How E-Commerce Improves the Brick and Mortar Shopping Experience: Explaining the Post-2002 Slowdown

Rachel Soloveichik
(U.S. Bureau of Economic Analysis)

Paper prepared for the 35th IARIW General Conference

Copenhagen, Denmark, August 20-25, 2018

Session 4A: Is Productivity Growth Slowing Down? I

Time: Wednesday, August 22, 2018 [14:00-17:00]

How E-Commerce Improves the Brick and Mortar Shopping Experience: Explaining the Post-2002 Slowdown

By Rachel Soloveichik*

Abstract

May 2018

Brick and mortar retailers provided $376 billion of "free" consumer shopping experiences in 2015. For example, vehicle dealerships provide "free" test drives and department stores provide "free" fashion advice. In addition, brick and mortar services like banks also provide valuable "free" experiences as well. The recent shift to e-commerce raises fears that these "free" experiences may be disappearing. To capture the output of "free" experiences, I model their provision as a barter transaction of sales attention for experiences, and track this modeled transaction consistently with the industry outputs and inputs already tracked in GDP.

Despite the rise of e-commerce, I find that brick and mortar shopping experiences grew faster than overall GDP after 2002. It may be true that Americans are spending less time at brick and mortar retailers – but retailers more than compensate by increasing the quantity of "free" experiences provided per hour. Consistent with the increased shopping output reported by retailers, shoppers self-reported lower stress levels during brick and mortar shopping. I argue that these changes are driven by competition from e-commerce, so the improvement in brick and mortar shopping experiences can be viewed as an indirect productivity effect from the Internet. Focusing on the wholesale and retail sector, the post-2002 productivity slowdown shrinks from 0.98 percentage points per year to only 0.13 percentage points per year. Across the entire private business sector, the post-2002 productivity slowdown shrinks from 0.44 percentage points per year to 0.26 percentage points per year.

* Rachel Soloveichik is a research economist at the U.S. Bureau of Economic Analysis; e-mail: rachel.soloveichik@bea.gov. The views expressed here are those of the author and do not necessarily represent the U.S. Bureau of Economic Analysis or the U.S. Department of Commerce.

Introduction

This paper uses an experimental methodology to capture the contribution of 'free' shopping experiences to consumer welfare while staying within the framework established by the official guidelines for national accounting, the System of National Accounts 2008 (SNA 2008). Most "free" shopping experiences are designed to provide potential customers with useful product information. For example, two car models might have similar features – but one car model causes back pain for a potential customer and the other doesn't. Different people have different back problems, so a potential buyer can't read online reviews or rely on a company's reputation for quality. Instead, they need to test drive multiple models and find one that is comfortable for them. In other words, shopping is a research activity that helps buyers derive more value from a fixed level of out-of-pocket spending. Shopping done by consumers is therefore part of household production and shopping done by businesses is market work.

The experimental methodology imputes a barter transaction between users and salespeople: users give sales attention in return for 'free' shopping experiences. My experimental methodology has at its heart two balancing components. On the expenditure side, I impute experience purchases equal to the cost of providing shopping experience services. These costs are paid by salespeople, so 'free' shopping experiences are actually sales-supported shopping experiences. On the income side, I impute sales attention revenue equal to the value of the sales-supported shopping experiences. By construction, the value of sales-supported shopping experiences is precisely equal to the cost of providing the "free" shopping experiences. As a result, the experimental methodology reduces to treating the provision of "free" shopping experiences as payment in kind for sales attention produced by households and businesses.

This paper studies **all** sales-supported shopping experiences, even if they occur outside traditional retail locations. Vehicle shoppers generally take test drives around the neighborhood rather than staying on the dealership lot. In the past, Tupperware distributors and other small non-store retailers sometimes provided "free" shopping experiences in clients' homes. Similarly, business salespeople often visit client locations to introduce new products and train users on existing products. Furthermore, products like timeshares or business software are often sold at conferences held in hotel ballrooms or other public locations. Finally, some e-commerce

companies like Stitch Fix provide personal shopping assistants who communicate with clients remotely to determine their clothing needs and then send samples for clients to try at home.

Conceptually, the imputed barter transaction described above is nearly identical to the imputed barter transaction developed in earlier work on advertising-supported media and marketing-supported information (Nakamura, Samuels and Soloveichik 2017). Furthermore, this paper will not include "free" shopping experiences provided by websites like Amazon because that "free" digital content was already studied in the earlier work. The main difference is that the earlier paper studies mass communication and this paper studies one-to-one communication. Mass media like television and the Internet occupy huge amounts of leisure time and may provide enormous consumer surplus (Brynjolfsson, Eggers and Gannanemi 2018). However, mass media has relatively low costs of production and therefore a low value in the supply-use tables and in the experimental methodology. In contrast, one-to-one experiences have higher costs of production and therefore a higher value in the supply-use tables and in the experimental methodology. In 2016, I calculate that "free" consumer shopping experiences added $662 billion to nominal GDP, quintuple the $121 billion contribution from "free" consumer digital content.

Figures 7 and 11 show the impact of the experimental methodology on real GDP and total factor productivity (TFP). Both series show an inflection point around 1995, a year that has been previously identified as an inflection point in the production of information technology (IT) equipment (Jorgenson 2001). In the paper discussion, I attribute this inflection point to the introduction of e-commerce in the late 1990's – but it is possible that other aspects of the digital economy also played a role. The wholesale and retail industries are most impacted by the experimental methodology, but other industries also supply "free" shopping experience as well. Since 2002, "free" shopping experiences have raised nominal GDP growth by 0.04 percentage points annually, real GDP growth by 0.06 percentage points annually and aggregate TFP growth by 0.13 percentage points annually. The increase in TFP growth is large enough to substantially ameliorate the recent slowdown in productivity growth.

One might argue that "free" shopping experiences are implicitly bundled together with purchased goods and services and therefore already counted in GDP. However, better shopping experiences are not always correlated with higher merchandise prices. By construction, potential customers provide sales attention in barter for "free" shopping experiences. This imputed barter transaction raises measured output and measured input by the exact same amount, so net value-

added does not change. For example, chain bookstores like Barnes & Noble provide both lower prices and better "free" shopping experiences than the independent bookstores they replaced. As a result, the experimental methodology does not double-count retailer margin in GDP.

Even if shopping experiences were implicitly bundled together with purchased goods and services, they would still represent an important quality attribute. So, an alternative methodology to account for shopping experiences might involve adjusting pre-existing price indexes for quality changes due to changes in the quantity or quality of the bundled shopping experiences. However, implementing such an alternative methodology is extremely difficult. To start out, it requires collecting data on the shopping experience bundled with every item tracked by the Bureau of Labor Statistics (BLS). And even if that data could be collected, adjusting every single price index used by BEA in the GDP calculations would still be a mammoth undertaking. As a robustness test, I calculated TFP using a simplified alternative methodology and found very similar results to Figure 11.

The paper will be divided into three parts. Section 1 provides background information on the current methodology for handling sales-supported experiences in GDP. I then describe the experimental methodology in more detail and review the previous literature on sales-supported experiences. Section 2 collects data on sales expenditures and estimates the nominal value of sales-supported experiences in the United States. I then use that data to recalculate nominal output and nominal GDP from 1929 to 2016. Section 3 introduces the price indexes for 'free' sales-experiences and sales viewership from 1929 to 2016. The section then goes on to recalculate real GDP and TFP by industry.

Section 1. Conceptual Discussion of "Free" Shopping Experiences

What's Included in "Free" Shopping Experiences?

This paper studies three separate types of shopping experiences: verbal experiences, display experiences, and tactile experiences. Verbal experiences are provided directly by

salespeople, who talk to customers and help them individually. In contrast, display experiences are provided indirectly by salespeople, who organize displays and then allow customers to browse items at their leisure. Finally, tactile experiences are provided by the items themselves when customers touch, try on or test items. Most brick and mortar stores provide all three types of shopping experience simultaneously. For example, a clothing salesperson might provide general fashion advice, direct a shopper towards a display of clothing, and then direct the shopper towards a fitting room where they can try select items.

Readers should note that this paper studies the shopping experience only, and does not consider the purchasing experience at all. In Betancourt's terminology, the paper studies information and ambiance but not physical goods, personal services or distribution services (2016). As a result, previous papers studying the transition from full-service purchasing to self-service purchasing are not relevant to this paper. In particular, Basker, Foster and Klimek (2017) examined the transition from gas stations attendants pumping gas to drivers pumping gas. This transition raised measured productivity for gas stations and increased household production of gasoline pumping services – but had minimal impact on the supply of "free" shopping experiences because modern gas stations provide neither verbal, display nor tactile experiences to gasoline customers.[1] Similarly, the introduction of barcodes and barcode scanners (Basker 2012) primarily impacted the purchasing experience and had little impact on the shopping experience. Many retailers are currently trying to switch from cashier checkout to self-checkout. If they are successful, this switch may lower prices and raise productivity. But it will not directly impact the shopping experience.

Does This Methodology Double-Count Wholesale and Retail Output?

Some shopping experiences are already counted in the published GDP statistics. Warehouse clubs like Costco explicitly charge for membership and restrict entry to paid members. These membership fees are already counted in their retail margin. In fact, they approximately cover the cost of the shopping experience provided by warehouse clubs, so this

[1]Gas stations with convenience stores sometimes provide a display experience for soda, candy and other snacks.

industry provides virtually no "free" shopping experiences.[2] To the best of my knowledge, there is no legal or technological barrier preventing other retailers from charging similar membership fees. However, other brick and mortar stores allow potential customers to enter for free, talk to salespeople as long as they like, and then leave without charging them a penny. In fact, such behavior is recommended for high value goods like automobiles (Carmax 2017) or appliances (Anderson 2014). As a result, the current GDP methodology excludes the vast majority of shopping experiences from measured industry output and measured GDP.

Similarly, some sales attention is already counted in the published GDP statistics. Retailers frequently offer temporarily low prices on a few selected goods. These loss leaders are often very high profile items like turkey before Thanksgiving (Chevalier, Kashyap and Rossi 2003). Implicitly, shoppers are offered discounts as an incentive to come to the store – and once they're at the store they tend to buy additional items. These temporary low prices are currently tracked in BLS's price indexes just like any other price change. As a result, BEA's published PCE tables show an increase in real consumption associated with temporary loss leaders. However, permanent loss leaders like cheap milk at the back of stores are not currently counted.

One might argue that "free" shopping experiences are implicitly bundled together with purchased goods and services, and so the experimental methodology double-counts "free" shopping experiences. As a robustness test, I explored a simplified version of the alternative methodology[5] in which both the production cost of "free" shopping experiences and the amenity value of speedy service are fully reflected in merchandise prices.[6] By construction, this alternative methodology produces the same nominal GDP levels as BEA's current methodology. But the impact on measured TFP is quite similar to the results presented in the body of the paper using the experimental methodology.[7] Intuitively, BLS's current price indexes are focused on physical good prices and physical good attributes. As a result, changes in either the quality of

[2] I do not count premium programs, which offer discounts in return for an upfront payment, as paid experiences.
[5] In my simplified alternative methodology, "free" shopping experiences are distributed across all purchased goods and services in proportion to their revenue. This simplification allows me to keep all the pre-existing industry price indexes. I do not know how measured prices might change under the full alternative methodology.
[6] BLS's individual price series compare prices for the same item at a single seller over time. This methodology implicitly captures amenities bundled with items **if** individual outlets maintain consistent amenities over time and cheap chain stores offer fewer amenities. Many researchers argue that chain stores offer comparable amenities, and so BLS's current price indexes overestimate inflation (Reinsdorf 1993) (Hortascu and Syverson 2015).
[7] However, the alternative methodology treats decreased shopping time as output quality improvement rather than a reduction of inputs. Accordingly, the full TFP changes shown in Figure 11 appear as real GDP changes.

the shopping experience or the shopping time provided by customers are missed in the measured productivity statistics – but counted in both the experimental and alternative methodologies.

Current Treatment of Sales-Supported Experiences in SNA 2008 and the U.S. National Income and Product Accounts (NIPA's)

In the SNA 2008 and the U.S. Bureau of Economic Analysis (BEA) National Income and Product Accounts, sales-supported experiences are treated simply as an intermediate input to the production of other goods and services. If one thinks of exercise equipment as being the sold good, then a salesperson offering advice to dieters is considered an expense of the sporting goods store. The current methodology treats the costs of the salesperson's time just like the cashier's labor ringing up the sale. In this treatment, there is no consumption benefit to the consumer of the sales experience provided, except to the extent that the consumer pays for costs associated with receiving the sales experience, such as driving to the sporting goods store. Furthermore, the current methodology does not consider whether a consumer browsed for hours before selecting their purchase or bought immediately without browsing at all.

The difficulty with that treatment is sales-supported shopping experiences provide a much greater value to consumers than the cost of driving to a store. Because sales-supported experiences provide so much value to consumers, it is inconsistent to not count this as consumption in final expenditures. This difficulty is highlighted when sporting goods stores bid content providers, such as personal trainers away from the paid service sector into sales-supported experiences. Under the current treatment, a personal trainer offering advice in a sporting goods store cease to be providing consumer recreation services and becomes part of sales instead. Another way to think about this is how the value of exercise equipment to the consumer is affected by the possibility that a personal trainer will provide an optimal usage regimen. The mere possibility increases consumer choice and therefore welfare. Should this improvement in welfare be reflected in the quality-adjusted price for exercise equipment? Yet the exercise equipment might be bought from Amazon and then the usage regimen provided years later at a lecture held in a brick and mortar store. Does it make sense to increase the real output of Amazon and its measured TFP if there is no change in Amazon's product or process?

Stylized Model of "Free" Shopping Experiences

It is useful to clarify the conundrum with the following highly stylized model. I consider an exercise equipment company, a celebrity personal trainer and households.[8] The exercise equipment manufacturer company must hire salespeople before they can sell their product. Initially, the manufacturer spends $55,000 to produce exercise equipment, spends $25,000 on telemarketing with no experience value, and sells 800 pieces of equipment for $100 each. The celebrity then sells 800 tickets to her event for $25 each. Eight hundred households each spend $100 on exercise equipment and $25 on celebrity classes. Now, suppose the manufacturer hires the celebrity for $20,000 and cuts telemarketing costs by $20,000. The celebrity then provides her event for "free" but includes a pitch to buy exercise equipment. The eight hundred households receive the exercise equipment and the event, but pay only $100 per household for the exercise equipment (and listen to a sales pitch for the exercise equipment). For simplicity, I assume that the demand for celebrity classes is unaffected by this switch. In other words, households act as if they were paying $25 for the celebrity classes, but instead, they are listening to the sales pitch and appear to perceive that listening to the celebrity classes costs them $25 each. Roughly speaking, the households consume the same amount but pay less out of pocket.

