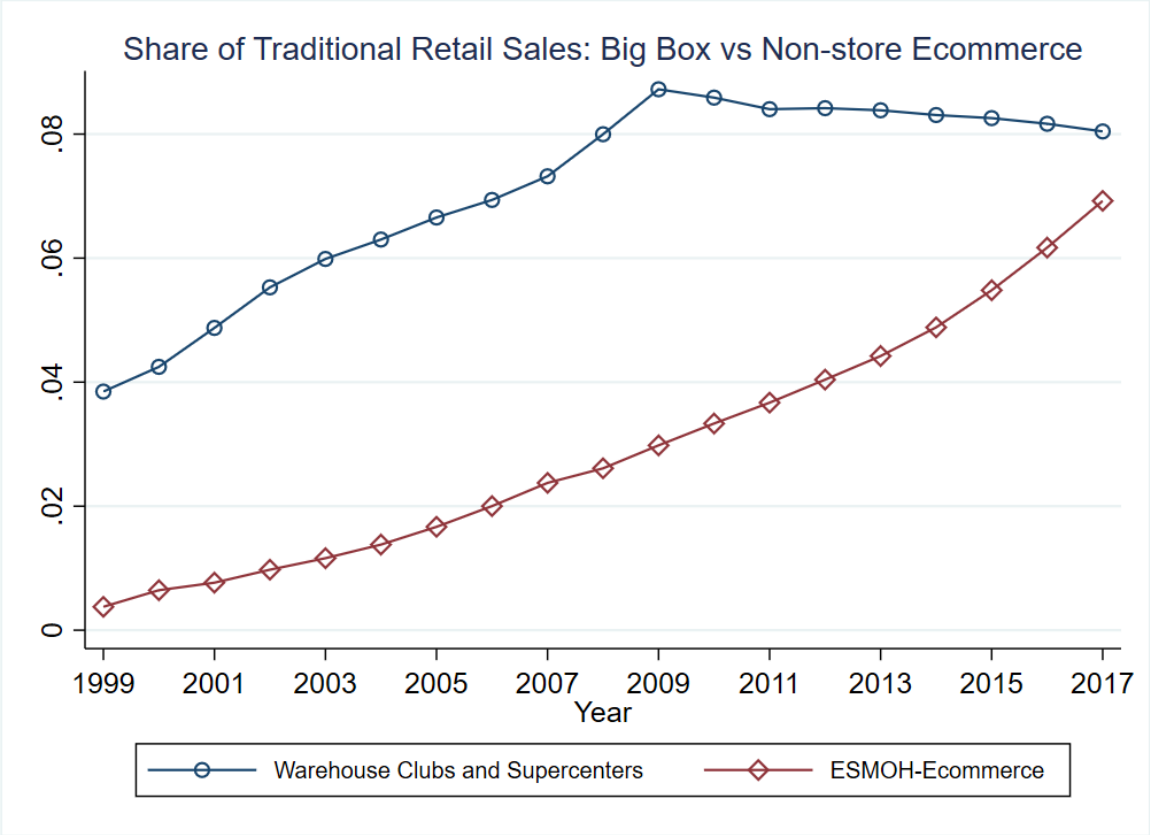


Figure 5: Nonstore (ESMOH) ecommerce share of different retail categories

Notes: This figure is based on imputing the breakdown of ESMOH ecommerce sales by merchandise lines in the US Census Bureau Annual Retail Trade Survey (ARTS) tables to individual retail NAICS codes (see Appendix Table A1 for the concordance used). Data on some merchandise lines for some years were suppressed in ARTS tables – these were interpolated on extrapolated based on data for adjacent years.

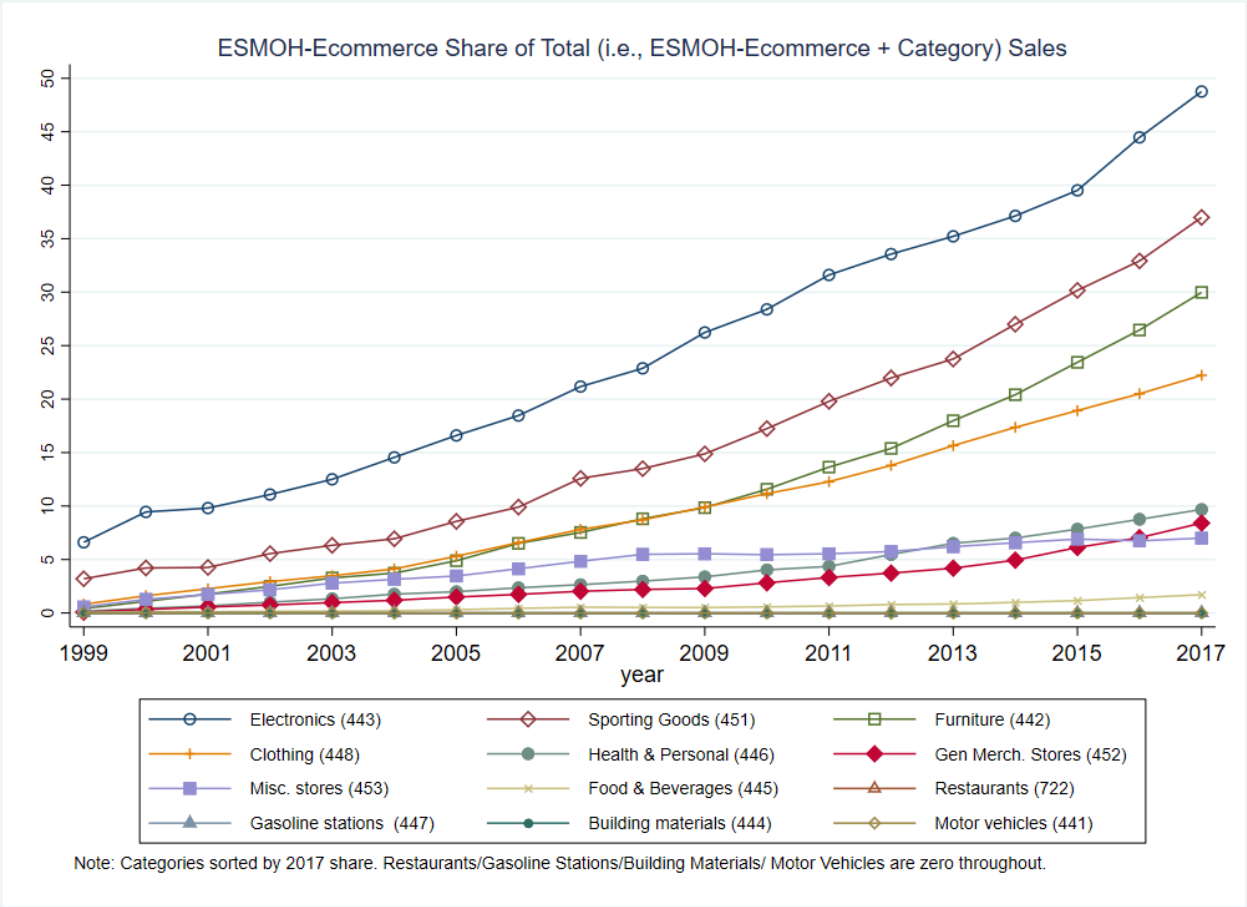
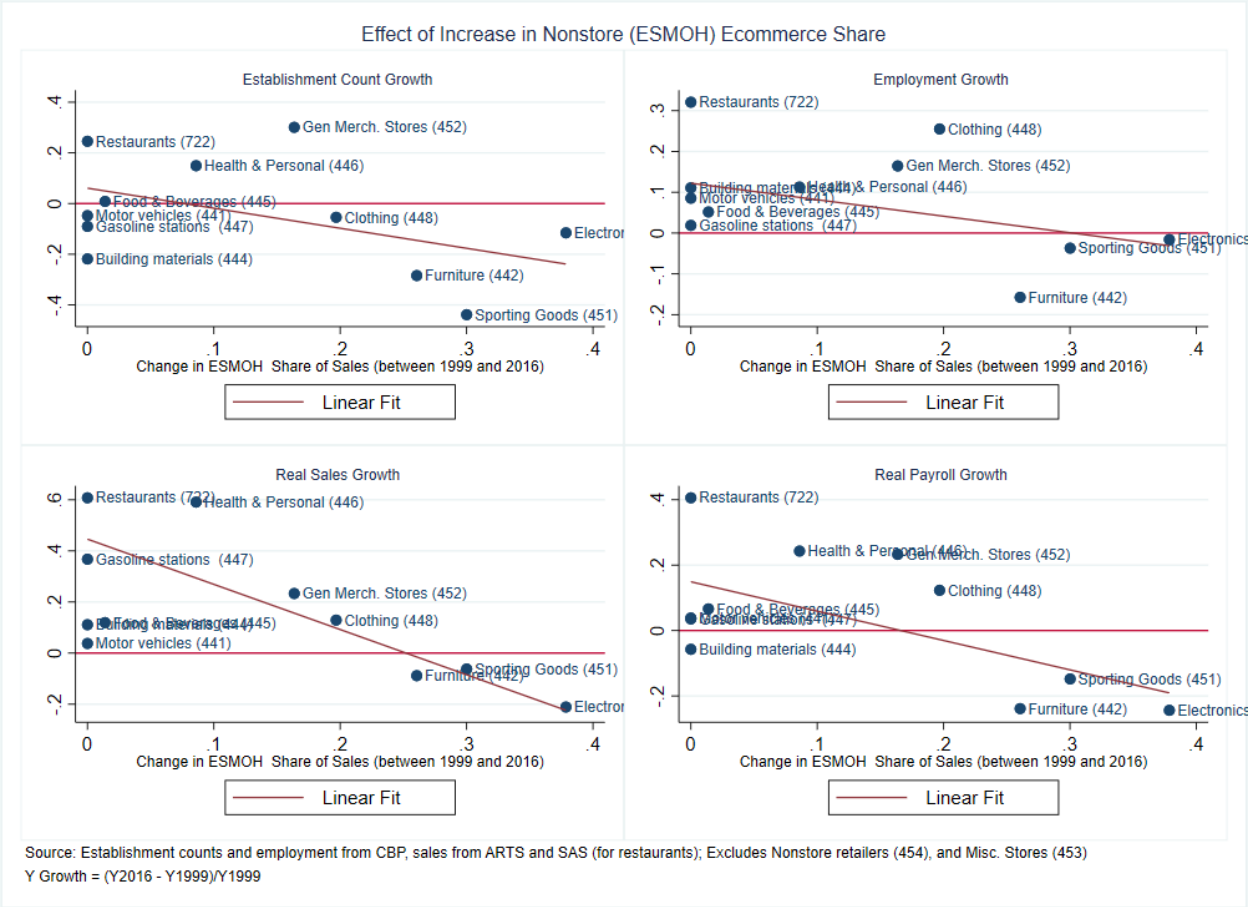


