Accounting for Improved Brick and Mortar Shopping Experiences: Explaining the Post-2002 Wholesale and Retail Slowdown

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Abstract

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Brick and mortar retailers spent $484 billion providing "free" shopping experiences in 2016. For example, vehicle dealerships provide "free" test drives, book stores provide "free" book signings and grocery stores provide "free" food samples. To capture the value of "free" shopping experiences, the paper models them as an implicit barter transaction of shopping experiences for sales attention. The paper then modifies previously created productivity accounts for the wholesale and retail sector (Jorgenson, Ho and Samuels 2016) to include shopping experiences as a new industry output and sales attention as a new industry input.

Despite the rise of e-commerce, "free" brick and mortar shopping experiences grew faster than overall retail margins after 2002. Furthermore, brick and mortar stores have dramatically increased service speed since 2002. Between 2002 and 2014, better shopping experiences contributed $110 billion to real industry output growth and faster service speed subtracted $78 billion from real industry input growth. Furthermore, slower service speed between 1947 and 2002 increases real industry input growth and decreases productivity growth for that time period. Combining all these modifications together, the post-2002 wholesale and retail productivity slowdown shrinks from 0.98 percentage points per year to only 0.08 percentage points per year.

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Introduction

This paper uses an experimental methodology to capture the contribution of "free" shopping experiences within the framework established by the official guidelines for national accounting, the System of National Accounts 2008 (SNA 2008). The experimental methodology has at its heart two balancing components. On the expenditure side, it imputes experience purchases equal to the cost of providing shopping experience services. On the income side, it imputes sales attention revenue equal to the value of the "free" shopping experiences. By construction, the value of "free" shopping experiences equals 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. In other words, shoppers barter sales attention for "free" shopping experiences.

This experimental barter methodology may seem more complicated than an alternative methodology which assumes that the cost of "free" shopping experiences is embedded in the retail margin. This alternative methodology reduces to treating store environment as a bundled characteristic of products and then quality-adjusting product prices for changes in the store environment. Implementing this alternative methodology is straightforward in a world with only one product per store. However, brick and mortar stores generally sell thousands of separate products simultaneously. Accordingly, implementing this alternative methodology requires collecting data on the store environment for each product sold, which is practically impossible. The paper focuses on the experimental barter methodology because it is far less complicated to implement than the alternative methodology and just as consistent with SNA 2008.

Conceptually, "free" shopping experiences are nearly identical to "free" digital, print and audiovisual content studied in earlier work (Nakamura, Samuels and Soloveichik 2018). Mass media like the Internet, newspapers and television occupy huge amounts of leisure time and may provide enormous consumer surplus (Brynjolfsson, Eggers and Gannanemi 2018)—but have relatively low provision costs and therefore a low weight in the aggregate productivity accounts. In contrast, "free" shopping experiences have high provision costs and therefore a high weight in the aggregate productivity accounts. "Free" shopping experiences reduce the post-2002 slowdown in aggregate productivity growth from 0.44 percent points per year to 0.31 percentage points per year, double the productivity acceleration from "free" digital content. Furthermore,

"free" shopping experiences contributed $524 billion to nominal GDP in 2016; quadruple the $121 billion contribution to nominal GDP from "free" digital content.

The paper will be divided into four parts. Section 1 provides background information on the current methodology for handling "free" shopping experiences in GDP. This section then describes the experimental methodology in more detail and reviews previous literature on shopping. Section 2 estimates nominal output of shopping experiences from 1929 to 2016. Section 3 introduces price indexes for "free" shopping experiences from 1929 to 2016. The section then goes on to recalculate real GDP when "free" consumer shopping experiences are included in final output. Finally, section 4 calculates input prices for sales attention and uses those input prices to calculate wholesale and retail TFP.

Section 1. Conceptual Discussion of "Free" Shopping Experiences

This paper studies three separate types of "free" shopping experiences: verbal, display, and tactile. Verbal experiences are provided directly by salespeople, who talk to customers and help them individually. Display experiences are provided by printed posters, shelves with arranged products, and other in-store fixtures. Finally, tactile experiences are provided by physical interaction with the products themselves. Most retailers provide all three types of shopping experience simultaneously. For example, a vehicle salesperson might first describe feature verbally, then direct a shopper towards a poster displaying information on the feature, and finally allow the shopper to test drive the vehicle and try the feature. To be clear, this paper only treats wanted sales help as a component of "free" shopping experiences. Time spent enduring or avoiding unwanted sales help is treated as a component of sales attention.