In the current national income accounts treatment, output drops. The celebrity class is no longer measured as part of personal consumption, only the exercise equipment is. In the initial case, $100,000 in economic resources was used to produce $100,000 in consumption output. With sales-supported shopping experiences, $80,000 is used to produce $80,000 in consumption output. Effectively, $20,000 has disappeared from real output. However, this appears to be a misrepresentation in that the households are still consuming the same real amount of exercise instruction, but it has disappeared from measured output.

[8] For simplicity, I assume that the exercise equipment company hires the personal directly, manufactures the equipment themselves and then hosts classes in their offices. In a more realistic model, a celebrity personal trainer might hire assistants to conduct the actual classes. Furthermore, the exercise equipment company might offshore the physical manufacturing of equipment and rent space in a gym to host the class. Regardless of the number of parties, and the payments between them, the imputed barter transaction of sales viewership in return for shopping experiences is the same and measured GDP is the same.

One possible treatment would be to view the celebrity class with sales pitches included as having the same real value but falling in price to zero. That is, nominal output is $80,000, but real output is $100,000. While I do not actually observe the market value to the consumer of the information in most cases, I can impute the market value based on the production cost. But standard economic formulas do not work well when analyzing goods and services with zero prices. For example, it is difficult to explain why consumers sometimes pay to avoid sales pitches if the price for sales-supported shopping experiences is zero. Furthermore, if the situation should reverse and a price be paid, the rate of inflation for that item cannot be calculated.

A more satisfactory treatment was explored in (Nakamura, Samuels and Soloveichik 2017). That paper treated advertising-supported media and marketing-supported information as a barter trade: the consumer receives entertainment in return for viewing advertising or marketing. I propose doing the same for sales-supported shopping experiences. I would record a dollar as paid by the consumer to the manufacturer for the celebrity show, and the manufacturer would pay it back to the consumer for listening to the sales pitch. In this treatment, sales-supported experiences are reflected in the real income and consumption of the consumer. The amount mirrors the true value of shopping experiences to modern society and in a way which finds parallels with the treatment of similar products with no out-of-pocket price.

The experimental methodology does not imply including all household production in the NIPA's. Instead, this paper treats sales-supported shopping experiences as a payment in-kind for services produced by households. SNA 2008 already counts other noncash payments as labor income (Section 7.51). SNA also imputes cash values for barter transactions (Section 3.75), owner-occupied housing (Section 6.34), and financial services indirectly measured (Section 6.163). Just as with those transactions, I impute a value for sales-supported shopping experiences based on estimated costs. However, since the household is not 'employed' by the experience producer, I treat the household production of the service of providing access to sales as a form of production by an unincorporated household enterprise. These unincorporated household enterprises are part of the market sector and their output is therefore included in GDP (Section 4.155-4.157). But their productivity is difficult to measure because the capital assets used in producing sales attention are inextricably mingled with the consumer durables used in general household production (Section 7.36). To minimize deviation from BEA's official industry

product accounts, I do not consider the production process for sales attention. I intentionally avoid this due to the plethora of issues involved in measuring unincorporated household enterprises.

Consumers use "free" shopping experiences for both household production and pure leisure. For example, some people might visit sporting goods stores so they can improve their health with exercise. As a result, their exercise could be seen as type of household production. Other people simply enjoy examining motor boats but don't intend to improve their health with exercise. SNA 2008 currently excludes almost all household production from GDP, and therefore combines consumer purchases for household production with consumer purchases for direct consumption in PCE. Consistent with this treatment, the experimental methodology does not distinguish between sales supported shopping experiences used for household production and sales-supported shopping experiences used for pure leisure. If future editions of the international guidelines for national accounts choose to include household production in either measured GDP or a recognized satellite account, then the experimental methodology might be revised to match the new treatment.

Review of Literature

To the best of my knowledge, no existing paper has yet studied "free" shopping experiences through the lens of a barter transaction. However, my research is related to existing literature on household production, product variety, within-store shopping spillovers, within-neighborhood shopping spillovers, resale price maintenance, permanent income hypothesis and "free" media content. This section will give a brief overview of the first six literatures and explain why each is relevant to the shopping experience. I already discussed earlier research on "free" media content in the introduction, so I will not repeat it here.

Shopping is a major category of household production, and there is a rich economics literature documenting how it helps lower out-of-pocket spending. Holding the exact item fixed, consumers pay lower prices if they spend more time shopping (Aguiar and Hurst 2007, Griffith, et al. 2009, Nevo and Wong 2015). Knowledgeable consumers also pay lower prices without sacrificing product quality (Bronnenberg, et al. 2015). Finally, there is a general literature

studying household production consistently with the national income and product accounts (Abraham & Mackie 2005, Bridgman et. al. 2012, Bridgman 2016). These papers are all focused on consumer behavior, and they largely take the barter transaction of sales attention for "free" shopping experiences as given.

There is also a rich economics literature studying product variety. On the one hand, some researchers have found substantial welfare gains from new varieties like Apple-Cinnamon Cheerios (Hausman 1997), and minivans (Petrin 2002). BLS's currently published price indexes do not include these welfare gains, and recent research suggested that measured inflation rates might fall substantially if these variety gains were accounted for (Lecznar and Smith 2017). On the other hand, other researchers have found that consumers can become overwhelmed by excessive product variety (Iyenger and Lepper 2000) and may even accidentally select a clearly inferior product (Sinaiko and Hirth 2011). In other words, the welfare gains from product variety depend enormously on the quality of the shopping experience. This dependence does not require any violations of standard economic theory. Even rational consumers with full self-control prefer shopping at well organized and easy to navigate stores.

There is an enormous marketing literature studying within-store spillovers. Items located near eye level sell much more rapidly than items located a few feet down or up. Shoppers are also more likely to buy items located near the ends of aisles or close to the checkout counter. The retail industry is extremely aware of these location effects, and manufacturers frequently pay slotting fees in return for prime shelf space (FTC 2003, White, Troy and Gerlich 2000). Many of the papers in this literature are qualitative, and so cannot be used to create a precise value for aggregate sales attention. However, recent experiments have used mobile coupons to exogenously increase the distance that grocery shoppers walk in the store. Those experiments demonstrate that a 10% increase in store distance increases total basket size by about $2.50 out of a $40 basket (Hui, et al. 2013). Based on that result, I calculate that grocery stores earned $64 billion additional profits from the unplanned purchases created by sales attention.[9] Later in the paper, I will calculate that wholesalers and retailers spent $53 billion on salespeople, store

[9] This calculation assumes that 25% of grocery store costs are fixed and 50% of food wholesaler costs are fixed. If so, than a $2.50 increase in basket size will increase profits by $0.29, or $0.71% of the $40 basket. I assume that merchandise damage is linear with shopping time, so I do not count that aspect of sales attention.

displays and other inputs to the "free" shopping experience. In other words, the cost-based value for "free" shopping experiences matches implicit market transactions quite closely.

The next level of spatial spillover is between nearby stores. A recent paper by Koster and Pasidis (2017) estimated that each pedestrian walking by provides €0.005 of value to Dutch stores. In the Netherlands, stores are typically small and owned separately. As a result, these spillovers are considered externalities, which are generally excluded from the supply-use tables (SNA 2008, Section 3.92-3.95). However, such unpriced externalities are rare in the United States. A paper by Gould, Pashigan and Prendergast (2005) demonstrates that small stores in malls benefit enormously from the foot traffic generated by the large anchor stores. They argue that privately owned shopping malls are able to internalize this externality by charging minimal rents to anchor stores and high rents to small stores. Similarly, big box stores frequently lease small kiosks to specialty retailers (Zumbach 2016). Even outside shopping malls, real estate management companies frequently own nearby properties and set rents to internalize the spillovers (Jardim 2016). Finally, business improvement districts sometimes set dues to internalize the spillovers from large anchors (Brooks and Strange 2011). Considering all of these arrangements together, it seems likely that the spillovers from pedestrian traffic are mostly internalized in the United States, and so the spillovers should be tracked in the supply-use tables.

Resale price maintenance is a practice where manufacturers specify the minimum price that their products can be sold for. There is a vast economic and legal literature studying this practice and arguing whether it violates anti-trust law (Klein 2009). Since the 1970's, courts have generally held the resale price maintenance is permitted if it facilitates the provision of "free" shopping experiences (Gundlach, Manning and Cannon 2014). Resale price maintenance has gained new prominence with the rise of "showrooming", where people browse at brick and mortar stores before buying online (Kalyanam and Tsay 2013). The resale prime maintenance literature contains many of the same concepts as the experimental model, and a few papers even discuss the importance of shopping time explicitly (Overstreet 1983). However, that literature does not use an accounting framework to value either the "free" shopping experiences or the sales attention systematically.

Finally, the permanent income hypothesis is a theory that consumers smooth income over time – and therefore consumption should not respond to short-term income shocks (Friedman

1957). In recent decades, economists have demonstrated that expenditures on non-durable goods spike when individuals receive predictable income like Social Security Checks (Stephens 2003), bi-weekly paychecks (Stephens 2002) and food stamps (Hasting and Washington 2008). Based on that spike, they reject the permanent income hypothesis. This paper suggests a possible alternative explanation for the observed spike: retailers sometimes provide "free" check cashing to their customers. In other words, individuals are visiting retailers to utilize the "free" check cashing services, and then buying items while they're in the store anyway.[10]

Section 2. Measuring the Value of "Free" Shopping Experiences

This paper focuses on sales-supported shopping experiences and excludes other items which are provided without explicit cost. To start out, I exclude advertising-supported media and marketing-supported information because those categories are already tracked in a previous paper (Nakamura, Samuels and Soloveichik 2017). I also exclude shopping experiences which are explicitly paid for through membership dues. Finally, I exclude post-purchase services like repairs or tech support which are provided without any explicit cost. Those services are restricted to buyers only, so they are considered to be bundled with the purchased product.

Sales Expenditures by Wholesalers and Retailers 2002-2015

To the best of my knowledge, no company or industry tracks the production cost for shopping experiences explicitly. Companies often report spending for a combined category 'sales, general, and administrative' (SG&A), but that category includes many costs which are unrelated to the "free" shopping experience. In this paper, I will use occupational data to estimate the cost of producing "free" shopping experiences.

[10]Food stamps are now loaded electronically, but recipients may still want to check the balance. Even individuals with a bank account may choose to combine shopping with check deposit if the bank is near a retail store.

The primary data is taken from the Occupational Employment Survey (OES). That survey reports employment and earnings for selected industry/occupation combinations.[11] I then classified all workers in the wholesale and retail sector into three separate groups: a) definitely non-sales; b) definitely sales and c) ambiguous. The first groups covers a very broad range of occupations, from manufacturing workers who create a product[12] to the cashiers who ring up the sale and the repair workers who fix the product after purchase. The key factor uniting these occupations is that the workers focus on serving individuals who are actually buying a good or service, not just browsing. The second group covers the narrow range of sales workers.[13] Finally, the third group covers support staff who work in both. For example, a janitor generally cleans both the sales aisles where shoppers browse and the cash registers where goods are purchased. I then calculate the sales labor share with the following formula:

(Sales Labor Share) = (Earnings for Definitely Sales Workers)/

[(Earnings for Definitely Sales Workers) + (Earnings for Definitely Non-Sales Workers)]

Across the entire wholesale and retail industry, the sales labor share averages around 50%, but there is enormous variation across subsectors. Clothing retailers (NAICS 448) have a sales labor share of more than 80% and gasoline retailers (NAICS 447) have a sales labor share of less than 5%. In the empirical analysis, I analyze each OES subsector separately, but the aggregate sales labor share is robust to combining the subsectors.

The secondary data is taken from Economic Census's detailed data on non-labor operating expenses.[14] Most of the non-labor cost categories are general, but there are four categories which are definitely unrelated to production of "free" shopping experiences: 'purchased packaging', 'purchased delivery', 'purchased sales commissions'[15], and 'purchased

[11] The OES does not include self-employed workers. I used the American Community Survey (ACS) to calculate a self-employment rate for all three categories of workers, and then adjust the OES data by that rate. The ACS is much smaller than the OES and its industry data is not so reliable. So, I calculate a single self-employment rate for the wholesale/retail category rather than one for each individual subcategory.
The OES's published data are based on a three-year combined sample, so they are slightly smoothed.
[12] For example, a supermarket butcher might cut individual roasts or a department store tailor might hem clothing.
[13] I include a few selected support occupations like sales supervisors. I exclude advertising sales agents and other individuals who were already counted in the previous paper on "free" media content.
[14] This detailed data is only available in 2002, 2007 and 2012. I interpolate between the years.
[15] This category only tracks sales commissions paid to other companies. The labor earnings for those salespeople are tracked on their employer's books – so I exclude the resold sales services to avoid double counting.

advertising and marketing'. In addition, the IRS corporate income statistics also include another unrelated category: 'write-off for bad debt'. I subtract these five non-labor categories from total operating expenses and allocate the remaining non-labor expense categories proportionally to the sales labor share. I also allocate returns on own capital and other profits proportionally to the sales share of operating expenses. In the end, I estimate:

(Sales Share) =(Sales Labor Share)*[1-(Packaging Share)-(Delivery Share) –

(Sales Commission Share) – (Advertising and Marketing Share) – (Bad Debt Share)]

Figure 1 shows sales expenditures by contribution factor from 2002 onward. Salesperson compensation always represents the highest contribution cost, but the imputed categories sum up to more collectively. Despite the explosive growth in e-commerce, the nominal sales share for the overall retail and wholesale sector has remained steady. This steadiness is due to an increase in sales expenditures at brick and mortar stores over the past decade. This increase on the intensive margin is sufficient to approximately cancel out the decrease on the extensive margin from customers switching from brick and mortar to e-commerce.

Figure 1 also shows a decline in sales expenditures in 2009. This decline is primarily caused by the imputation methodology. Business profits plummeted during the recession, so the imputed return on capital used for sales declined dramatically. In addition, many salespeople are paid on commission – so their labor earnings fell during the recession. None of the results in this paper adjust for this cyclical issue, so readers should exercise caution when interpreting short-term results. The discussion will focus on long-term trends, which are not changed by 2009.