Figure 6: Cross-industry Outcomes: Slower growth in sectors with greater ESMOH Ecommerce penetration

Notes: See appendix Table A1 for corresponding regression results. We include nonstore retailers (454) and treat them as facing zero competition from ESMOH (i.e., change in ESMOH for that category is zero).



Source: Establishment counts and employment from CBP, sales from ARTS and SAS (for restaurants); Excludes Nonstore retailers (454), and Misc. Stores (453)
Y Growth = (Y2016 - Y1999)/Y1999

Figure 7a: Commercial Real Estate Vacancies, by Type

Notes: This figure is Chart 3 in the Capital Markets Special Report of the National Association of Insurance Commissioners and the Center for Insurance Policy and Research, accessed from https://www.naic.org/capital_markets_archive/170601.htm. Source data for the figure is cited as REIS Inc.

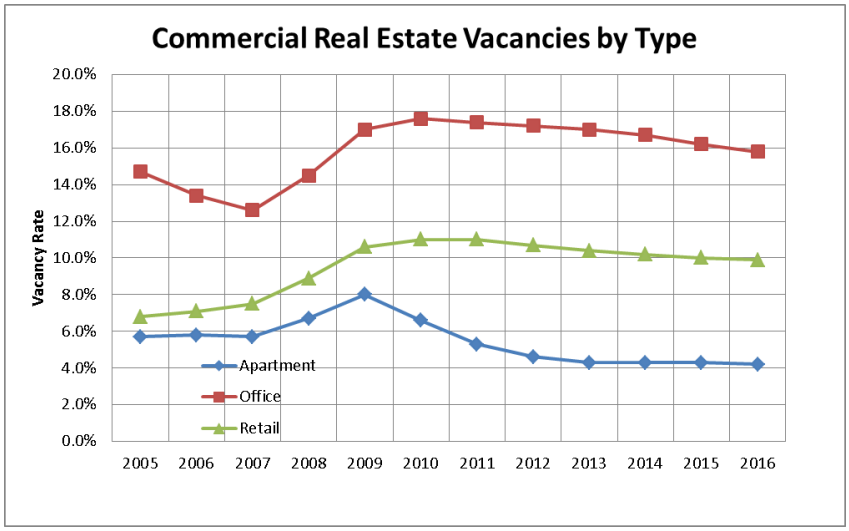
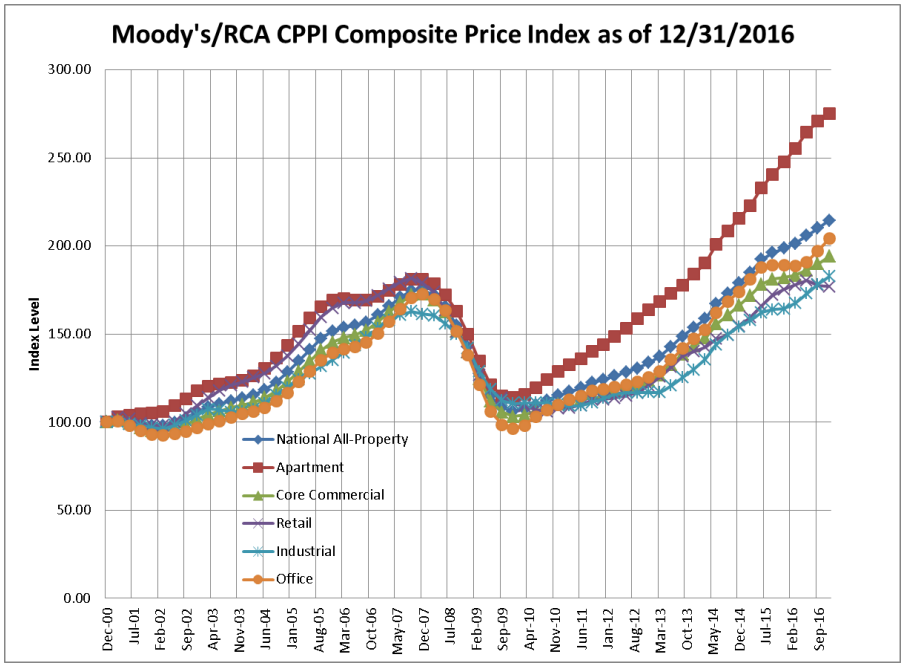


Figure 7b: Commercial Real Estate Price Index by Property Type

Notes: This figure is Chart 1 in the Capital Markets Special Report of the National Association of Insurance Commissioners and the Center for Insurance Policy and Research, accessed from https://www.naic.org/capital_markets_archive/170601.htm. Core commercial includes retail, industrial and office.



**Core commercial includes retail, industrial and office.*

Figure 8: Restaurant Growth (between 1999 and 2016) vs Traditional Non-Restaurant Physical Retail Activity

Restaurants grew more where other physical retail grew, except the counties with the highest growth in payroll per employee saw somewhat slower growth in restaurant establishments and employment