This paper studies all "free" shopping experiences, even if they occur outside traditional brick and mortar stores. Vehicle shoppers generally take test drives around the neighborhood rather than staying on the dealership lot. Business-to-business salespeople and Tupperware distributors often visit client locations to introduce new products and train users on existing products. Finally, some e-commerce companies like Stitch Fix provide personal shoppers who communicate with clients remotely to determine their individual needs and then send samples for

clients to try at home. However, e-commerce websites were previously studied as "free" digital content (Nakamura, Samuels and Soloveichik 2018) and therefore excluded from this paper.

Current Treatment of "Free" Shopping Experiences

In the SNA 2008 and the U.S. Bureau of Economic Analysis (BEA) national income and product accounts, shopping experiences are treated simply as intermediate service input to the wholesale and retail sector. If one thinks of automobiles as being the sold good, then the costs of a salesperson offering advice to drivers is considered an expense of the vehicle dealer just like the casher's labor ringing up the sale. In this treatment, there is no benefit to the consumer from the shopping experience provided, except to the extent that the consumer pays for costs associated with receiving the shopping experience, such as driving to the vehicle dealership. Furthermore, the current methodology does not consider whether a consumer tests multiple vehicles before selecting their purchase or buys immediately without any test drives.

The difficulty with this treatment is that "free" shopping experiences provide a much greater value to consumers than the cost of driving to a store. This difficulty is highlighted when vehicle dealerships bid experience providers, such as driving instructors away from the paid service sector into the "free" shopping experience sector. Under the current treatment, a driving instructor offering test drives in a vehicle dealership ceases to be providing consumer education services and becomes part of business intermediate inputs instead. One might argue that "free" shopping experiences are correlated with high merchandise prices and therefore implicitly counted in BLS's outlet-based consumer price indexes. 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. Furthermore, chain stores may grow rapidly once customers learn that the cost savings offered outweigh the difference in shopping experience (Reinsdorf 1993). As a result, "free" shopping experiences are missed entirely in the current treatment.

Stylized Model of "Free" Shopping Experiences

It is useful to clarify the conundrum with the following highly stylized model. I consider a vehicle dealership, a driving instructor, and households. Initially, the dealership spends $55,000 to buy automobiles wholesale, spends $20,000 on telemarketing with no experience value, and sells 5 vehicles for $15,000 each. The driving instructor then sells 5 tickets to her class for $1,000. Five households each spend $15,000 on a vehicle and $1,000 on the driving class. Now, suppose the dealership hires the driving instructor for $5,000 and cuts telemarketing costs by $5,000. The driving instructor then provides her class for "free" but includes a pitch to buy vehicles from that dealership. The five households receive the vehicles and the class, but pay only $15,000 for the vehicles (and listen to a sales pitch for the vehicles). For simplicity, the model assumes that the demand for driving instruction is unaffected by this switch. In other words, households act as if listening to the sales pitch costs them $1,000 each.

In the current national income accounts treatment, measured output drops. The driving instruction is no longer measured as part of personal consumption, only the vehicles are. In the initial case, $80,000 in economic resources was used to produce $80,000 in consumption output. With "free" shopping experiences, $75,000 is used to produce $75,000 in consumption output. However, the disappearance of $5,000 in measured output appears to be a misrepresentation in that the households are still consuming the same amount of driving instruction as before.

One possible treatment would be to view the quality-adjusted vehicle price as falling by 6.25 percent. This is, nominal output is $75,000, but real output is $80,000. However, that alternative price index is only feasible in a stylized model with one product. In practice, vehicle dealerships sell hundreds of models and it is not feasible to determine how much instructor time is spent on each model. Another possible treatment would be to view the driving class with a sales pitches included as having the same real value but falling in price to zero. That is, nominal output is $75,000, but real output is $80,000. But standard economic formulas do not work well when analyzing goods and services with zero prices. A more satisfactory treatment was explored in a recent paper on "free" print, audiovisual, and digital content (Nakamura, Samuels and Soloveichik 2018). That paper treated advertising-supported and marketing-supported content a

part of a barter transaction: the consumer receives entertainment or information in return for viewing advertising or marketing. This paper does the same for "free" shopping experiences. The experimental methodology imputes "earnings" for consumers from listening to a sales pitch and "purchases" by consumers of driving instruction from the dealership. In this treatment, "free" shopping experiences are reflected in the real income and consumption of the consumer. By construction, the imputed "earnings" are precisely equal to the imputed "purchases"—so there is no net impact on business value-added or consumer savings. At first glance, the assumption of precise equality appears controversial. After all, dealerships lose money on careful shoppers who test drive multiple vehicles without buying anything and make money on impulsive shoppers who test drive one care and buy it immediately. However, random variation in profitability is common and national accountants often use production costs as a proxy for value. Hence, the assumption in this paper is not remarkable.