Sales Expenditures by Other Industries, 2002-2015

Many stores outside the wholesale and retail sector offer "free" shopping experiences. For example, a bank might teach customers about investment products. I use the same OES data described earlier to calculate salesperson compensation for each industry tracked in the supply-use accounts. Each industry has its own production process, so it is difficult to calculate support costs and non-labor costs using the same formulas described earlier for the wholesale and retail industries. Instead, I will assume a fixed ratio of sales support costs to salesperson compensation

costs across all industries in a given year. Since 2002, the ratio of sales support costs to salesperson compensation costs in the wholesale and retail sector rose steadily. I assume the same increase in support costs for other industries as well.

In total, I calculate that sellers spent $2.7 trillion on sales in 2015. At first glance, this number appears very large – but it is consistent with company reports. Using Compustat data, I calculated that publicly traded firms in the United States spent $2.0 trillion on sales, general and administrative (SG&A) in 2015. I was not able to buy data on privately traded firms, but I use Compustat's SG&A ratios by industry to impute SG&A spending of $3.1 trillion for those companies. Furthermore, the OES reports that salespeople and sales support staff[16] account for approximately one third of the total compensation earned by sales, general and administrative employees. I do not have data on the ratio of output to spending for sales alone, but the overall wholesale and retail sectors enjoyed operating profits of 35% in 2015. Accordingly, I calculate sales expenditures of $2.3 trillion [(2.0+3.1)*33%*135%] based on the Compustat data. This is very close to the $2.7 trillion value calculated earlier.

Historical Sales Expenditures, 1929-2001

Unfortunately, the OES data described earlier is not available before 2002.[17] Instead, I use the Current Population Survey (CPS) to extrapolate an annual sales share. Like the OES, the CPS contains data on employment and earnings by industry and occupation. However, the CPS data is self-reported and therefore considered to be less reliable (Fisher and Houseworth 2012). A particular problem is that individuals employed in manufacturer's sales branches frequently report their industry as manufacturing rather than wholesale. The CPS is a small survey, and its data on sales workers by NAICS code is extremely noisy. I collapse the industry codes into three broad categories: wholesale, retail and everything else. I also smooth the calculated sales share for each category over three years to minimize annual volatility. In addition the Census

[16] I cannot observe sales support staff directly. Just like before, I split general and administrative employees in proportion to sales compensation and non-sales compensation.

[17] The OES does report data by SIC code from 1998 to 2002. These two coding systems handle many subsectors differently and so I was not able to match the two datasets. There is also some OES data before 1998, but the industry coverage is incomplete and the occupation codes are not consistent. For simplicity, I do not use this data.

occupation codes are much coarser than the OES occupation codes.[18] Instead, I then use their reported sales shares as a proxy to extrapolate the OES data back to 1967.

I also use the decennial population Census to estimate historical expenditures on sales. The Census is a larger survey, and so I am able to get estimates of sales share by detailed NAICS code for Census years. I use those detailed sales shares to allocate the total sales labor observed in the CPS across wholesale and retail subsectors. Before 1967, the CPS data is not available.[19] So, I use the Census data to estimate sales shares back to 1929. I have not yet been able to find annual data back to 1929, so I assume a smooth growth rate of sales share between Censuses.

Figure 2 shows aggregate sales expenditures relative to GDP. The most important result is that sales have been gradually shifting from the wholesale and retail sector to other industries. A portion of this increase can be attributed to the long-term transformation of the U.S. economy from goods to services. But the service sector has also increased its sales share over time. Malls are now partially supported by nail salons, restaurants and other service industries.

Readers should note that the long-term nominal trend is somewhat sensitive to the extrapolation method used before 2002. For some reason, the decennial population Census shows a large decrease in the average sales retail sales share in 1990 that the CPS does not show. I welcome suggestions from readers on why this discrepancy exists. For now, I chose to use the CPS because its methodology appears to be more consistent over time. I welcome suggestions on how to balance these two datasets better. Readers should also note that the aggregate total shown in Figure 2 relies on a combination of OES and Economic Census data. The OES is conducted by the Bureau of Labor Statistics (BLS) and the Economic Census is conducted by the Census Department. These two agencies use different survey techniques and data cleaning techniques. It is possible that these methodology differences may result in an aggregate total which neither the BLS's methodology nor the Census's methodology would produce alone.[20]

[18] This coarseness is exacerbated by my choice to use the Ipums summary variable occ1950 rather than the full occupational data available. I made that choice because it enabled more consistent comparisons over time.
[19] The CPS microdata goes back to 1962, but they changed their industry coding in 1967 without an overlap.
[20] Factoryless goods producers are a particular issue. These companies often report as manufacturers, but the Census generally shifts them to the wholesale sector.

Sales Opportunity Costs from "Free" Shopping Experiences

The previous sections focused on seller expenditures and omit a major cost of tactile shopping: it's hard on the goods being examined. Generally accepted accounting principles (GAAP) mandates that ordinary damage should be tracked in cost of goods sold (COGS) rather than operating expenses (Epstein, Nach and Bragg 2009).[21] For example, a grocery store might buy 10 apples, lose 2 when a careless customer knocks over the display and then sell the remaining 8. Implicitly, the store earns a negative retail margin on the damaged apples. In other words, the value of the damaged apples is currently considered an opportunity cost rather than an expense. Regardless of the accounting treatment, it is an economic cost for the provider of "free" shopping experiences and therefore should be included in their value.

Unfortunately, I have not been able to find any data tracking total sales opportunity costs. In this preliminary draft, I will estimate sales opportunity costs for **goods** from three separate sources: consumer shoplifting, consumer returns,[23] and consumer food-handling. These three sources represent only a portion of the opportunity costs associated with tactile shopping – so my estimates should be seen as a lower bound on the total cost of tactile shopping. Vehicle dealers, prescription drug pharmacists and gas stations rarely allow unsupervised tactile shopping and almost never allow returns – so I assume that customer damage for those items is negligible.

My data on consumer shoplifting is taken from the National Retail Federation (NRF). Since 1991, the NRF has published annual estimates of total inventory shrinkage and the share attributable to customer theft. Before 1991, I use periodic reports on inventory shrinkage from the Merchant Retailers Association. These reports do not split customer shoplifting from employee theft, so I use my best judgement and industry research (Curtis 1960, 1973 and 1983) to estimate the consumer share of shrinkage. In practice, consumer shoplifting is relatively rare and my aggregate results are not sensitive to the treatment of this item.

[21] This treatment only applies to unrepaired damage. Repair costs are included in operating expenses.
In many cases, damaged items are mixed together with undamaged items. Rational shoppers expect that a portion of the items purchased will be damaged and therefore demand a lower average price.

[23] Very few consumer returns are prompted by genuine product defects or other store error. Instead, customers simply changed their mind on an item after they took it home. By law, retailers could forbid this type of return – but most explicitly permit it and advertise their return policy prominently.
Readers should note that retail returns are not synonymous with the "returns and allowances" tracked by the IRS.

My data on consumer returns is also taken from the NRF. Since 2004, the NRF has published annual estimate of consumer return rates. According to the National Retail Federation, department store customers returned approximately 15% of their purchases in 2016 (Appriss Retail 2017).[24] Modern shoppers typically expect merchandise to be neatly packed in unopened boxes, and modern retail stores are too busy to process returns in-house. As a result, most returns are sold almost immediately to specialty liquidators for about 30 cents on the dollar. In total, I estimate that consumer returns reduced net department store revenue by approximately 9.5% in 2016.[25]

The 9.5% reduction in net revenue from returns is a recent phenomenon. Since 1995, online liquidation companies grew from almost nothing to buying most retail returns. For example, Bstock.com auctions truckloads of returns from major companies like Walmart or Best Buy. Even though these auctions significantly increase the average price paid for liquidated returns, they also increase the likelihood that companies will liquidate returns and therefore dramatically reduce the average resale price for consumer returns. I assume that these online specialty liquidators grew at the same rate as the retail ecommerce sector. Before 1995, consumer returns had very little impact on net revenue. Department stores had desks devoted to processing returns, and they generally did any necessary repairs in-house. One 1942 study estimated that 78% of returns sold at full price and many of the discounted returns might have been marked down even if they hadn't been sold (Gault and Goodman). Over the next five decades, retail discounting gradually become more common. Between 1929 and 1995, I use the average return rate and the average markdown rate as extrapolators to estimate annual sales opportunity costs. In total, I estimate that consumer returns only reduced department store margins by only 1% in 1929 and 4% in 1995, much lower than the 10% calculated for 2016.

Finally, I estimate the opportunity cost of food shopping. Food items are rarely shoplifted or returned to stores – but in-store damage is common. For example, a fruit shopper might poke items to find the ripest one or cereal shopper could accidentally knock boxes down. Even though damaged food is generally completely safe, modern supermarkets generally discard it anyway (Jacobs 2014). According to the USDA, current food losses at the retail level are

[24] They report a median, and includes e-commerce, but excludes grocery stores, gasoline and automobiles.
[25] My numbers are based on research published by Professor Zac Rogers (Kroll 2017), and personal conversations with him giving industry background. All estimates calculating the average value of returns are my own.

approximately 10%-12% (Buzby, et al. 2016 Buzby, Wells and Hyman 2014). Historically, food discards were much rarer. One 1943 study estimated only 3% food losses at the retail level (Education Federal Security Agency), and a 1977 study estimated food losses of 4% at the distribution (Comptroller General). Between years with data, I use the consumer returns for non-food items estimated earlier to interpolate food damage numbers.[26] For all years, I assume that customer shopping accounts for half of the lost food.

Unfortunately, I have not been able to locate any data tracking sales opportunity costs outside the consumer goods sector. Anecdotally, "free" trials are common for consumer services like cable television and business services like software. For now, I will assume that the consumer service sector, the business goods sector and the business service sector all have the same ratio of sales opportunity costs to sales expenses as the consumer goods sector for each year studied.[27] In other words, I assume that sales opportunity costs have risen in all sectors, not just the consumer goods sector.

Figure 3 shows my estimate of sales opportunity costs over time. I find they grew rapidly after 1995 and now account for nearly 5% of nominal GDP. In an economic sense, sales opportunity costs from reselling consumer returns are almost exactly equivalent to sales labor costs from processing returns in-house. As a result, my empirical analysis will count both sales opportunity costs and sales labor costs when valuing "free" shopping experiences. As a robustness test, I also calculated nominal GDP, real GDP and TFP when only the sales expenses tracked in Figure 3 are included in final output. That methodology results in a much lower growth impact from "free" consumer shopping experiences. In other words, sales opportunity costs are an important and growing component of the economy in recent years.

The Internet has almost certainly contributed to the rise in sales opportunity costs. For goods, e-commerce companies typically have higher return rates than their brick and mortar counterparts. Some of these returns might be explained by the difficulty of buying items remotely, and could potentially be avoided with better virtual shopping technology. But e-commerce companies, also make returns extremely easy – so customers return items that they

[26] Some of these studies include food loss at the wholesale level, so the exact numbers might not be comparable. Readers should note that the USDA's currently published statistics assume each commodity has a fixed loss ratio over time. However, metabolic models indicate actual food waste increased after 1970 (Hall et al. 2009)

[27] I use the consumer share developed in the next section to calculate sales expenses for consumer goods alone.

might have otherwise kept. I calculate that consumer returns reduced e-commerce revenue by approximately 23% in 2016. This is approximately enough to offset the lower e-commerce sales expenditures discussed earlier. In other words, e-commerce companies are substituting in-home tactile shopping for in-store verbal and display shopping. Similarly, the Internet has made it much easier to request and receive "free" trials of services which can be delivered electronically.

Readers should note that Figure 4 implicitly includes open source software like Linux. Even though Linux is owned and controlled by a non-profit corporation, most of the programming is done by private companies such as Red Hat or Intel (Anthony 2014).[28] Intuitively, those companies offer a basic software version to attract clients, and then sell paid services like premium software, consulting and computer design. I calculate likely producers of open source software may have provided $30 billion of "free" trials to domestic businesses in 2016.[29] In comparison, an industry study estimated that open source software reduced proprietary software sales by $60 billion worldwide (Standish Group International, 2008) and an academic study estimated that Apache, an open source server software, would cost $2-$12 billion to replace with proprietary software (Greenstein and Nagel 2014). If the entire $30 billion of "free" trials was recorded as additional software investment, then measured software investment would rise from the $333 billion currently recorded in Table 5.6.5, line 2 to $363 billion. This is a nontrivial increase, but not enough to change economic history much.

Valuing the "Free" Shopping Experience.

Only a portion of the sales expenditures shown in Figure 2 provides experiences desired by shoppers. Salespeople spend significant resources preparing and practicing the sale pitch that they include with the 'free' shopping experience. Furthermore, the merchandise damage and "free" trials shown in Figure 3 are valued at retail prices, which may overstate the true economic cost to sellers. I have not been able to find any data estimating the split between shopping experiences and other spending. For now, I will assume that half of sales expenditures are devoted to preparing and practicing the sales pitch, and half of sales opportunity is a true cost to

[28] https://www.extremetech.com/computing/175919-who-actually-develops-linux-the-answer-might-surprise-you
[29] I focus on the industries: computer manufactures (NAICS 334), publishers (NAICS 511) and computer system designers (NAICS 5415). These industries produce other products, so $20 billion in an upper bound on software.

retailers. In other words, only $0.50 out of every $1 in nominal spending shown in Figures 2 and 3 genuinely benefit the recipient. A small portion of those shopping experiences are funded through membership fees and other explicit charges. These paid shopping experiences are already well tracked in the GDP, so I subtract them from the experimental estimates of "free" shopping experiences.

Figure 4 shows the value of "free" consumer shopping experiences relative to GDP over time. I find a U-shaped pattern, with "free" consumer shopping experiences growing slower than overall GDP before 1995 and faster than overall GDP afterwards. The 1990's have previously been identified as a crucial turning point for the information technology (Jorgenson 2001), so it seems likely that the Internet was a major cause of the increase in "free" consumer shopping experiences. However, this paper does not test that hypothesis formally. Regardless of the reason, the experimental methodology suggests that nominal economic growth is modestly overestimated prior to 1995 and modestly overestimated after 1995.

Section 3: Price Indexes, GDP Quantity Indexes and TFP

Conceptual Discussion

Shopping experiences are a very difficult service to deflate properly. One issue is that sellers frequently create new sales campaigns to introduce new goods, to change the perception of existing goods or to simply entertain frequent shoppers who are bored with the old campaign. So I cannot track the cost of producing the exact same sales campaign over time. In addition, experiences are a non-rival good with poorly defined units of output. For example, a store might switch from starting their Christmas promotions right after Thanksgiving to starting the promotions in September. Is this additional mistletoe decoration an increase or decrease information is in shopping experience? Finally, some sellers are sometimes forced to trade-off between providing a pleasurable shopping experience and one that provides information more efficiently. For example, should a salesperson flatter customers trying on a new outfit or give

accurate advice on how to improve their selection. Which one approach represents a higher quality shopping experience?