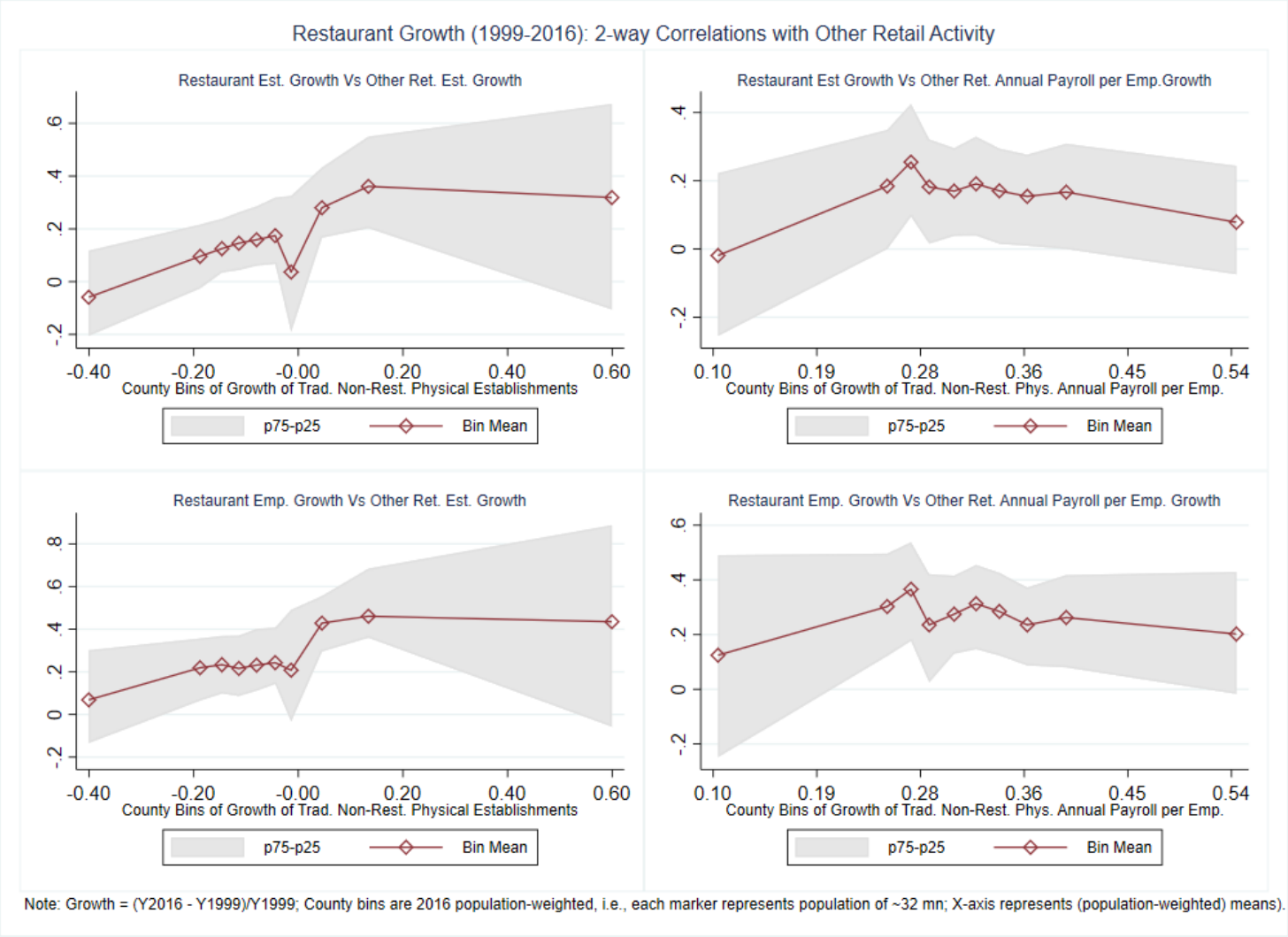


Figure 9: Aggregate Restaurant Sector Productivity

See Appendix Figure A6 for level trends.

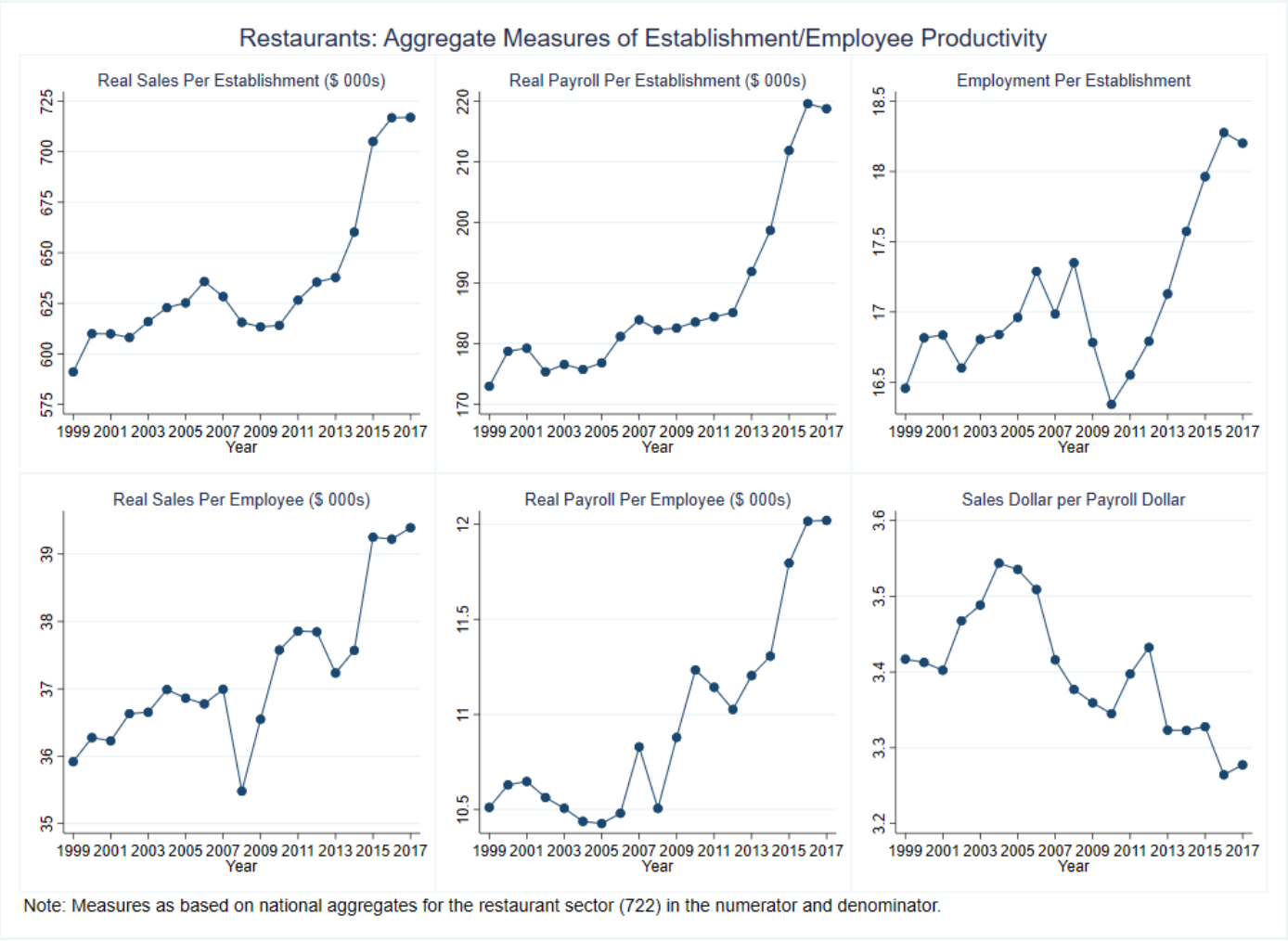


Figure 10: Real Value Added and Payroll, per Employee (Labor Productivity and Average Annual Payroll per Employee)

Notes: Auto refers to Motor Vehicles and Parts Dealers (NAICS 441), Nonstore refers to NAICS 454, and Restaurants refers to Food Services and Drinking Places (NAICS 722). Other Retail is total traditional retail (NAICS 44-45) less Auto and Nonstore. Data on sales are from US Census Bureau ARTS, employment and establishments are from the US Census Bureau County Business Patterns data, and value added are from BEA.