What's Excluded from "Free" Shopping Experiences

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 (Betancourt 2016). In Oi's terminology, the paper studies product line and convenience, but not exchange, production or ancillary services (Oi 1992). Recent research by 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 virtually no shopping experiences for gasoline. Around the same time, universal product codes made the supermarket purchasing experience faster (Basker 2012), but had little direct impact on the shopping experience. More recently, Mandel (2017) examined the travel time savings associated with e-commerce.[1] Those time savings are valuable to consumers and worthy of study, but delivery is normally restricted to purchasers and is therefore not part of the "free" shopping experience.

[1] I estimated service shopping time and shopping travel time back to 1954. The data is available upon request.

The explicit membership fees charged by warehouse clubs like Costco are already counted in retail output.[2] To the best of my knowledge, there is no legal or technological barrier preventing other retailers from charging similar membership fees. Nevertheless, other brick and mortar stores allow potential customers to talk to salespeople, examine store displays, handle merchandise and then leave without charging them a penny. In fact, Carmax recommends that potential customers shop around before buying (2017). As a result, the current GDP methodology excludes the vast majority of shopping experiences from measured industry output.

Review of Literature

To the best of my knowledge, no previous research has yet studied "free" shopping experiences through the lens of a barter transaction. However, my research is related to existing literature on the following topics: household production, product variety, within-store product arrangement, within-neighborhood shopping spillovers, and resale price maintenance.[3] This section will give a brief overview of each topic and explain why it is relevant.

Shopping is a major category of household production, and there is a rich economics literature studying it. 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 shopping in the context of household production and national accounts (Landefeld, Fraumeni, and Vojtech 2009 and Bridgman et. al. 2012). Those papers are all focused on household production and largely take the store environment as given. In contrast, this paper studies the costs and benefits of changes in the store environment over time from the perspective of wholesalers and retailers.

Product variety has mixed welfare implications in the existing economic literature. On the one hand, some researchers have found substantial welfare gains from new varieties like

[2] Warehouse clubs spend more on shopping experiences than they earn from membership fees. Conceptually, this is similar to newspapers and cable television, which are partially subscription supported. I include any experience costs over and above the membership fee together with "free" shopping experiences.

[3] The paper has already discussed the barter transaction for "free" media content, so I will not repeat it in this section. "Free" shopping experiences may also have implications for seemingly unrelated fields like behavioral economics, racial prejudice, etc. This paper will not explore those esoteric implications.

Apple-Cinnamon Cheerios (Hausman 1997) and minivans (Petrin 2002). 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). These disparate findings can be reconciled by a complementarity between shopping experiences and product variety. This complementarity does not require any violations of standard economic theory. Even rational consumers with full self-control may lack information on specific product varieties, and therefore benefit from stores with helpful salespeople, well organized displays and plentiful opportunities to touch the merchandise..

There is an enormous marketing literature studying within-store product arrangement. 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 arrangement effects, and manufacturers frequently pay slotting fees in return for prime shelf space (FTC 2003, White, Troy and Gerlich 2000). Modern stores hire special consultants to help them arrange products optimally (Underhill 2000 and 2005). Retailers also offer temporarily low prices on high-profile items like turkey before Thanksgiving to bring in store traffic and sell nearby products (Chevalier, Kashyap and Rossi 2013). 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 $31 billion of additional profits from the unplanned purchases created by sales attention. Later in the paper, I will calculate that food stores spent $33 billion on verbal and display shopping experiences.[4] This near match suggests that production costs for "free" shopping experiences track the input value of sales attention very closely.

The economics literature studies spillovers between nearby stores. Koster and Pasidis (2017) estimate 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, and therefore excluded from the supply-use tables (SNA 2008, Section

[4] This calculation assumes that 25% of food retailing costs are fixed. If so, than a $2.50 increase in basket size will increase profits by $0.17, or $0.44% of the $40 basket. I assume that merchandise damage is linear with shopping time, so I do not count tactile shopping experiences in either the cost or value comparison.