Verbal Shopping Experiences

Verbal shopping experiences are a very labor intensive service to provide with little productivity growth over time.[30] Shoppers typically expect that salespeople will listen to their unique circumstances and give individual advice. Furthermore, new technology like smartphones may harm rather than help personal conversation skills. If sales wages were the only input to verbal shopping experiences, then it would seem plausible that prices for verbal shopping experiences would track wages for salespeople exactly. However, verbal shopping experiences also require a space for salespeople to meet customers and other non-labor costs. The current price index is an equally weighted geometric mean of salesperson compensation[31] and space rental costs.[32] I assume no productivity growth since 1929.

Display Shopping Experiences

Display shopping experiences are less labor intensive to provide and have experienced significant productivity growth. Early in the century, displays were generally planned individually by skilled artists or experience managers (Leach 1994). Since the 1970's, marketing professionals have observed shopping behavior scientifically (Underhill 2000 and 2005) and used those observations to create pre-printed signs and other mass produced marketing displays that can be implemented by unskilled workers. My current price index is taken from BLS's producer price index for store displays (WPU159A04). This series is available back to 1982.

[30] I have also experimented with constructing a price argument from restaurants. The basic argument is that restaurants meals are more expensive because they include a dining experience provided by waiters, bartenders and other salespeople. So, the difference should correspond to the cost of providing a verbal dining experience. This price index grows even faster than my input-based method, suggesting negative productivity growth.

[31] My primary data for compensation costs is BLS's Employment Cost Index. This provides data on compensation back to 1984 and wages back to 1977. I supplement withdecennial population Census data and other sources to get annual compensation estimates back to 1929. My compensation data is based on mean compensation per employee, and does not adjust for labor quality. Salesperson quality partially depends on traditional human capital factors like education and experience – but it also depends on retail specific factors like honest, personality and a willingness to work odd hours. I welcome suggestions for measuring quality-adjusted wages over time.

[32] For now, I use BLS's PPI for shopping center leasing (PCU5311205311201) back to its start in 1996. Before then, I use BEA's existing price index for hotel accommodations (BEA Table 2.4.4, line 85). I use those two indexes rather than a construction cost index because those two indexes include maintenance costs like cleaning and utilities.

Before then, I use BEA's pre-existing price indexes for household appliances (Table 2.4.4, line 10) as a proxy for the cost of electronic store displays and pre-existing price index for recreational books (Table 2.4.4, line 17) as a proxy for the cost of print store displays.[33] Just like verbal shopping experiences, display shopping experiences require also require a space for customers to stand while looking at displays. My current price index is an equally weighted geometric mean of display costs and space rental costs.

Tactile Shopping Experiences

The main cost of tactile shopping experience is the sales opportunity cost. For goods, the merchandise may be damaged by customers. For services, the "free" trial may cannibalize purchases. As a result, the cost of tactile shopping depends on the cost of the items being examined. For example, retailers frequently put costume jewelry out for customers to handle on their own – but lock up genuine jewelry for customers to observe from afar. My price index for tactile shopping is simply an average of BEA's pre-existing price indexes for consumer goods and services (Table 2.4.4), weighted by the estimated value of for each major good or service provided "free". Readers should note that this price index focuses on consumer shopping experiences and might not capture the cost of tactile business shopping perfectly.[34]

Figure 5 shows the three price indexes over time. The most important result is that tactile experience prices and display experience prices both grew slower than overall GDP prices, and verbal experience prices grew faster than overall GDP until 1995. The slower price growth for display and tactile shopping can be explained by productivity growth and outsourcing in the manufacturing sector. It is now very cheap for retailers to design a new product line, and commission posters promoting the product from specialty manufacturers, and then put the product in stores for customers to handle and damage. On the other hand, verbal shopping experiences are very labor intensive and the basic process of talking to a salesperson has not changed much over the past century. So, prices for verbal shopping experiences rose with blue-collar wages.

[33] I assign electronic store displays a weight of 33% and print store displays a weight of 67% in my index.
[34] In theory, the TFP formulas could allow a separate tactile shopping price index for every industry which provides "free" trials. But that would be unwieldy to calculate in practice and would have little impact on aggregate TFP.

Combined Prices for "Free" Shopping Experiences

Figure 5 shows that the three types of shopping experiences have very different price trends, so the combined price index depends enormously on the weight for each category. To start out, I weight tactile shopping by the sales opportunity costs shown in Figure 3 **plus** an estimate of the sales expenses which are devoted to promotional products like pencils with the company name and "free" product samples. I will use that lower bound as a weight for tactile shopping experiences in my analysis. In contrast, it is harder to determine expenditures on display shopping experiences versus verbal shopping experiences. The basic problem is that the same employees provide both, and the only data I found splitting salesperson time by task was a 1928 study of department store salespeople (Bittner).

In the absence of more recent data, I will use three minor occupations in the OES as proxies: merchandise displayers (occ_code 27-1026), demonstrators and models (occ_code 41-9011 & 41-9012).[35] The first occupation is clearly focused on display shopping experiences and the next two occupations are clearly focused on verbal experiences. For each industry, I assume that general sales expenditures are allocated in proportion to compensation for these three minor occupations. For example, direct selling establishments (NAICS 4543) employ no merchandise displayers and plenty of demonstrators and models. Accordingly, it seems reasonable to assume that general salespeople employed in that industry are mostly providing verbal experiences. I also assume that the display share for each industry is fixed throughout my sample.

Figure 6 compares prices for "free" shopping experiences with prices for "free" content calculated in earlier research (Nakamura, Samuels and Soloveichik 2017).[36] The most important result is that prices for "free" shopping experiences have grown slightly slower than overall GDP since 1929. In comparison, prices for "free" digital content have been plummeting. In other words, setting up a website to sell products is now much cheaper than setting up a brick and mortar store. This increasing cost advantage explains the rapid growth of e-commerce.

[35] These occupations only account for 3 percent of total sales compensation in the OES data, and are sometimes omitted in the public OES data. Furthermore, their aggregate employment share is not stable across OES years. I aggregated the public OES across all years in the sample (2002-2015) and calculated a ratio for each wholesale category, each retail category, the combined manufacturing sector and the combined rest of the economy. I then assume that these shares are fixed over time.

[36] These values are calculated for consumer experiences, so each retail subsector and wholesale subsector is weighted by its consumer share. Results are mostly robust to different weighting schemes.

However, most people still prefer to shop at brick and mortar stores and therefore "free" shopping experiences still account for a large majority of consumer purchases.

GDP Quantity Indexes with "Free" Shopping Experiences

Figure 7 recalculates overall GDP quantity using the nominal values in Figure 4 and the price indexes in Figure 5.[37] Just like Figure 4, I find a clear trend break in the early 2000's. Between 1929 and 2002, measured real growth falls very slightly. Between 2002 and 2016, measured real growth increases by 0.07 percentage points per year. I calculate that the experimental methodology reduces the post-2002 slowdown in real GDP growth from 1.66 percentage points per year to 1.60 percentage points per year. This is not enough to reverse the economic slowdown – but it does ameliorate it.

In 1988, Gordon and Bailey argued that BLS's published statistics do not track improved retail amenities and therefore underestimate recent output growth in the retail sector. Consistent with that argument, Figure 7 shows that "free" consumer shopping experiences add 0.04 percentage points annually to real GDP growth from 1972 to 1986. In other words, retail amenities are one component of the "free" consumer shopping experiences tracked in my experimental methodology. As a result, Figure 7 captures longer store hours and other shopping improvements in real GDP. However, I will show in the next section that this real output growth is almost precisely offset by an increase in shopping time, so there is little net change in the real quantity of "free" shopping experiences provided per hour or retail productivity.[38]

In earlier research, I found a dramatic decline in print content that was almost certainly caused by competition from digital content (Nakamura, Samuels and Soloveichik 2017). When I first started this research, I expected to find similar declines in "free" shopping experiences caused by competition from e-commerce. In fact, Figure 7 shows that "free" shopping experiences have risen faster than overall GDP. This result is consistent with industry research on 'webrooming' (Hof 2015), where shoppers first research products online and then visit stores

[37] I calculate separate price indexes for each major industry sector, with each price using a different weight for display versus verbal. The weights are based on estimated consumer sales, so they should be seen as a CPI rather than a PPI. Aggregate GDP results are similar if I used a combined price index rather than a separate one.
[38] Longer shopping times may explain the difference in productivity growth for food and non-food shopping. However, I was not able to find reliable historical data splitting food shopping, so I cannot be certain.

to test them in person. Or they might order them online, test them at home and then return them if they are unsatisfactory. The complementarity is also consistent with a theoretical model developed by Ofek, Katona and Sarvary (2011) where retailers differentiate by offering both online and offline purchasing options. Of course, this current complementarity may eventually disappear when consumers get familiar enough with e-commerce.

The dramatic real GDP impact shown in Figure 7 may help explain the high consumer surplus from e-commerce reported by Brynjolfsson, Eggers and Gannanemi (2018). At first glance, a consumer surplus of $842 per person per year from e-commerce seems implausibly high. After all, total retail e-commerce sales were only $1,200 per person in 2016 and most goods bought online are priced similarly online and offline (Cavallo 2017). So, it might seem that giving up e-commerce would entail only a few extra trips to the store and possibly a minor increase in out-of-pocket spending. However, Figure 7 suggests that brick and mortar stores may be providing significantly better "free" shopping experiences in response to the competition from e-commerce. Since 2002, I calculate that the improvement in "free" shopping experiences increases real GDP growth by 0.06% per year. Cumulating over 14 years, that growth increase adds approximately $700 per adult per year to real GDP - close to the $842 reported.[42]

Quantity Indexes for Sales Attention

If there was only interest in real GDP, Figure 7 would be enough to fully measure the impact of 'free' shopping experiences on the economy. However, most policy-makers and researchers are interested in decomposing real GDP growth into the component parts of TFP growth for individual industries, quantity growth of capital, quantity growth of labor and quantity growth of other inputs. Holding real information output fixed, my experimental methodology treats more sales attention as an increase in inputs and therefore a reduction in TFP for the industries producing shopping experiences. For other industries, more sales attention is considered an increase in gross output and therefore an increase in TFP. The intuition for this is that some companies use shopping experiences as an input. Sales attention is the implicit payment for that 'free' business information, so it is counted as an output.

[42] I assume children do little shopping, and therefore allocate all consumption gains to adults. Of course, a single individual who gives up e-commerce might still benefit from economy-wide changes in the retail sector. However, it seems reasonable to assume that survey respondents do not consider pooling equilibria in their answers.

I use shopping time as a quantity index for sales attention. Since 2003, the American Time Use Survey (ATUS) has tracked time use for a large and representative sample of adults. The ATUS tracks both activities and location for their sample, so it is straightforward to calculate the time spent at both grocery stores and other consumer goods stores. I use this time as a quantity index for sales attention at brick and mortar retailers.[43] Unfortunately, the ATUS does not report usable data on sales attention for services, sales attention for e-commerce or other non-traditional shopping.[44] In my TFP calculations, I assume that those sellers pay the same viewership price as brick and mortar retailers in every given year. In other words, service sector industries improve their "free" shopping experience at the same rate as goods sector industries.

Figure 8 shows average time spent on shopping from 2003 to 2016. The effects of e-commerce are plain: non-food shopping time fell 20% even as food shopping remained steady. Over the same time period, the non-food market share for e-ecommerce only rose from 1% to 7%. Even if every online shopper completely avoided brick and mortar stores, it would not be enough to explain the decline. Clearly, brick and mortar shoppers are buying their goods faster.

Figure 9 shows self-reported stress for 2010, 2012 and 2013. Once again, the effects of e-commerce are plain: non-food shopping stress fell 30% even as food shopping stress rose. This decrease in stress may indicate that stores are using fewer high pressure sales tactics. In other words, brick and mortar stores may be demanding less attention per hour of shopping. If so, then the time decrease shown in Figure 8 may underestimate the true impact of e-commerce. However, the ATUS only tracks stress for three years and the relationship between stress and sales attention is somewhat speculative. Accordingly, I will not adjust the quantity index shown in Figure 8 for self-reported stress. I will also not adjust for potentially relevant factors such as shopper income, time of day, credit card usage, or other factors that retail stores might value.

---

[43] Some individuals report non-shopping activities while in stores. For example, a husband might accompany his wife to the mall and then read while she shops. Conversely, some people report shopping at home. This research is focused on brick and mortar stores, so I track location rather than activity. In practice, the ratio (time in brick and mortar stores): (time spent shopping) has not changed much. Either e-commerce is very quick, or people report another activity code for it.

[44] Prescription drug salespeople generally target potential customers through doctors offices and other medical locations. Similarly, vehicle dealers generally target potential customers with offsite test drives or "free" vehicle services like oil changes. Accordingly, I believe that shopping time for these categories is unlikely to be reported with a location "other consumer good stores". In order to be consistent, the hourly "earnings" index shown in Figure 10 only counts "free" shopping experiences at brick and mortar stores.

A small portion of brick and mortar store sales are actually transacted online, over the phone or otherwise done remotely. In future drafts of this paper, I hope to adjust my calculations in Figure 10 for these remote sales

It is difficult to track shopping time before 2003. Time diary studies were conducted periodically, but they are often small and unrepresentative. For now, I use the time diaries available on Ipum's website back to 1965. These time diaries often focused on a specific population or a specific month, so they might be representative. I adjust for these sample differences by constructing an ATUS sample to match each earlier time use survey. Before 1965, I was only able to locate two potentially representative studies: a 1954 Ward and Beecher time diary study described in a later book (de Grazia 1964) and a 1939 time diary done on a small sample (Sorokin and Berger). I use those studies to extrapolate shopping time back to 1929. Consistent with the broad studies cited above, time diary surveys focusing on suburban married women also show a large increase in shopping time (Walker and Woods 1976).

Splitting food and non-food shopping time is particularly difficult. I was not able to find time diary data before 1993, so I relied on the academic literature. In particular, I used a 1986 survey of dual career households (Kolodinsky and LeBrecque 1996), a 1978 thesis tracking employed and nonemployed women (Amling), a 1950's study of shopping time by store type (Highway Research Board 1955), and a 1952 survey giving a count of shopping trips by store type (de Grazia 1965). Just like before, I use the ATUS's microdata to adjust for these sample differences. Readers should note that my precise historical TFP results are somewhat sensitive to the split between food and non-food shopping. However, the qualitative results are robust.[45]

Figure 8 shows average time spent shopping from 1929 to 2016. The most striking results is a very large increase in shopping time from 1955 to 1975. After 1975, shopping time plateaued and then started to decrease in 2003.[46] To be clear, this increase in consumer shopping time represents a large **input** increase for brick and mortar stores. Every minute that a shopper is in a store, they are exposed to more sales pitches and are more likely to buy unplanned items.