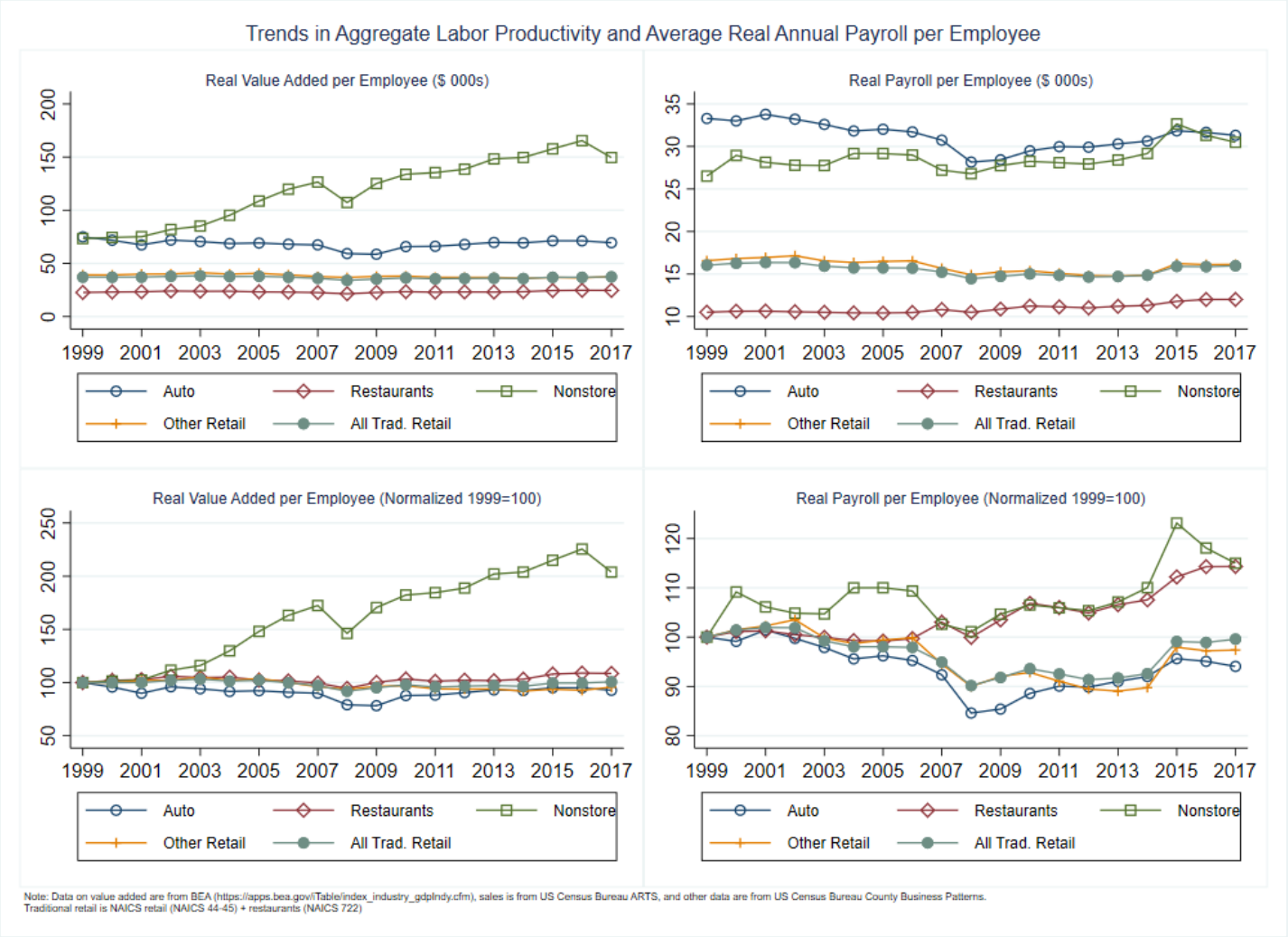


Figure 11a: Relative Increase in Restaurant Expenditure Share

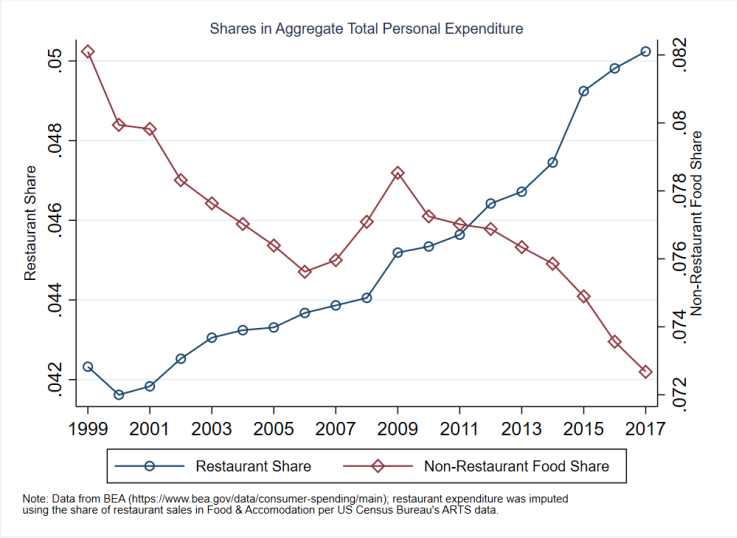
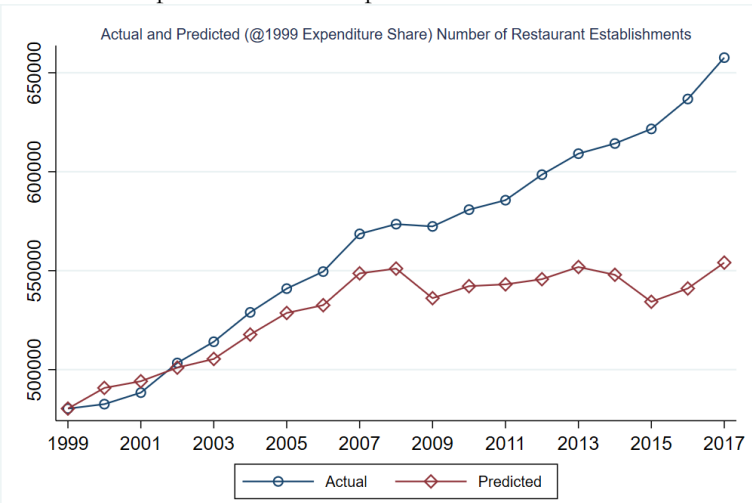


Figure 11b: A Simple Estimate of the Role of Expenditure Shift in the Growth of Restaurants

Increase in expenditure share explains about 50% of the increase in employment and 2/3rd of increase in number of restaurant establishments.



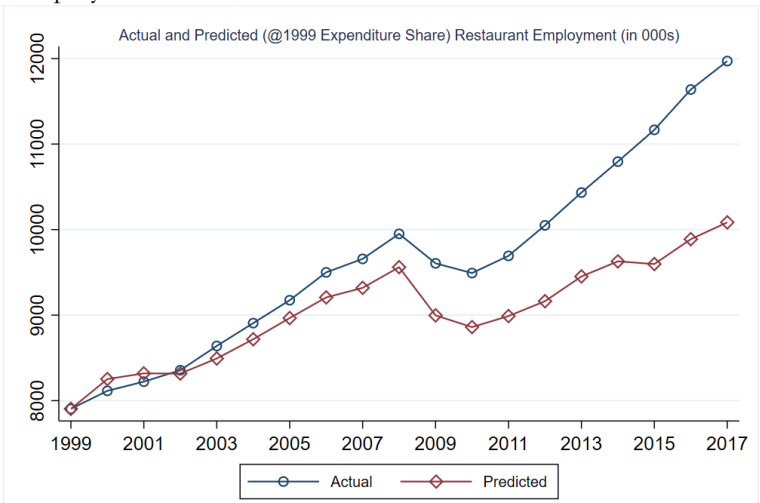


Figure 12: Indicators of variety and quality of restaurants: Yelp restaurant data

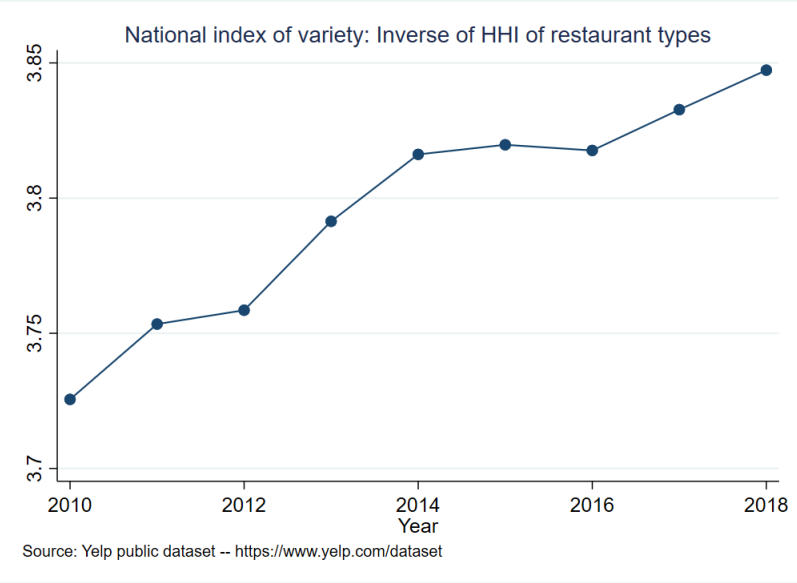


Figure 13: Did restaurants grow in rich counties only?