3.92–3.95). However, such unpriced externalities are rare in the United States. Gould, Pashigan, and Prendergast (2005) demonstrate that privately owned shopping malls internalize the spillover from large anchor stores to small stores 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). In addition, business improvement districts set dues to internalize the spillovers from large anchors (Brooks and Strange 2011). Considering these arrangements together, it seems likely that the spillovers are mostly internalized in the United States, and so eligible to be tracked in the supply-use tables.

There is a vast economic and legal literature studying resale price maintenance (Klein 2009). Since the 1970s, courts have generally held that 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 in this paper, and a few papers even discuss the importance of shopping time explicitly (Overstreet 1983). However, that literature does not use an accounting framework to systematically value either "free" shopping experiences or sales attention.

Section 2. Nominal Values of "Free" Shopping Experiences

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.

This section collects data on three separate types of "free" shopping experiences: verbal, display, and tactile. Labor is the main cost of verbal shopping experiences. Customers generally

prefer individual demonstrations and advice, so retail stores must employ millions of salespeople to help every shopper who wants to talk. Floor space is the main cost of display shopping experiences. Curated displays take enormous amounts of room and customers also need room to stand while they examine the displays. Finally, inventory is the main cost of tactile shopping. Touching and testing merchandise often damages the items examined, and damaged items are generally discarded without attempting repair. This paper will use separate datasets to estimate nominal costs for each shopping category studied.

Verbal Sales Output

My primary data on verbal shopping experiences is taken from the Occupational Employment Survey (OES). The OES reports employment and earnings by occupation and industry. Based on that data, I calculate that wholesale and retail salespeople earned $357 billion in 2016. This $357 billion includes estimated costs for health insurance, and other non-cash compensation. In addition to these direct labor costs, I estimate that indirect support staff added $128 billion in labor costs and gross operating surplus added another $151 billion of costs. To be clear, the $151 billion in gross operating surplus partially represents compensation for self-employed sales labor and partially represents compensation for investor capital. This paper is not concerned with splitting labor compensation from capital compensation, so I combine all three costs to get a total of $635 billion in verbal sales output in 2016.

Unfortunately, the OES data described earlier is not available before 2002.[5] I use the decennial population Census to estimate historical sales labor by NAICS code back to 1930. Between Census years, I use the Current Population Survey (CPS) to extrapolate an annual sales share back to 1967.[6] Both the Census and the CPS contain data on industry, occupation and earnings – but their data is considered less reliable because it is self-reported (Fisher and Houseworth 2012). A particular problem is that individuals employed in manufacturer's sales

[5]The OES does report data by SIC code from 1999 to 2002. I did not use that data because the two industry coding systems are not consistent and the OES did not provide bridge data to match them.

[6] The CPS is a small survey and its data is noisy. I smooth by collapsing the industry codes into two broad categories: wholesale/manufacturing and retail. I also average sales employment over three years to minimize annual variation. I do not use any pre-1967 CPS data because the occupation coding is not consistent.

branches frequently report their industry as manufacturing rather than wholesale. Therefore, the sales labor reported in those two surveys are benchmarked to the 2002 OES totals.

Figures 1, 2 and 3 show sales output relative to retail margins for brick and mortar retailers, online retailers and wholesalers. Over the past century, verbal sales output has hovered around 25 percent of wholesale and retail margin. There is some annual variation, but it is not clear how much variation is caused by genuine long-term changes, how much variation is caused by short-term cyclical factors, and how much is caused by noisy data. The only clear result is that online retailers have a much lower verbal sales output than the other two industry sectors. As a result, a shift to online retail has the potential to lower verbal sales output dramatically.

Display Sales Output

My primary data on display shopping experiences is taken from BEA's pre-existing supply-use tables and fixed asset tables. In 2012, BEA estimates that retailers paid $103 billion in rent for multimerchandise shopping centers, food establishments, and other commercial buildings. In the same year, BEA estimates that the capital stock of structures owned by the non-residential real estate sector and rented to the retail sector was $231 billion.[7] Therefore, I calculate that every dollar in floor space provided 43 cents in rental services in 2012.