Why Has Shopping Time Increased So Much?

In the short-term, brick and mortar stores can easily increase shopping time. To start out, product variety is a major determinant of shopping time. Customers who want a specific item must spend more time searching for it when the specific item is surrounded by unwanted

[45] My historical TFP results are not robust to large changes in total shopping time. In particular, I do not use a 1959 study of Georgia women (Bailey) because its food shopping time is so inconsistent with other surveys.

[46] This pattern may partially explain why it is so difficult to find historical data on shopping time. Before the 1970's, shopping was a relatively minor category – so time diaries did not bother tracking it separately.

varieties. And customers who don't know their preferred item are likely to spend more time researching when there are more varieties available.[48] Stores can also use simpler methods like locating milk in the back of a grocery store or training salespeople to give long answers. However, all of these strategies come at a cost. Customers generally do not enjoy shopping and they are wary of being tempted to spend extra money. So, stores which demand more shopping time risk losing customers unless they provide better "free" shopping experiences to compensate.

Competition from e-commerce is one possible explanation for recent decrease in shopping time.[49] Even if relatively few people are buying online, almost all adults have enough Internet access to shop online if their local brick and mortar store does not offer a good enough "free" shopping experience. In particular, many brick and mortar stores have made consumer returns easier to compete with e-commerce (Phillips 2017). These easier returns probably substitute for careful examination before purchase, and therefore enable faster shopping on average. Similarly, better trained salespeople may also enable faster shopping.

Consistent with the competition explanation, grocery stores have not yet felt much competitive pressure from e-commerce and so food shopping time not yet decreased. However, e-commerce has started to move into the food sector. In particular, Amazon recently started delivering fresh food in select cities. If food becomes a significant part of the e-commerce sector, I predict that grocery stores will be forced to improve their service to compete. This prediction is consistent with a recent paper documenting that Walmart entry improves the shopping experience at nearby supermarkets (Matsa 2011).

The huge increase in shopping time from 1955 to 1975 is more difficult to explain. Declining competition from telephone shopping may have played a role. In 1943, approximately 5% of households did their shopping by phone (Cantril and Strunk 1951) and phone shopping was still common in 1960. However, discount department stores rarely offered phone shopping because they did not provide delivery services or other necessary compliments (Rich 1963). As

[48] Unfortunately, I was not able to find data tracking variety by store. It is true that the number of UPC codes has been increasing – but many UPC codes are such close substitutes (e.g. generic vs. name brand flour) that new varieties are irrelevant. Conversely, some UPC codes combine very different items (e.g. fresh vs. stale bread).

[49] Actual e-commerce sales were very small before 2005. However, Webvan, Pets.com and other dot.com failures may have provided competition without selling anything. Even non-retail Internet firms could have provided alternative leisure options for teens and thereby drove up the implicit price for their sales attention. Mail-order catalogues were important early in the 1900's,

a result, telephone shopping likely declined dramatically with the entrance of discount retailers.[50] In addition, the retail sector was gradually consolidating from small individual stores to shopping malls[51] and big box stores. Perhaps this consolidation reduced competition in the retail sector and allowed stores to make shopping longer? Another possibility is employee theft. Many retail stores use either paid mystery shoppers or regular amateur shoppers to supervise employees. Perhaps retailers felt that the young Baby Boomers entering the workforce from 1960 to 1980 required more supervision than their previous employees? In other words, the observed increase in employee theft might have been much higher if the young Baby Boomers hadn't been watched by customers constantly (Curtis 1983)

Prices for Sales Attention

Figure 10 calculates hourly 'earnings' for sales attention by dividing nominal sales output with the quantity index shown in Figure 8. I find a dramatic L-shaped pattern. In 1948, the typical employee earned $1.41 per hour working in the market sector, the typical non-food shopper earned $2.25 per hour of sales attention and the typical food shopper earned $1.58 per hour of sales attention. Over the next half century, hourly "earnings" for sales attention grew significantly slower than market wages. By 2002, the typical employee earned $20.48 per hour working in the market sector, the typical non-food shopper "earned" $4.02 per hour of sales attention and the typical food shopper "earned" $2.39 per hour of sales attention. After 2002, "earnings" for sales attention grow at approximately the same rate as market wages. This growth acceleration is large enough to have significant consumer welfare implications.

It is important to note that hourly prices for sales attention are much higher than hourly prices for advertising viewership or marketing viewership. In 2015, I calculate that the average television commercial viewer only "earned" $0.69 per hour, a seventh of the "earnings" for sales attention. This can be explained both from a supply side and a demand side. On the supply side, shopping is generally considered less pleasant and more difficult than watching television – so households expect higher value per hour. On the demand side, shoppers currently in a store are much more likely to buy a particular good in the near future than random television viewers – so

[50] Catalogues are another potential competitor to in-store shopping. These catalogues were important early in the 1900's, but but they shrank rapidly when the automobile was introduced. So, they are unlikely to explain the drop between 1955 and 1975. Furthermore, many catalogue sales were actually done by phone rather than postal mail.
[51] Each store in the shopping mall is individually owned, but the joint property manager makes collusion easier.

sellers expect a larger impact from promoting a product or service. As a result, my TFP calculations give a much higher weight to sales attention than television commercial viewership.

Recalculating TFP Using My Experimental Treatment of 'Free' Information.

This section calculates industry-level statistics for each of the 63 business sector industry categories tracked by BEA and BLS in their joint production accounts. By construction, the total change to private business sector TFP is simply the sum of each component. In order to make my TFP numbers more comparable to the existing literature, I treat the production of sales attention as an entirely new industry which is excluded from the 63 industry categories. I also exclude the government sector. Because of this focus, my TFP numbers only track private sector business and are not representative of the entire economy.[53]

Figure 11 shows the changes to aggregate TFP from each of the "free" shopping experience categories. I find a large increase in measured TFP growth after 2002, and a modest decline in TFP growth before 2002. In total, the post-2002 TFP slowdown shrinks from 0.44 percentage points per year to only 0.26 percentage points per year. In comparison, "free" digital content only shrinks the post-2002 TFP slowdown by 0.07 percentage points per year. The larger impact of "free" shopping experiences is due to its larger nominal size. In other words, "free" digital content has been growing much faster than "free" shopping experiences – but the sector is still so small that it has little aggregate impact.

Readers should note that the precise TFP calculations for each industry are somewhat speculative. Manufacturers, wholesalers, retailers and other industries often have complex contracts that share responsibility for "free" shopping experiences. For example, manufacturers frequently offer product discounts and other concessions in return for retailers stocking their product in endcaps or other high profile locations. Similarly, manufacturers often compensate retailers for accepting consumer returns. In this paper, I allocate both sales expenses and sales opportunity costs in proportion to the sales compensation in the OES data. As a result, the retail and wholesale industry produce a disproportionate share of "free" consumer shopping

[53] My exact TFP calculations are based on internal numbers collected by BEA for research purposes. These numbers do not always match perfectly with the joint BLS-BEA production accounts. However, the differences are typically very small and do not impact the revisions to TFP shown.

experiences. For the interest of readers, I will show those two industries separately. Results for other industries are available upon request.

Figure 12 focuses on TFP in the wholesale and retail sector. I find dramatic declines in measured TFP growth before 2002 and dramatic increases in measured retail TFP growth after 2002. In total, my experimental methodology reduces the post-2002 slowdown in wholesale growth from 1.13 percentage points to 0.16 percentage points and reduces the post-2002 slowdown in retail growth from 0.89 percentage points to 0.11 percentage points. These changes are primarily driven by brick and mortar stores providing "better" free shopping experiences faster than they had in the past. But the generous returns offered by e-commerce companies also contributed to the additional retail growth.

Conclusion

The "free" digital economy receives an enormous amount of attention from academics and policy-makers. However, most of that discussion has been focused on the direct effect of the Internet. This paper documents an important indirect effect of the Internet. Despite the relatively small size of the e-commerce sector, it is dramatically increasing competition in the overall retail sector. This new competition results in better shopping experiences and faster service at brick and mortar stores. This paper values those service improvements through the framework of a barter transaction where consumers give sales attention in return for "free" shopping experiences. I then recalculate GDP, GDP growth, aggregate level productivity of the business sector and industry-level productivity growth.

I find that my experimental methodology reduces the post-2002 TFP slowdown by 0.20 percentage points per year. In comparison, my previous research calculated that "free" digital content only reduces the post-2002 TFP slowdown by 0.07 percentage points per year. In other words, the indirect productivity effect of the Internet, through better shopping experiences is almost triple the direct productivity effect of "free" digital content. This result highlights the importance of competition between the digital economy and the brick and mortar sector.

References

Abraham, K., & Mackie, C. (2005). *Beyond the Market: Designing Nonmarket Accounts for the United States.* The National Academies Press.

Aguiar, M. and Hurst, E. (2007) "Life-Cycle Prices and Production" American Economic Review, American Economic Association, vol. 97(5), pages 1533-1559

Amling, J. (1978) "Practices and Preferences of Rural Grocery Shoppers" Unpublished Thesis https://ir.library.oregonstate.edu/downloads/js956k84b

Anderson, Peter (2014) "How To Save Money When Buying Appliances" Accessed March 12, 2018 https://www.biblemoneymatters.com/how-to-save-money-when-buying-appliances/

Anthony, S. (2014) "Who Actually Develops Linux? The Answer Might Surprise You" Extreme Tech, February 3, Accessed May of 2018

Appriss Retail (2005-2017) "*Consumer Returns in the Retail Industry, Annual Report*"

Bailey, M., and Gordon, R. (1988) "The Productivity Slowdown, Measurement Issues and the Explosion of Computer Power" https://www.brookings.edu/wp-content/uploads/1988/06/1988b_bpea_baily_gordon_nordhaus_romer.pdf

Baily, B. (1962) "Food Management Practices of Employed and Nonemployed Homemaker Families" Georgia Agricultural Experiment Station Bui. N.S. 98

Basker, E., Foster, L., and Klimek S. (2017). Customer-employee substitution: Evidence from gasoline stations. J Econ Manage Strategy. 26:876–896.

Basker, E. (2012). Raising the Barcode Scanner: Technology and Productivity in the Retail Sector. American Economic Journal: Applied Economics; 4:1-27

Betancourt, R. (2016) "Distribution Services, Technological Change and the Evolution of Retailing and Distribution in the Twenty-First Century" chapter in "Handbook on the Economics of Retailing and Distribition", pages 73-94, Edward Elgar Publishing

Bittner, G. (1928) "Analyzing Retail: Selling Costs" Department of Commerce Report https://babel.hathitrust.org/cgi/pt?id=mdp.39015073247093;view=1up;seq=3

Bridgman, B. (2016). Accounting for Household Production in the National Accounts: An Update, 1965–2014. *Survey of Current Business* 96 (February): 1-5

Bridgman, B., Dugan, A., Lal, M., Osborne, M. & Villones, S. (2012). Accounting for Household Production in the National Accounts, 1965–2010. *Survey of Current Business* 92 (May): 23–36.

Bronnenberg, B., Dube, J., Getzkow, M. and Shapiro, J. (2015) “Do Pharmacists Buy Bayer? Informed Shoppers and the Brand Premium,” The Quarter Journal of Economics 130 (4), 1669-1726

Brooks, L. and Strange, W. (2011) “The Micro-Empirics of Collective Action: The Case of Business Improvement Districts” Journal of Public Economics 95 (11-12), 1358-1372

Brynjolfsson, E., Eggers, E. and Gannamaneni, A. (2018), “Using Massive Online Experiments to Measure Changes in Well-being,” NBER working paper 24514.

Buzby, J., Bentley, J., Padera, B., Campuzano, J. and Ammon, C. (2016) “Updated Supermarket Shrink Estimates for Fresh Foods and Their Implications for ERS Loss-Adjusted Food Availability Data” https://www.ers.usda.gov/webdocs/publications/44100/eib-155.pdf?v=43068

Buzby, J., Wells, H. and Hyman, J. (2014), “The Estimated Amount, Value and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States” https://www.ers.usda.gov/webdocs/publications/43833/43680_eib121.pdf?v=41817.

Cantril, H. and Strunk, M. (1951) “Public Opinion, 1935-1946” Princeton University Press

Carmax (2017). “12 Smart Tips for Buying the Right Used Car, ” Accessed March 12, 2018

https://www.carmax.com/articles/12-car-buying-tips

Cavallo, A. (2017) “Are Online and Offline Prices Similar? Evidence from Large Multi-Channel Retailers” American Economic Review, 107(1), 283-303

Chevalier, J., Kashyap, A., and Rossi, P. (2003), “Why Don’t Prices Rise During Periods of Peak Demand? Evidence from Scanner Data” American Economic Review, 93, 15-37

Comptroller General of the United States (1977) “Food Waste: An Opportunity to Improve Resource Use” Department of Agriculture Report to Congress

Curtis, B. (1960) “Modern Retail Security” Charles C. Thomas

Curtis, B., (1973) “Security Control: Internal Theft” Chain Store Publishing Corporation

Curtis, B., (1983) “Retail Security: Controlling Loss for Profit” Butterworth-Heinemann, Ltd

de Grazia, S. (1964) “Of Time, Work, and Leisure”, Anchor Books

Epstein, B., Nach, R. and Bragg, S. (2009) "Wiley GAAP 2010: Interpretation and Application of Generally Accepted Accounting Principles", John Wiley & Sons

Education Federal Security Agency (1943) "A War Food Use Program" November 1, 1943, pages 3-5

https://babel.hathitrust.org/cgi/pt?id=mdp.39015038748656;view=1up;seq=251

Federal Trade Commission (2003). "Slotting Allowances in the Retail Grocery Industry: Selected Case Studies in Five Product Categories" https://www.ftc.gov/sites/default/files/documents/reports/use-slotting-allowances-retail-grocery-industry/slottingallowancerpt031114.pdf

Fisher, J. and Houseworth, C. ((2012) "Occupation Inflation in the Current Population Survey", CES Working Paper 12-26, https://www2.census.gov/ces/wp/2012/CES-WP-12-26.pdf.