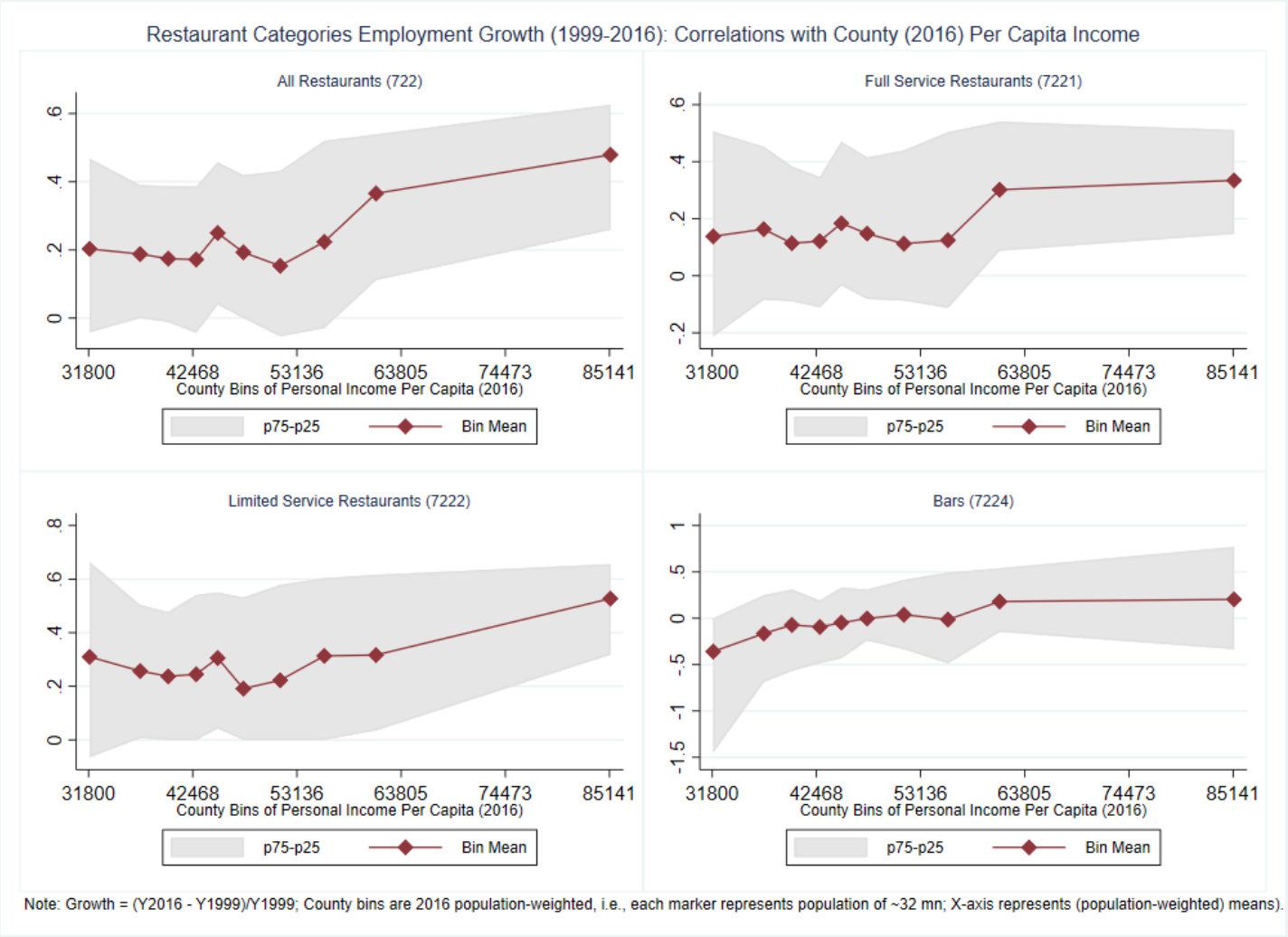


Table 1: Aggregate Cross-industry Exploration of the role of ESMOH Ecommerce on the Decline in Physical Stores

	(1)	(2)	(3)	(4)
	Establishment Growth (1999 to 2016)	Employment Growth (1999 to 2016)	Sales Growth (1999 to 2016)	Real Payroll Growth (1999 to 2016)
Change in Ecommerce share of sector (1999 to 2016)	-0.655	-0.440	-1.754**	-0.881*
	(0.481)	(0.285)	(0.695)	(0.391)
Constant	0.0338	0.139**	0.904***	0.154*
	(0.0888)	(0.0526)	(0.128)	(0.0722)
Observations	11	11	11	11
R-squared	0.171	0.209	0.414	0.360
Dep Var Mean	-0.0281	0.0768	0.797	0.0482
Dep Var SD	0.231	0.126	0.659	0.197
Mean of Change in Ecommerce share	0.112	0.112	0.112	0.112
SD of Change in Ecommerce share	0.129	0.129	0.129	0.129

Table 2: Traditional Non-Restaurant Physical Retail Growth and Big Box Growth – Long Difference Estimates

Note: Observations are weighted by county population. County population and income data are from the BEA regional economic accounts https://apps.bea.gov/regional/downloadzip.cfm .

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var: Growth (99 to 16) in Trad. (non-rest) Retail:	Estabs.	Estabs.	Emp.	Emp.	Estabs.	Estabs.	Emp.	Emp.
Growth in Big Box Estabs.	**0.0985*** **		**0.120*** **		**0.0512*** **		**0.0721*** **	
	(0.0087)		**(0.0074)**		**(0.0084)**		**(0.0065)**	
Big Box growth Cat 2 (growth=0)		-0.00634		0.0483		-0.00771		0.0445
		(0.0528)		(0.0452)		(0.0489)		(0.0380)
Big Box growth Cat 3 (growth>0 & <=1)		**0.0837***		**0.125*** **		**0.0477**		**0.0913** **
		(0.0506)		**(0.0433)**		**(0.0469)**		**(0.0365)**
Big Box growth Cat 3 (growth>1)		**0.190*** **		**0.245*** **		**0.0840***		**0.139*** **
		(0.0506)		**(0.0433)**		**(0.0472)**		**(0.0367)**
Growth in County Population					0.782***	0.781***	0.893***	0.903***
					(0.0336)	(0.0345)	(0.0259)	(0.0269)
Growth in County Personal Income (per capita)					0.276***	0.295***	0.701***	0.713***
					(0.0615)	(0.0621)	(0.0474)	(0.0484)
Constant	-0.108***	-0.132***	0.0238***	-0.0274	-0.333***	-0.350***	-0.443***	-0.487***
	(0.0103)	(0.0498)	(0.0087)	(0.0427)	(0.0353)	(0.0578)	(0.0272)	(0.0450)
Observations	3,088	3,088	3,088	3,088	3,088	3,088	3,088	3,088
R-squared	0.040	0.042	0.079	0.064	0.184	0.181	0.353	0.339

Summary Statistics for Interpreting Table 2:
Note: Observations are weighted by county population.

						Growth in Big Box Estabs: Breakdown by Category bins			
	Dep Var: Growth in Other (Phys) Retail Estabs	Dep Var: Growth in Other (Phys) Retail Empl.	Growth in Big Box Estabs	Growth in County Pop.	Growth in County Personal Income (per capita)	(Omitted) BB growth Cat 1 (gr<0)	BB growth Cat 2 (gr=0)	BB growth Cat 3 (gr>0 & <=1)	BB growth Cat 4 (gr>1)
N	3,088	3,088	3,088	3,088	3,088	41	1,535	393	1,119
Mean	-0.013	0.140	0.968	0.159	0.531	-1.031	0.000	0.652	1.588
SD	0.335	0.290	0.677	0.169	0.090	0.787	0.000	0.225	0.349
P25	-0.139	-0.015	0.571	0.048	0.472	-2.000	0.000	0.500	1.294
P75	0.049	0.226	1.440	0.239	0.578	-0.400	0.000	0.857	2.000

Table 3: Restaurant Growth and Growth in Traditional Non-Restaurant Physical Retail Activity

Note: Observations are weighted by county population.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var: Growth (99 to 16) in Restaurant	Estabs.	Emp.	Estabs.	Emp.	Estabs.	Emp.	Estabs.	Emp.
Growth in Other (Phys) Retail Estabs.	**0.623*** (0.0108)**	**0.595*** (0.0123)**			**0.599*** (0.0110)**	**0.572*** (0.0126)**	**0.472*** (0.0105)**	**0.443*** (0.0123)**
Growth in Non-Restaurant Phys. Retail Average Payroll per Worker			**-0.429*** (0.0391)**	**-0.382*** (0.0411)**	**-0.190*** (0.0277)**	**-0.154*** (0.0315)**	**-0.252*** (0.0244)**	**-0.232*** (0.0285)**
Growth in Big Box Estabs.					0.0303*** (0.0054)	0.0340*** (0.0061)	0.0049 (0.0048)	0.0129** (0.0056)
Growth in County Population							0.639*** (0.0210)	0.634*** (0.0245)
Growth in County Personal Income (per capita)							0.274*** (0.0356)	0.529*** (0.0416)
Constant	0.321*** (0.0036)	0.411*** (0.0041)	0.454*** (0.0138)	0.529*** (0.0145)	0.354*** (0.0109)	0.429*** (0.0124)	0.150*** (0.0213)	0.0914*** (0.0249)
Observations	3,088	3,088	3,088	3,088	3,088	3,088	3,088	3,088
R-squared	0.519	0.433	0.038	0.027	0.531	0.443	0.640	0.552

Summary Statistics for Interpreting Table 3:

Note: Observations are weighted by county population.

	Dep Var: Growth (99 to 16) in Restaurant Estabs.	Dep Var: Growth (99 to 16) in Restaurant Employment	Growth in Other (Phys) Retail Estabs.	Growth in Other (Phys) Retail Annual Payroll per Emp.	Growth in Big Box Estabs.	Growth in County Population	Growth in County Personal Income (per capita)
N	3,088	3,088	3,088	3,088	3,088	3,088	3,088
Mean	0.313	0.404	-0.013	0.328	0.968	0.159	0.531
SD	0.289	0.303	0.335	0.131	0.677	0.169	0.090
P25	0.178	0.253	-0.139	0.287	0.571	0.048	0.472
P75	0.414	0.504	0.049	0.371	1.440	0.239	0.578

APPENDIX

Figure A1: Share of Motor Vehicle Dealers in Retail Activity

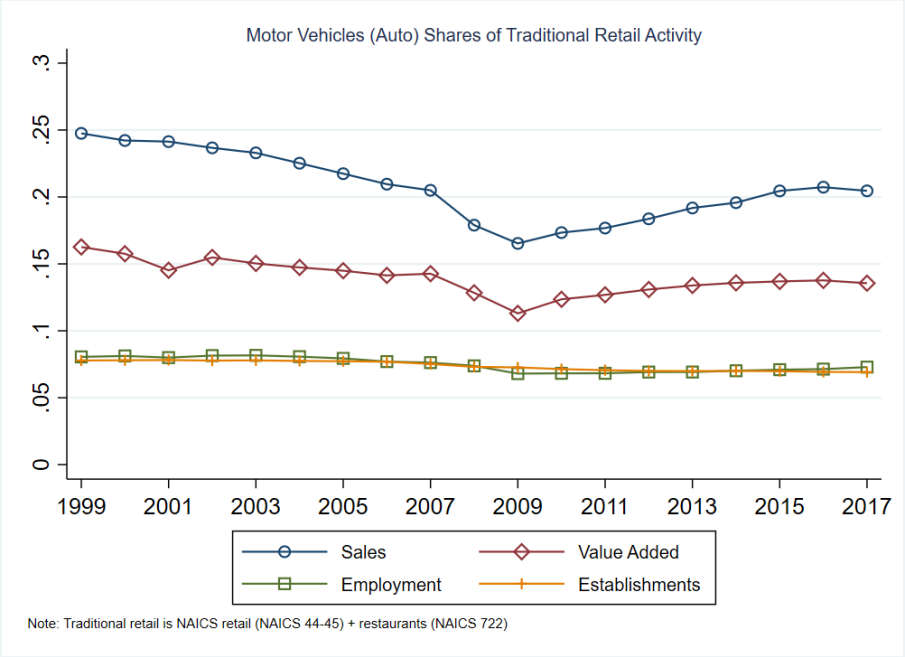


Figure A2: Category wise shares of sales, value added, establishments and employment

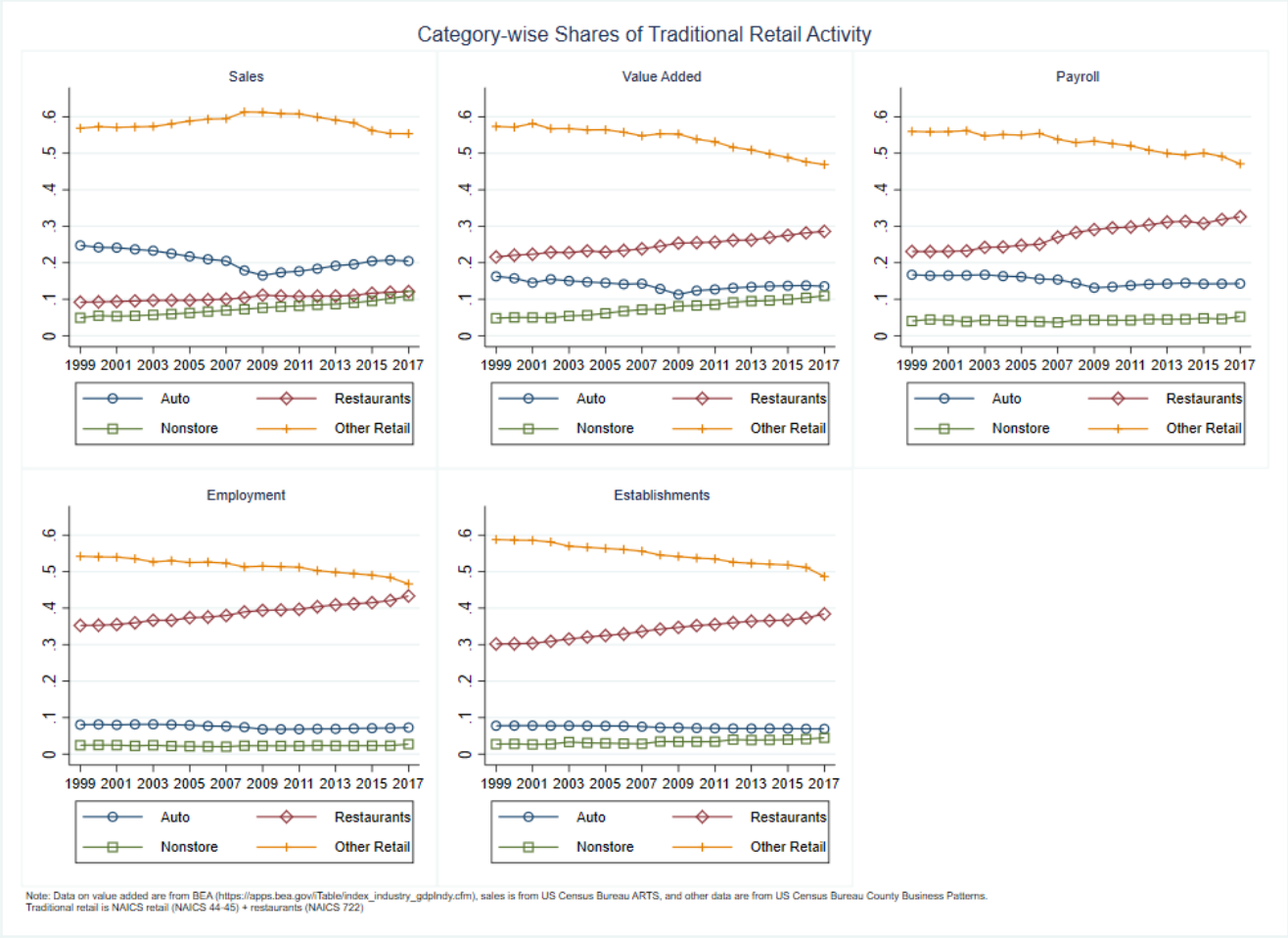


Figure A3: Patent count share trends over time

Notes: This figure is based on data in from Goldschlag, Lybbert and Zolas (2019)

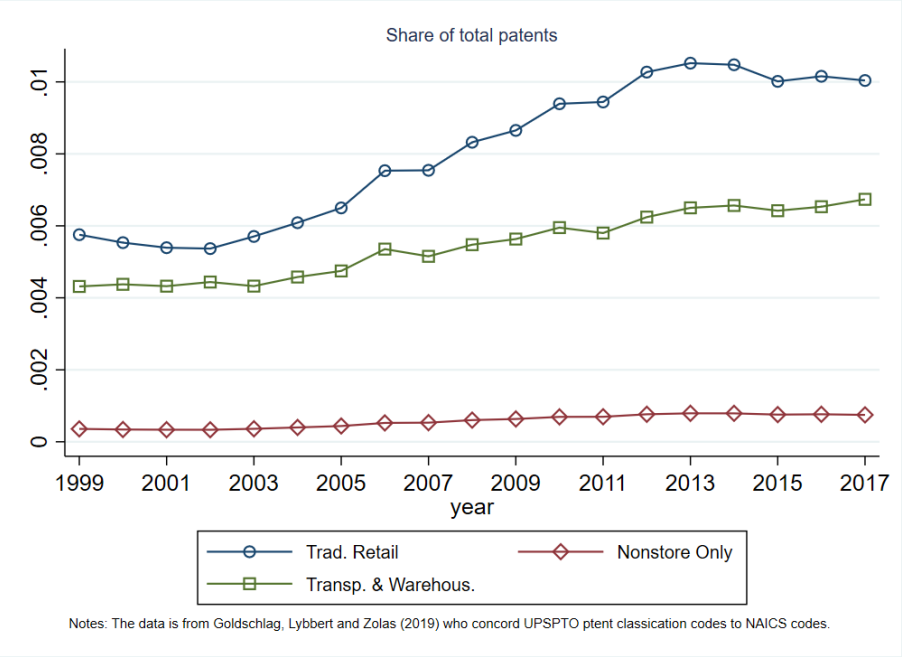


Figure A4: Non-store Sales -- Growth Driven Primarily by Ecommerce

Notes: Traditional Retail includes all subcategories of NAICS 44, 45 and 722. ESMOH stands for NAICS 4541 (Electronic Shopping and Mail-order Houses). Other non-ESMOH Non-Store retailers (NAICS 454) includes Vending Machine Operators (NAICS 4542) and Direct Selling Establishments (4543). Data are from US Census Bureau's Annual Retail Trade Survey (ARTS) and the Services Annual Survey (SAS) and their antecedents.

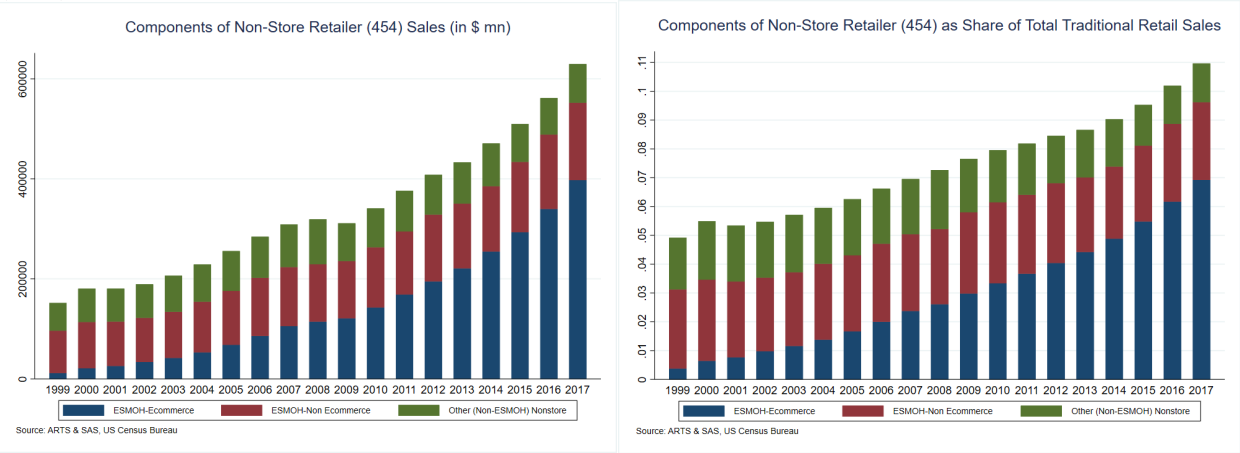


Figure A5: Physical General Merchandise Sales – Overall Decline Since 2009, Big Box Share of Total Retail has flattened

Notes: Traditional Retail includes all subcategories of NAICS 44, 45 and 722. General Merchandise refers to NAICS 452, while "Big Box" is the subcategory NAICS 45291 (Warehouse Clubs and Supercenters). Data are from US Census Bureau's Annual Retail Trade Survey (ARTS) and the Services Annual Survey (SAS) and their antecedents.