Friedman, M.(1957) "A Theory of the Consumption Function", Princeton University Press, 20-37

Gault, E. and Goodman, C. (1942) "The Control of Customer Returns: A Critical Examination of Store Policies in Handling Returns in Department and Specialty Stores", Michigan Business Studies 10,

Gould, E., Pashigan, P. and Prendergast, C. (2005) "Contracts, Externalities and Incentives in Shopping" The Review of Income and Statistics 87 (3), 411-422

Griffith, R., Leibtag, E., Leicester, A. and Nevo, A. (2009). "Consumer Shopping Behavior: How Much Do Consumers Save" Journal of Economic Perspectives, 23, 99-120

Greenstein, S. and Nagel, F. (2014) "Digital Dark Matter and the Economic Contribution of Apache" Research Policy, Elsevier, vol 43(4), pages 623-631

Greenwood, J. & Vandenbroucke, G. (2005). Hours Worked: Long-Run Trends. NBER Working Paper http://www.nber.org/papers/w11629.pdf

Gundlach, G., Manning, K. and Cannon, J. (2014) "Resale Price Maintenance: A Review and Call for Research" https://www.antitrustinstitute.org/sites/default/files/WorkingPaper14-03.pdf

Hall, K., Guo, J., Dore, M. and Chow, C. (2009) "The Progressive Increase of Food Waste in America and its Environmental Impact" PLoS One. 2009 Nov 25;4(11):e7940

Hasting, J. and Washington, E. (2008). "The First of the Month Effect: Consumer Behavior and Store Responses" NBER Working Paper 14578

Hausman, J. (1997) "Valuation of New Goods under Perfect and Imperfect Competition" NBER Studies in Income and Wealth 58, The University of Chicago Press. http://www.nber.org/chapters/c6068.pdf

Hof, R. (2015) "Webrooming: How Mobile Ads Are Driving Shoppers to Stores" Forbes https://www.forbes.com/sites/roberthof/2015/11/27/webrooming-how-mobile-ads-are-driving-shoppers-to-stores/#46428e604c04

Highway Research Board (1955) “What Parking Means to Businesses” https://babel.hathitrust.org/cgi/pt?id=mdp.39015008081195;view=1up;seq=1

Hortacsu, A. and Syverson, C. (2015) “The Ongoing Evolution of US Retail: A Format Tug-of-War” Journal of Economic Perspectives, American Economic Association 29 (4), 89-112.

Hofferth, S., Flood, S., and Sobek, M. (2017) American Time Use Survey Data Extract Builder: Version 2.6 [dataset]. College Park, MD: University of Maryland and Minneapolis, MN: University of Minnesota

Hui, S., Inman, J., Huang, Y and Suher, J. (2013). “The Effect of In-Store Travel Distance on Unplanned Spending: Applications to Mobile Promotion Strategies” Journal of Marketing 77(2), 1-16

Hulten, Charles and Nakamura, Leonard, 2017, “Accounting for Growth in the Age of the Internet: The Importance of Output-Saving Technical Change” *https://www.aeaweb.org/conference/2017/preliminary/paper/TzriretB*.

Iyengar, S. and Lepper, M. (2000) “When Choice is Demotivating: Can One Desire Too Much of a Good Thing?” Journal of Personality and Social Psychology 79 (6), 995-1006 https://faculty.washington.edu/jdb/345/345%20Articles/Iyengar%20%26%20Lepper%20(2000).pdf

Jacobs, H. (2014) “Why Grocery Stores Like Trader Joe’s Throw Out So Much Perfectly Good Food” http://www.businessinsider.com/why-grocery-stores-throw-out-so-much-food-2014-10

Jardim, E. (2016) “All in the mix: Spillovers and the Agglomeration of Neighborhood Retail” https://sites.duke.edu/eduardojardim/files/2016/01/EFJ_business_spillovers.pdf

Jorgenson, D. (2001) “Information Technology and the U.S. Economy.” *American Economic Review* 91 (1), 1-32

Jorgenson, D., Ho, M. and Samuels J. (2014), “Long-term Estimates of U.S. Productivity and Growth.” Manuscript http://www.worldklems.net/conferences/worldklems2014/worldklems2014_Ho.pdf.

Jorgenson, D., Ho, M. & Samuels, J. (2017) Education, Participation, and the Revival of U.S. Economic Growth. NBER Working Paper 22453 http://www.nber.org/papers/w22453

Kalyanam, K. and Tsay, A. (2013). “Free Riding and Conflict in Hybrid Shopping Environments: Implications for Retailers, Manufacturers, and Regulators” The Antitrust Bulletin http://journals.sagepub.com/doi/abs/10.1177/0003603X1305800102

Klein, B. (2009) “Competitive Resale Price Maintenance in the Absence of Free-Riding”

Kolodinsky, J. and Labrecque J. (1996) “The Allocation of Time to Grocery Shopping: A Comparison of Canadian and U. S. Households” Journal of Family and Economic Issues 17(3/4), pages 393-409

Koster, H. and Pasidis I. “Shopping Externalities and Retail Concentration: Evidence from Dutch Shopping Streets” CEPR Discussion Paper DP12216 https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3018470

Kroll, A. (2017) "*Underwear of Uncertain Origin: On The Strange Afterlife of Goods We Return to the Store*" Pacific Standard Magazine November 9th, 2017 https://psmag.com/magazine/underwear-of-uncertain-origin

Leach, W. (1994) "Land of Desire: Merchants, Power, and the Rise of a New American Culture" Vintage Publishing

Lecznar, J. and Smith, A. (2017), "Geographic Aggregation and the Measurement of Real Consumption Growth and Volatility" working paper

Landefeld, J.S., Fraumeni, B., & Vojtech, C. (2009). Accounting for Household Production: A Prototype Satellite Account Using the American Time Use Survey. *Review of Income and Wealth* 55, No. 2 (June): 205–225.

Matsa, D., (2011) "Competition and Product Quality in the Supermarket Industry" Quarterly Journal of Economics 126 (3), 1539-1591

Nakamura, L. (2014), "Hidden Value: How Consumer Learning Boosts Output," *Federal Reserve Bank of Philadelphia Business Review*, Third Quarter.

Nakamura, L., Samuels, J., and Soloveichik R. (2017), "Measuring the 'Free' Digital Economic Within the GDP and Productivity Accounts" orking paper 2017-9,

National Retail Federation, (1991-2017) "*National Retail Security Survey*" Last report available at https://nrf.com/system/tdf/Documents/NRSS-Industry-Research-Survey-2017.pdf?file=1&title=National%20Retail%20Security%20Survey%202017

Nevo, A. and Wong, A. (2015) "The Elasticity of Substitution Between Time and Market Goods: Evidence from the Great Recession" NBER Working Paper 21318 http://www.nber.org/papers/w21318

Ofek, E., Katona, Z. and Sarvary, M. (2011) "'Bricks and Clicks': The Impact of Product Returns on the Strategies of Multichannel Retailers" Marketing Science 30: 1, pages 42-60

Overstreet, T. (1983) "Resale Price Maintenance: Economic Theories and Empirical Evidence"

Petrin, A. (2002) "Quantifying the Benefits of New Products: The Case of the Minivan" Journal of Political Economy 110 (4), 705-730, http://pages.stern.nyu.edu/~acollard/Petrin.pdf

Phillips, E. (2017) "Retailers Offer Myriad Return Options to Retain Customers" Wall Street Journal https://www.wsj.com/articles/retailers-offer-myriad-returns-options-to-retain-customers-1514308299

Reinsdorf, Marshal (1993). "The Effect of Outlet Price Differentials on the U.S. Consumer Price Index". Chapter in *Price Measurements and Their Uses*, University of Chicago Press

Rich, S. (1963) "Shopping Behavior of Department Store Customers" Dissertation from Boston, MA https://babel.hathitrust.org/cgi/pt?id=uc1.b3859818;view=1up;seq=5

Sinaiko, A. and Hirth, R. (2011). "Consumer, Health Insurance and Dominated Choices". Journa of Health Economics 30 (2), pages 450-457

Standish Group International (2008) http://www.marketwired.com/press-release/Free-Open-Source-Software-Is-Costing-Vendors-60-Billion-New-Standish-Group-International-844462.htm

Stephens, M. (2002), "Paycheck Receipt and the Timing of consumption" NBER Working Paper 9356

Stephens, M. (2003), "'3rd of the Month': Do Social Security Recipients Smooth Consumption Between Checks?", The American Economic Review 93 (1), pages 406-422

Syverson, C., 2016, "Challenges to Mismeasurement Explanations for the U.S. Productivity Slowdown," *NBER Working Paper* 21974.

Triplett, J., 1989 "Prices and Technological Change in a Capital Good: A Survey of Research on Computers." *Technology and Capital Formation.* Edited by D.W. Jorgenson and R. Landau, pp. 127-213. Cambridge, MA: MIT Press, 1989.

Underhill, P. (2000), " Why We Buy: The Science of Shopping, " Simon & Shuster

Underhill, P. (2005) "Call of the Mall: The Geography of Shopping," Simon & Shuster

United Nations Statistics Division. (2008). *Updated System of National Accounts 2008*. Accessed May 20, 2013. http://unstats.un.org/unsd/nationalaccount/sna2008.asp

Walker, K. and Woods, M. (1976) "Time Use: A Measure of Household Production of Family Goods and Services" Center for the Family of the American home Economics Association

White, J., Troy, L. and Gerlich, R. (2000) "The Role of Slotting Fees and Introductory Allowances in Retail Buyers' New-Product Acceptance Decisions" Journal of the Academy of Marketing Science 28:291

Zumbach, L. (2016) "To Draw Customers, Retailers Invite Other Companies Inside" Chicago Tribune, http://www.chicagotribune.com/business/ct-stores-within-stores-0518-biz-20160517-story.html