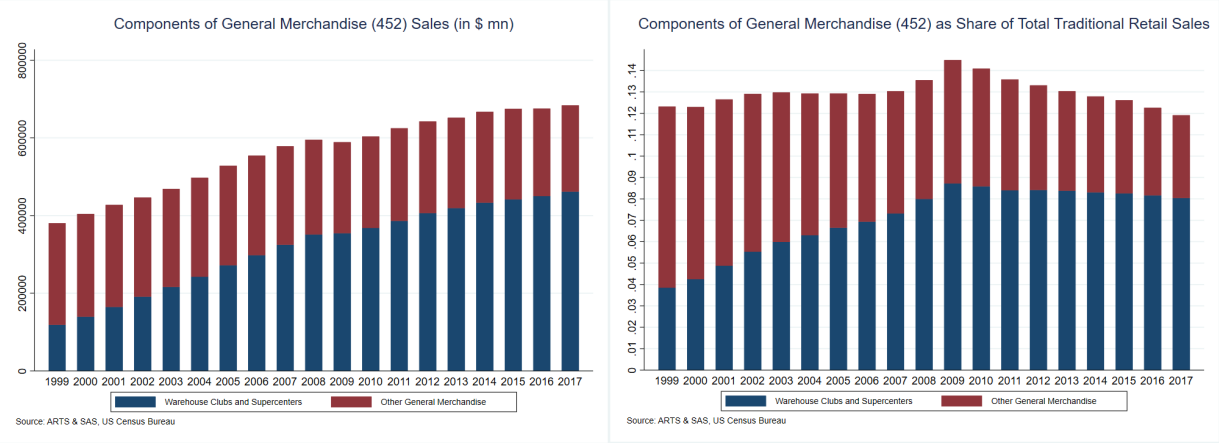


Figure A6: Aggregate Restaurant Sector Productivity – Normalized Trends

See Figure 9 for level trends.

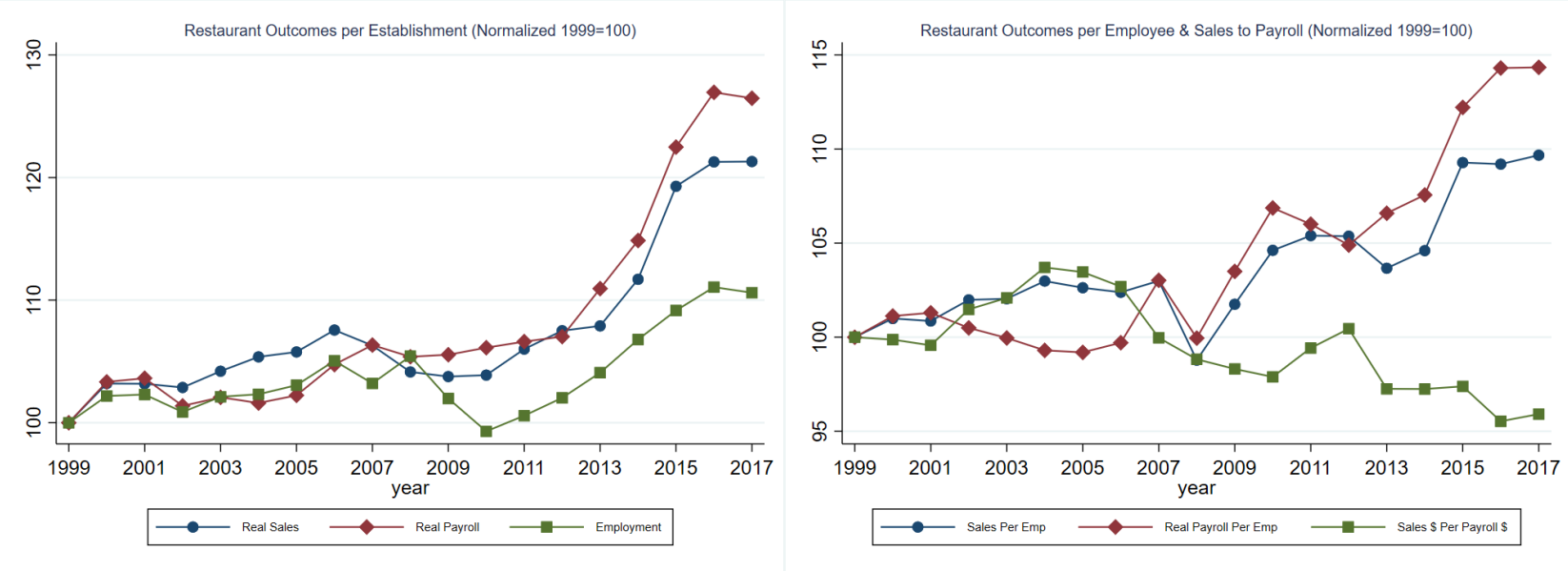


Figure A7a: Restaurant category-wise shares by income quintile, 1999 vs 2016

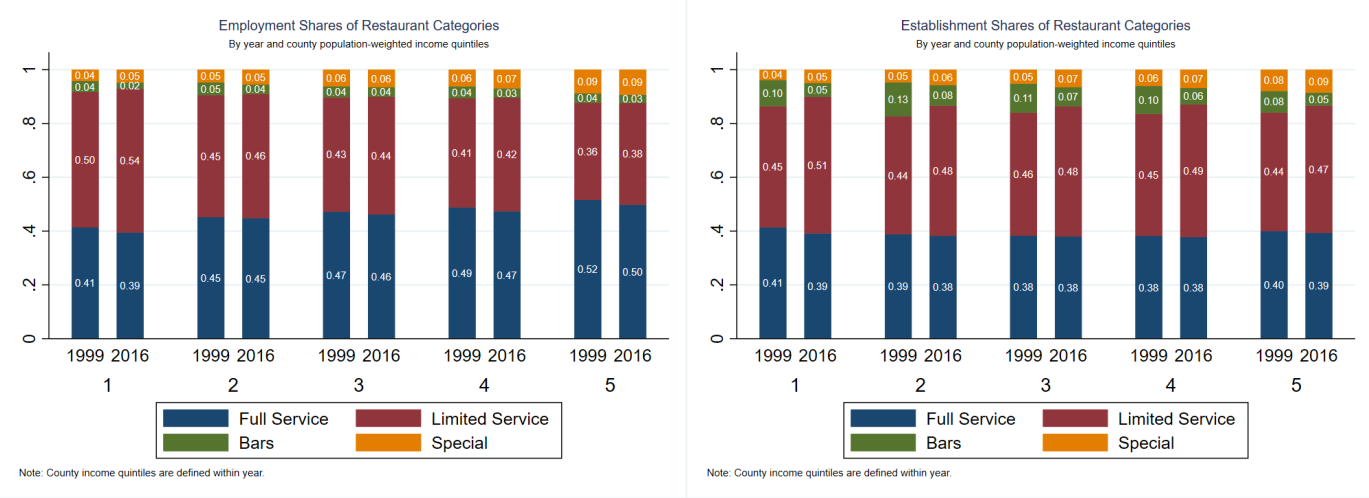
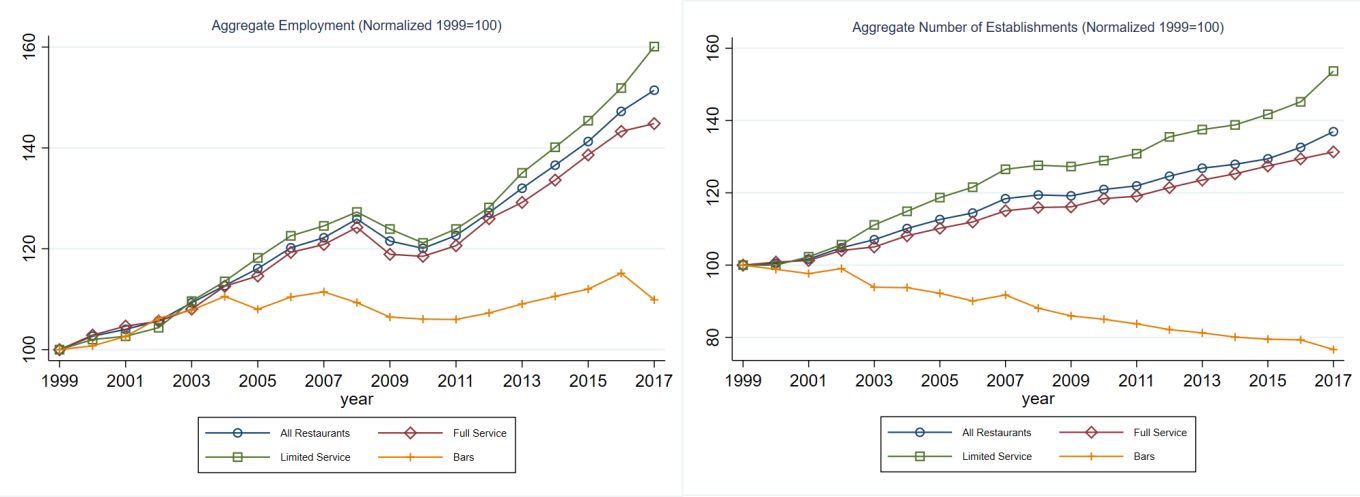


Figure A7b: Restaurant category-wise growth



Appendix Table A1: Concordance of Merchandise lines to NAICS 2012 codes

Merchandise Lines (in ESMOH Ecommerce Data)	Imputed NAICS 2012 3-digit Code	NAICS 2012 Description
Books (includes audio books and e-books)	451	Sporting goods, hobby, musical instrument, and book stores
Clothing and clothing accessories (includes footwear)	448	Clothing and clothing access. stores
Computer and peripheral equipment, communications equipment, and related products (includes cellular phones)	443	Electronics and appliance stores
Computer software (includes video game software)	443	Electronics and appliance stores
Drugs, health aids, and beauty aids	446	Health and personal care stores
Electronics and appliances	443	Electronics and appliance stores
Food, beer, and wine	445	Food and beverage stores
Furniture and home furnishings…	442	Furniture and home furnishings stores
Jewelry	448	Clothing and clothing access. stores
Audio and video recordings (includes purchased downloads)	443	Electronics and appliance stores
Office equipment and supplies	453	Miscellaneous store retailers
Sporting goods	451	Sporting goods, hobby, musical instrument, and book stores
Toys, hobby goods, and games	451	Sporting goods, hobby, musical instrument, and book stores
Other merchandise	452	General merchandise stores
Nonmerchandise receipts	499	Not classified

Appendix Table A2: Frequency distribution by keywords we used to define restaurant "varieties" in Yelp data

Variety	Frequency	Percent	Variety	Frequency	Percent	Variety	Frequency	Percent
hot dog	79,530	50.15	chicken wings	337	0.21	gelato	33	0.02
american	13,046	8.23	buffet	324	0.2	mongolian	28	0.02
italian	10,164	6.41	street	243	0.15	portuguese	27	0.02
mexican	7,490	4.72	french	228	0.14	moroccan	25	0.02
burgers	5,396	3.4	bubble tea	227	0.14	british	24	0.02
chinese	5,210	3.29	southern	219	0.14	poke	23	0.01
sandwich	4,152	2.62	filipino	194	0.12	pub	22	0.01
tea	4,012	2.53	cafe	166	0.1	russian	22	0.01
ice cream	3,277	2.07	gluten-free	156	0.1	noodle	18	0.01
specialty	3,025	1.91	cajun/creole	155	0.1	indonesian	17	0.01
japanese	2,686	1.69	vegan	153	0.1	african	16	0.01
deli	1,976	1.25	asian	149	0.09	hungarian	16	0.01
bagel	1,135	0.72	pretzel	130	0.08	nepalese	16	0.01
donut	1,050	0.66	creperies	120	0.08	arabian	12	0.01
local	1,034	0.65	breweries	104	0.07	butcher	12	0.01
thai	961	0.61	middle eastern	98	0.06	polish	11	0.01
greek	923	0.58	spanish	98	0.06	belgian	10	0.01
fast food	866	0.55	fish & chips	87	0.05	argentine	9	0.01
soul food	808	0.51	shaved ice	80	0.05	soup	9	0.01
bakeries	758	0.48	kosher	79	0.05	comfort	7	0
wine	738	0.47	cupcake	77	0.05	european	7	0
indian	727	0.46	turkish	69	0.04	burmese	6	0
dessert	694	0.44	cuban	60	0.04	pakistani	5	0
barbeqe	504	0.32	ethiopian	54	0.03	halal	4	0
diners	498	0.31	cambodian	52	0.03	waffle	4	0
vietnamese	497	0.31	afghan	51	0.03	fondue	3	0
juice	493	0.31	taiwanese	51	0.03	poutineries	3	0
salad	492	0.31	brazilian	44	0.03	hot pot	2	0
hawaiian	466	0.29	irish	44	0.03	malaysian	2	0
mediterranean	442	0.28	german	42	0.03	diy	1	0
brunch	425	0.27	peruvian	37	0.02	honey	1	0
seafood	394	0.25	iranian	34	0.02	ukrainian	1	0
korean	352	0.22						
Total							**158,579**	**100**

Appendix Table A3: Top funded 25 retail-related start-ups founded after 1998 per Crunchbase data

Notes: The data is from Crunchbase. We want to note a strong caveat that start-ups in other categories also operate and impact the retail market, e.g., Uber Eats is a competitor to DoorDash but is not listed here as Uber is not primarily a delivery start-up. Similarly, Nuvo is primarily an autonomous vehicle start-up but operates in the retail delivery space as well. Large online retailers (e.g., Amazon) are excluded if they were founded prior to 1999. Finally, funding data is missing on 55% (2538 of 4566) companies we identified as in retail-related activity in the Crunchbase data.

Name	Description	Founding year	Total Funding (to date, USD mn)	Complementary tp Physical Retail?
DoorDash	DoorDash provides a delivery service that connects customers with local and national businesses.	2013	2071.82	COMPLEMENT
Instacart	Instacart delivers groceries and home essentials from a variety of local stores.	2012	1895.8	COMPLEMENT
Sears Holdings Corporation	Sears Holdings Corporation is a leading integrated retailer focused on seamlessly connecting the digital and physical shopping experiences	2005	1710	NEUTRAL
Groupon	Groupon is a deal-of-the-day website that offers discounted gift certificates usable at local or national companies.	2007	1387	COMPLEMENT
Affirm	Affirm is a financial technology services company that offers installment loans to consumers at the point of sale.	2012	1020	COMPLEMENT
Postmates	Postmates powers local, on-demand logistics focused on fast deliveries from any type of merchant at scale.	2011	903.01	COMPLEMENT
Authentic Brands Group	Authentic Brands Group is a brand development and licensing company.	2010	875	NEUTRAL
Lineage Logistics	Lineage Logistics is a warehousing and logistics company built to deliver sophisticated, customized, and dependable cold chain solutions.	2012	700	COMPLEMENT
Jet	Jet operates an e-commerce platform that allows its member to shop online from various retailers.	2014	570	RIVAL
Rent the Runway	Rent the Runway is an online e-commerce website that allows women to rent designer apparel and accessories.	2009	541.15	RIVAL
Toast	Toast is an all-in-one point-of-sale and restaurant management platform for businesses in the food service and hospitality space.	2011	501.95	COMPLEMENT
Chewy	Chewy.com delivers pet happiness by conveniently shipping 500+ brands of pet food and goodies for free.	2011	451	RIVAL
Zume Pizza	Zume Pizza is a food delivery company that operates an automated pizza delivery platform.	2015	423	RIVAL

Name	Description	Founding year	Total Funding (to date, USD mn)	Complementary tp Physical Retail?
CloudKitchens	CloudKitchens is a real estate company that provides smart kitchens for delivery-only restaurants.	2016	400	COMPLEMENT
thredUP	thredUP is a fashion resale marketplace that enables individuals to buy and sell clothing for women and children.	2009	381.12	RIVAL
Wayfair	Wayfair is an online retailer of home products for bedroom, living room, kitchen and dining, home entertainment, bathroom, and more.	2002	358	RIVAL
MOD Super Fast Pizza	MOD Super Fast Pizza owns and operates a chain of pizza restaurants in the United States and the United Kingdom.	2008	352	NEUTRAL
Casper	Casper is a sleep startup that launches a comfortable mattress sold directly to consumers, eliminating commission Âdriven, inflated prices.	2013	339.7	RIVAL
TechStyle Fashion Group	TechStyle is a global membership fashion commerce company focused on reimagining the global fashion business.	2010	336	RIVAL
ezCater	ezCater is an online catering marketplace that allows individuals to order food from local caterers in the U.S.	2007	319.79	COMPLEMENT
RetailMeNot	RetailMeNot is a marketplace for online coupons and deals that operates a portfolio of coupon and deal websites.	2007	299.5	NEUTRAL
Moda Operandi	The leading platform for fashion discovery. We connect consumers directly with established and emerging designers from around the world.	2010	293.7479	RIVAL
Shift	Shift is an online marketplace for buying and selling used cars.	2013	293	RIVAL
Brandless	Brandless is a direct-to-consumer company providing household items.	2016	292.5	RIVAL
Total funding for top 25 companies			16,715	
Total complement funding			9,199	
Proportion complement			55.0%	