Figure 1: Sales Share for Wholesale and Retail Sector

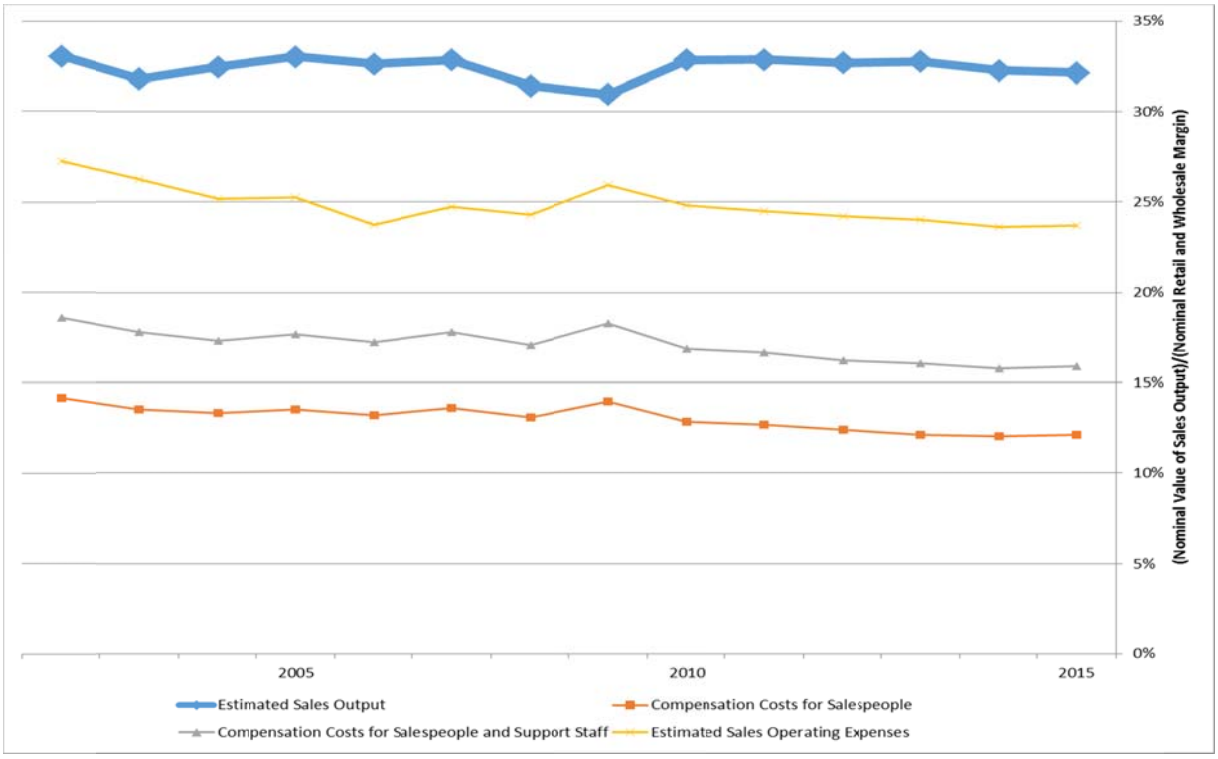

Figure 2: Sales Expenses by Sector

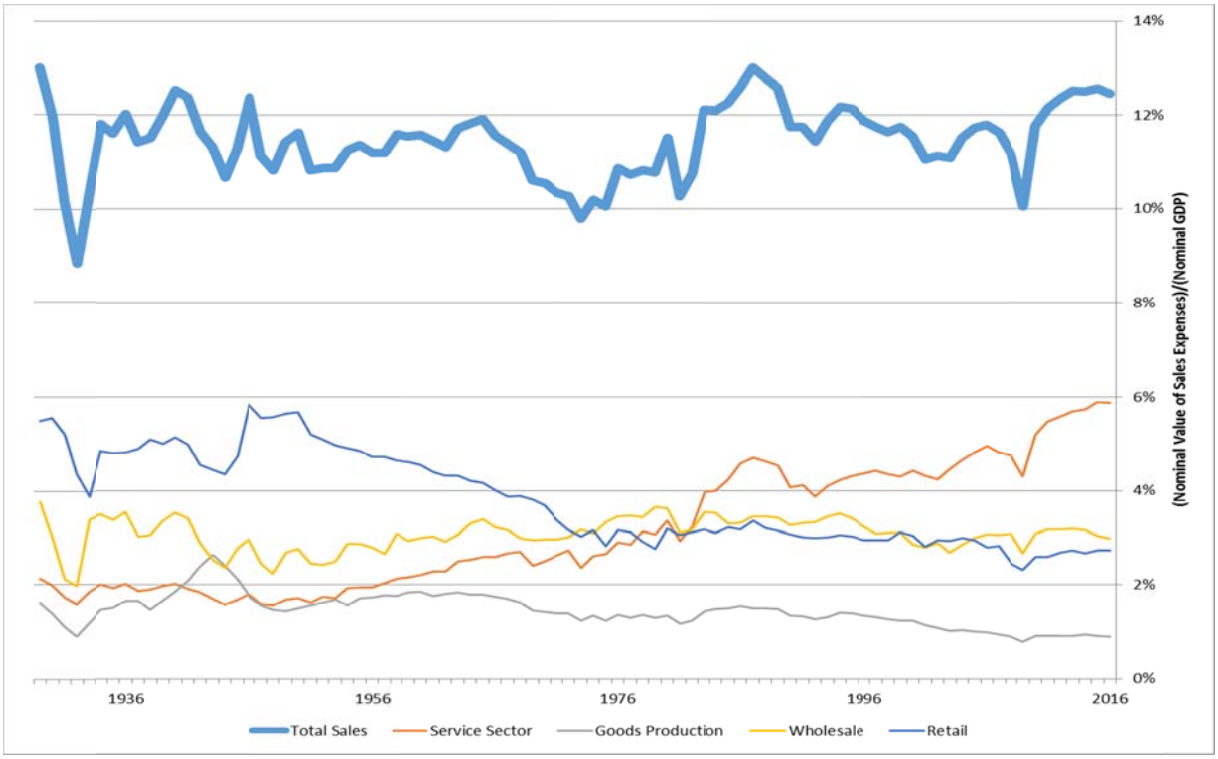

Figure 3: Sales Opportunity Costs by Sector

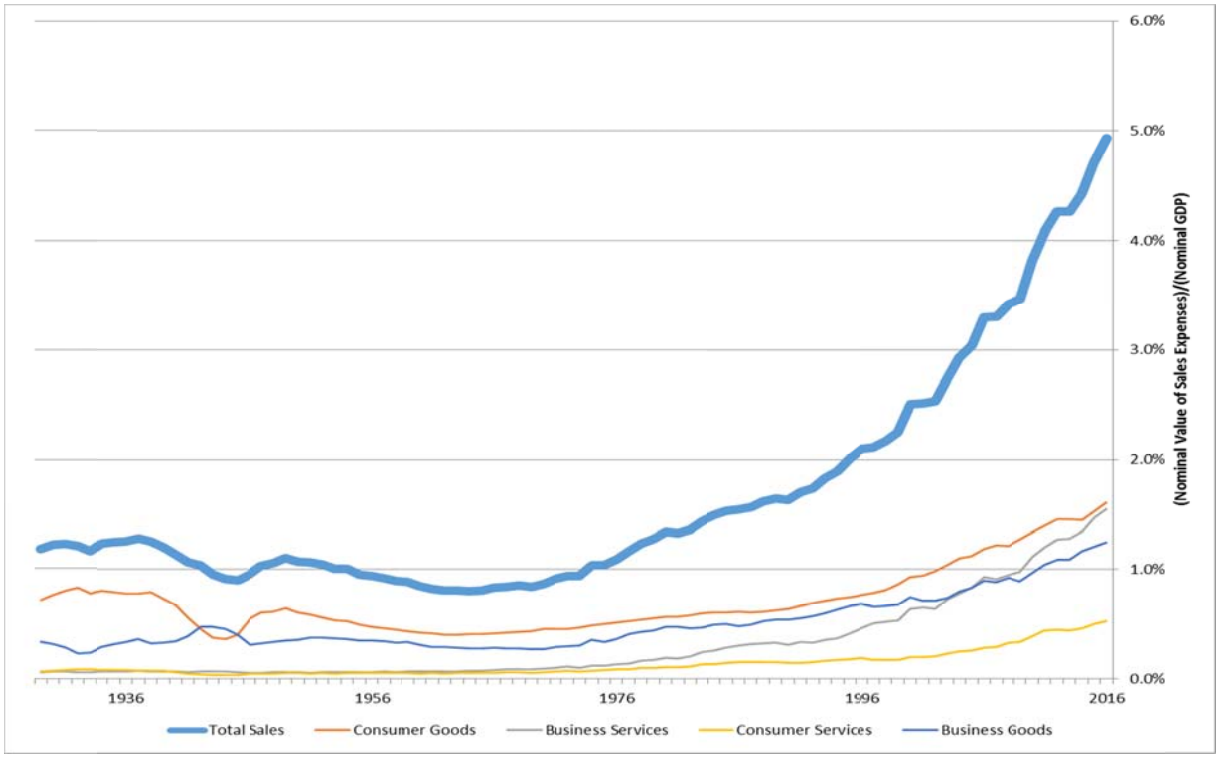

Figure 4: Value of "Free" Consumer Shopping Experiences

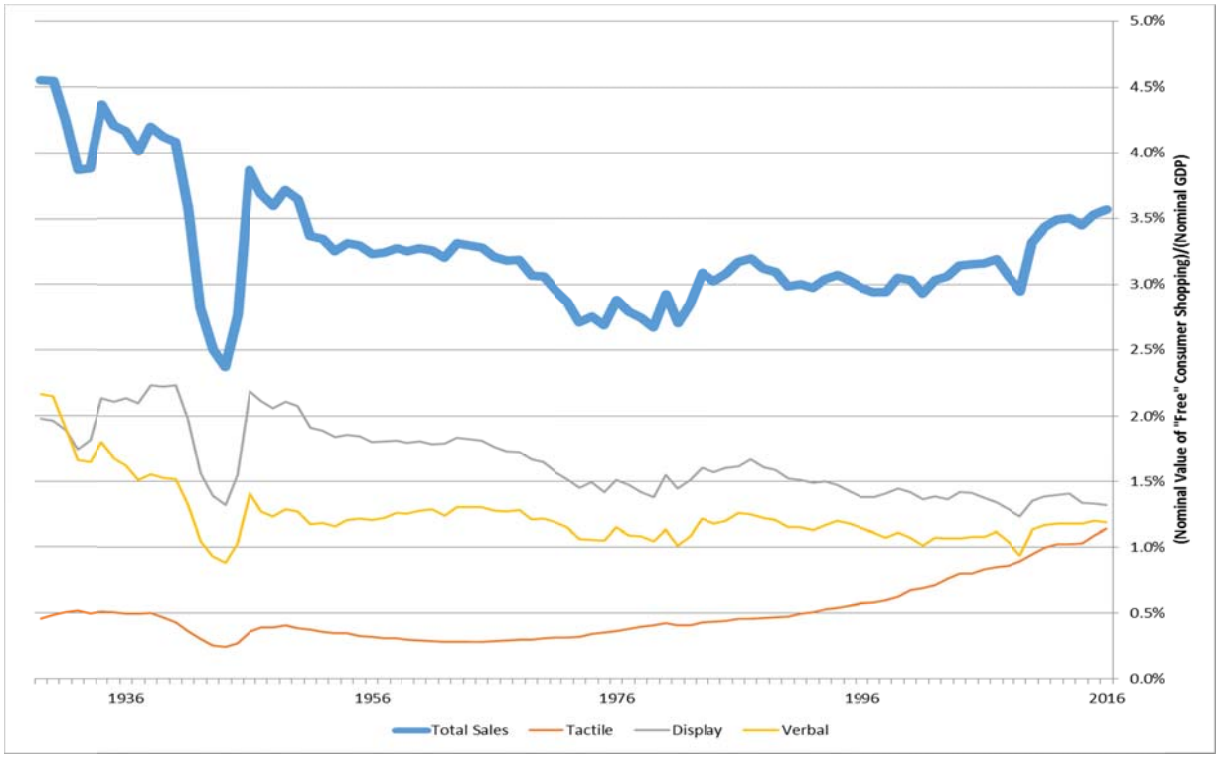

Figure 5: Prices for Shopping Experiences

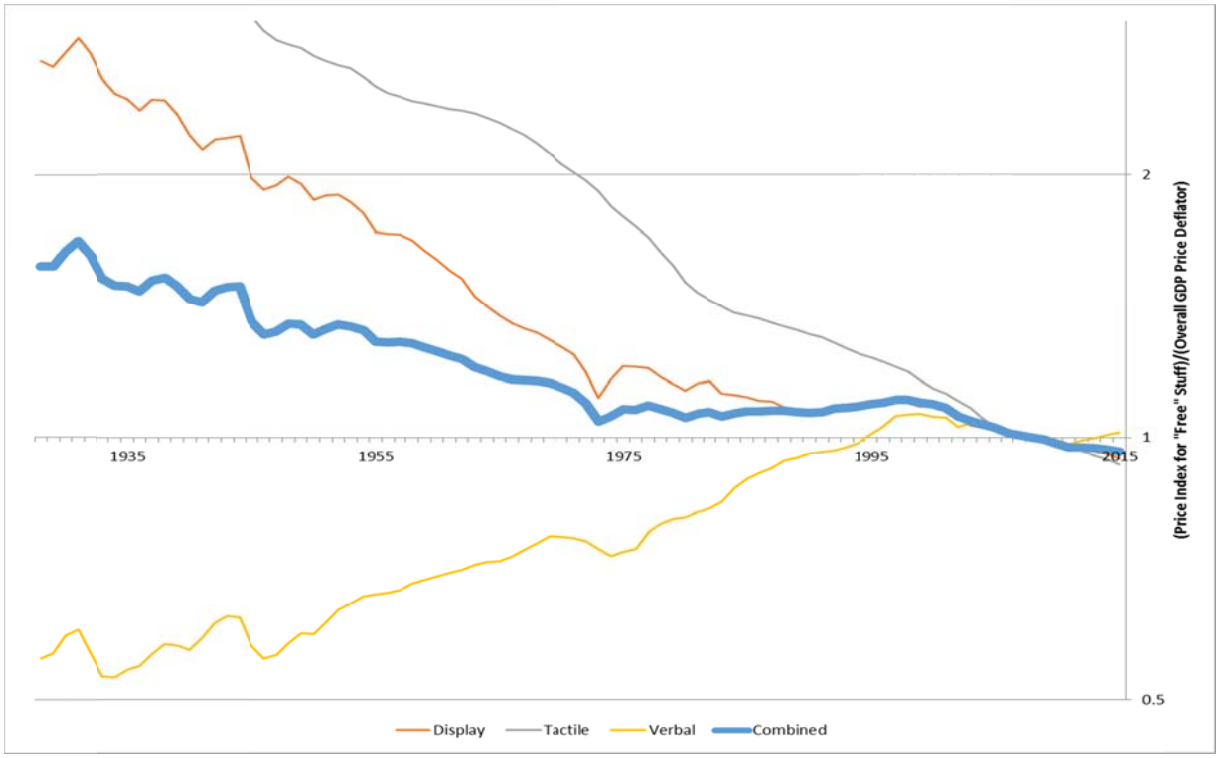

Figure 6: Prices for "Free" Stuff

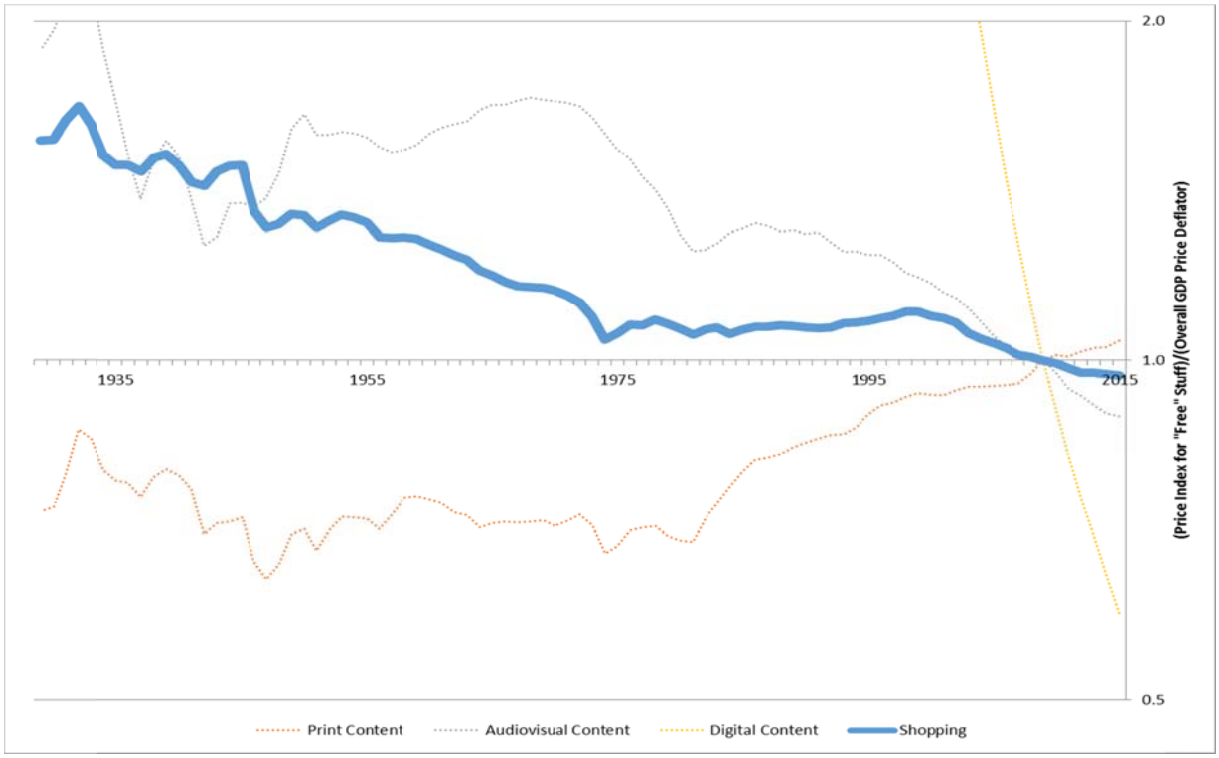

Figure 7: GDP Quantity Index Changes from “Free” Stuff

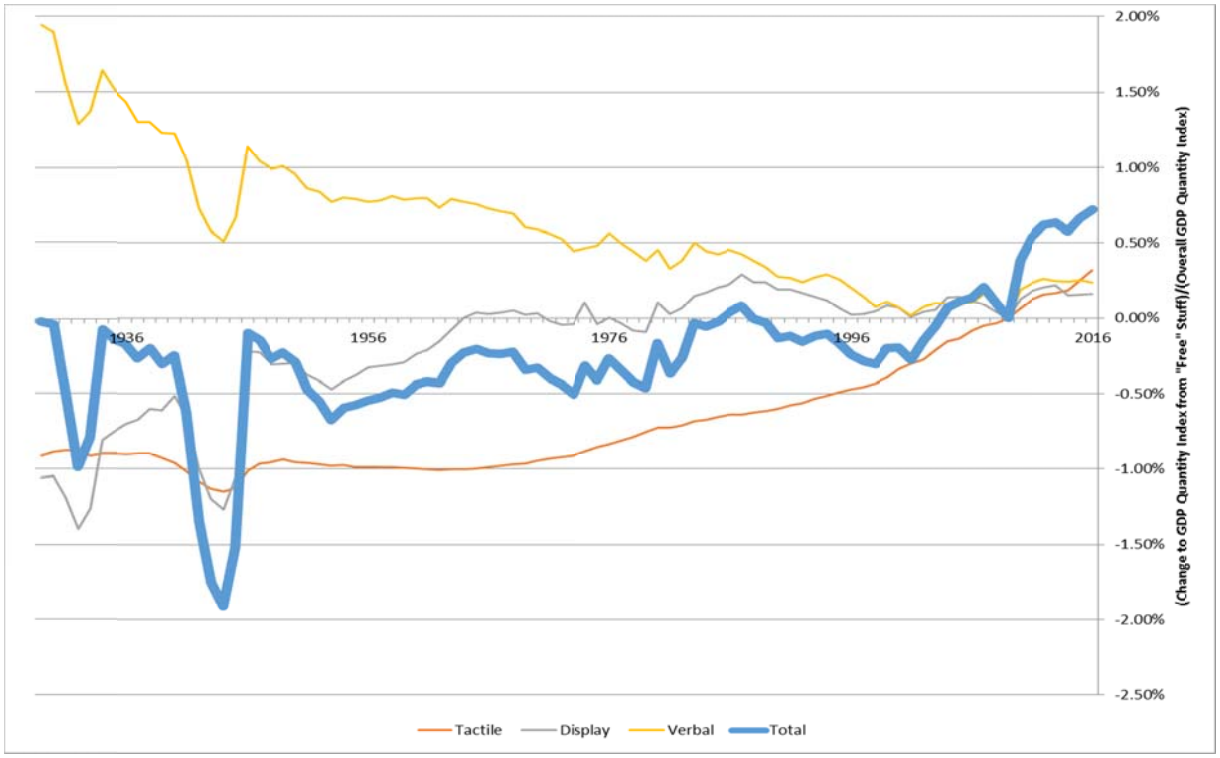

Figure 8: Estimated Sales Attention Time

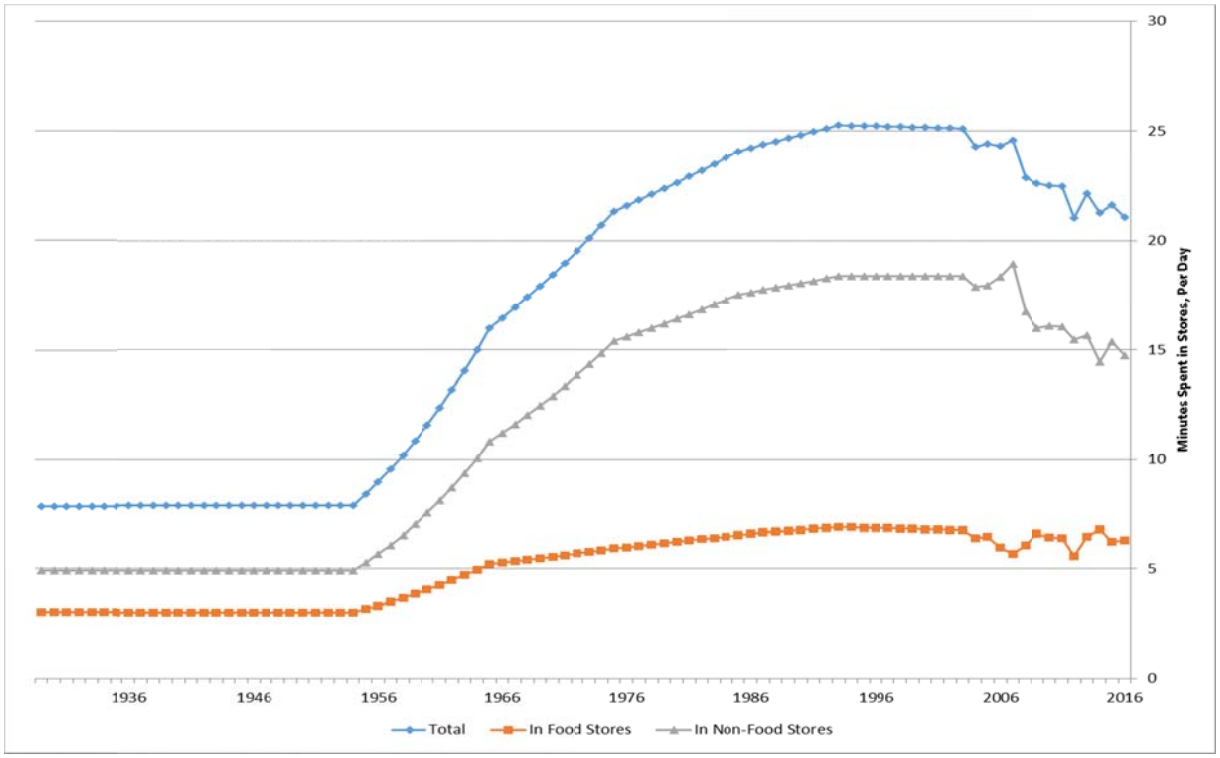

Figure 9: Self-Reported Stress, Mean

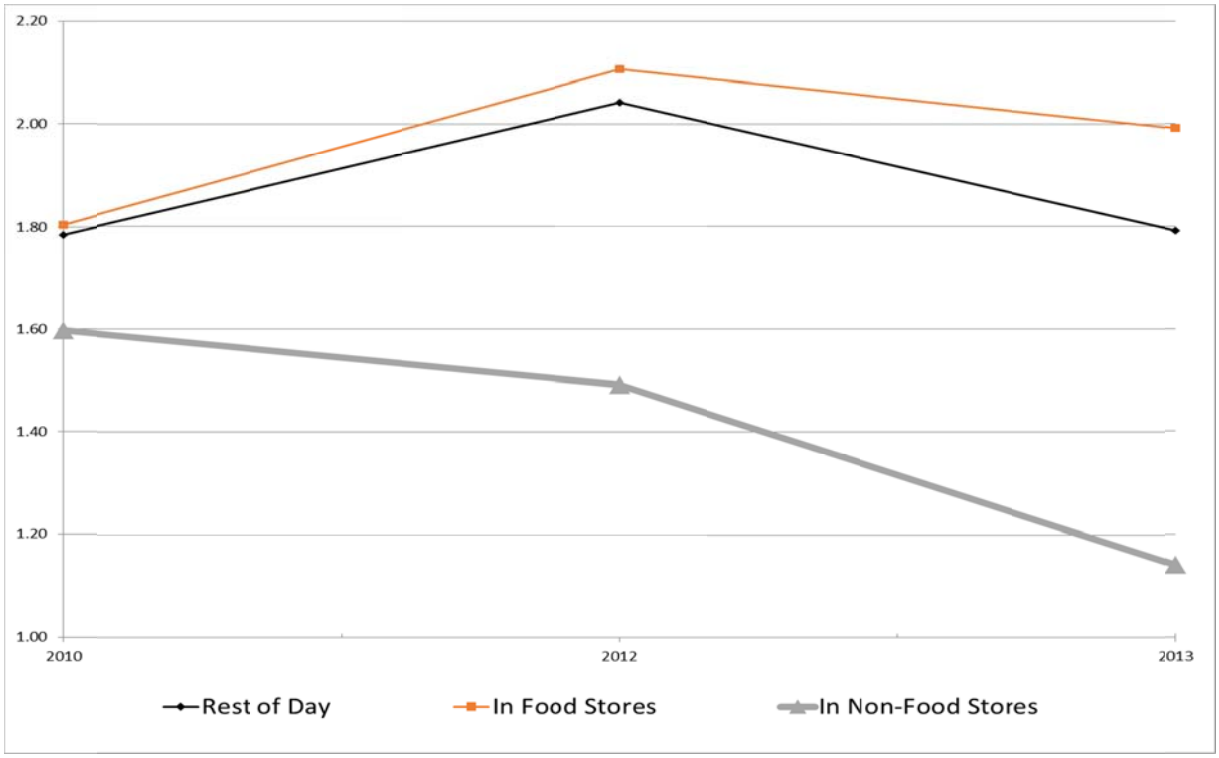

Figure 10: Viewership Prices for Sales Attention

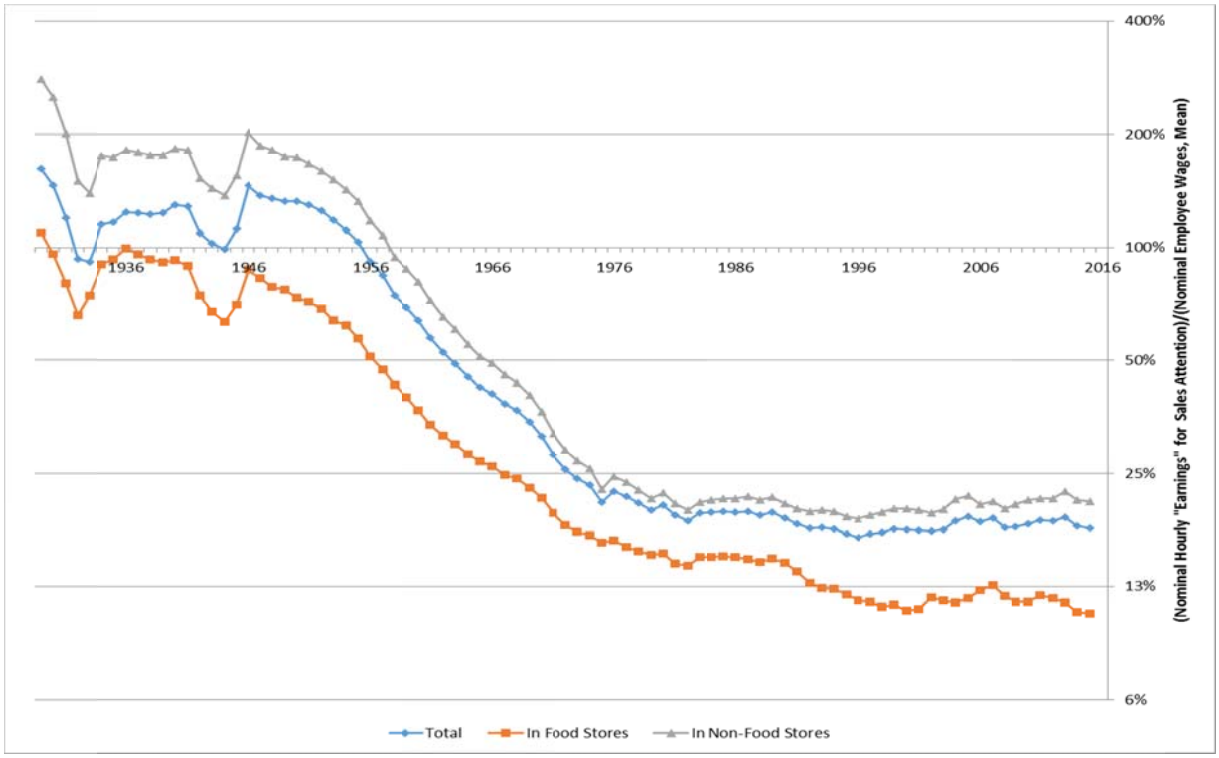

Figure 11: Change to TFP from “Free” Stuff

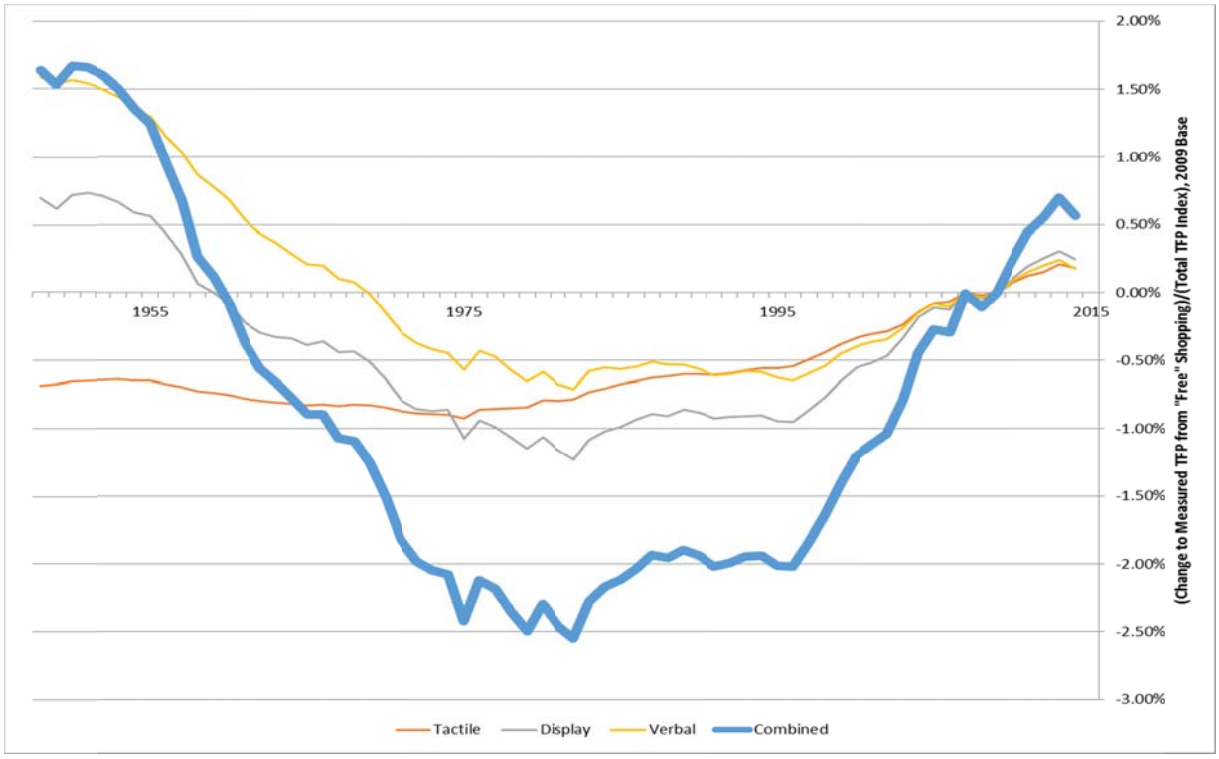

Figure 12: Change to TFP for Wholesalers and Retailers