To be clear, these 43 cents of imputed rental services are not just a return on capital. Retail stores are required by law and custom to provide shoppers with basic amenities like lighting, cleaning, security, and parking. In addition, many stores voluntarily provide entertainment amenities like celebrity book signings, pictures with Santa, etc. The hotel industry has a similarly high ratio of accommodation output to structures. In total, I calculate that the nominal capital services from retail display shopping structures was $91 billion and the nominal capital services from wholesale display structures was $7.5 billion in 2016. I then multiply those

[7]The non-residential real estate sector rents to many industries, and the fixed asset tables do not split capital stock by client. I use own-account capital stock by category to estimate the likely value of retail structures.

stocks by the 2012 ratio of rent to capital services to estimate $448 billion of retail display experiences and $42 billion of wholesale display experiences.[8]

Figure 1 shows display sales output relative to brick and mortar retail margins. The most important result is that the display sales share grew steadily for decades, peaked in 2006, and fell since. The likely explanation for this recent drop is the housing bubble and bust. During the housing bubble, Americans moved out to the suburbs and retailers followed with malls and big box stores that offered plenty of display space. After 2006, urban neighborhoods revived, and many of the suburban malls closed or re-purposed their floor space to attract service sector industries like nail salons. I was not able to get reliable data on display sales output for online retailers, so figure 2 assumes it is zero for simplicity.[9]

Tactile Sales Output

According to generally accepted accounting principles (GAAP), merchandise damage is tracked in cost of goods sold rather than operating expenses (Epstein, Nach, and Bragg 2009). For example, a vehicle dealership might buy ten Ferraris, lose two when careless test drivers crash them, and then sell the remaining eight. GAAP currently treats the economic loss associated with the two crashed Ferraris as a negative retail margin rather than a component of operating expenses. Regardless of the accounting treatment, merchandise damage is an economic cost associated with tactile shopping and therefore must be included in sales output.

I use retail returns as a proxy to measure non-food merchandise damage. Very few retail returns are prompted by genuine product defects, and stores are legally permitted to refuse returns not prompted by product defects. Nevertheless, retailers generally permit shoppers to return items for full refunds. My data on consumer returns is taken from the National Retail

[8] The actual calculations were slightly more complex because they incorporate consumption of fixed capital and assume a 7 percent real rate of return on capital stock. Spreadsheets are available upon request. BEA's supply-use tables are available annually back to 1947, so I could calculate a new ratio for each year. In practice, the estimated annual ratio is quite noisy with no long-term trend from 1975 onwards. So, I use a fixed ratio to avoid volatility.
[9] I explored using cleaning and security compensation in the OES to split display sales output between retail subcategories. This proxy produces a small but nonzero display shopping share for online retail. I believe that this is caused by measurement error and therefore do not use those estimates in the paper. However, it is possible that some online retailers may actually maintain showrooms or rent department store kiosks (Zumbach 2016).

Federation (NRF). According to the National Retail Federation, shoppers returned approximately 10 percent of their purchases in 2016 (Appriss Retail 2017). 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. I was not able to find data on returns to wholesalers, grocery stores, prescription drugs, vehicle dealerships, or gasoline stations – so I set return rates to zero for those merchandise categories. Based on that assumption, I calculate that tactile shopping for returnable items reduced net sales revenue in 2016 by 9.9 percent.[10]

The 10 percent reduction in net sales revenue from returns is a recent phenomenon. Retail returns always involve a forgone retail margin on the items returned, but other sales opportunity costs are discretionary. 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 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. Before 1995, returns had lower sales opportunity costs. One World War 2 study estimated that 78 percent of returns sold at full price and that many of the discounted returns would have been marked down even if they hadn't been sold (Gault and Goodman 1942). 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 to estimate merchandise damage from consumer returns. In total, I estimate that consumer returns only reduced department store margins by only 4 percent in 1929 and 5 percent in 1995, much lower than the 10 percent calculated for 2016.

I use in-store loss to measure food merchandise damage. For example, a fruit shopper might poke bananas to find the ripest one or cereal shopper could accidentally knock boxes down. Grocery stores rarely charge shoppers for this in-store damage, so it is implicitly included in the "free" shopping experience. Even though damaged food is generally safe, modern supermarkets generally discard it anyway (Jacobs 2014). According to the USDA, current food

[10] 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 value of returns over time are my own.

losses at the retail level are approximately 10 percent to 12 percent (Buzby et al. 2016). Historically, food discards were much rarer. One 1943 study estimated only 3 percent food losses at the retail level (Education Federal Security Agency), and a 1977 study estimated food losses of 4 percent at the distribution level (Comptroller General). Between years with data, I use the non-food returns to interpolate food damage numbers.[11] For all years, I assume that customer shopping accounts for half of the lost food.

Figures 1 and 2 show tactile sales output for brick and mortar retailers and online retailers respectively. The most important result is that online retailers devote a much larger share of their retail margin to tactile sales output. Some of the additional 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 and prominently advertise their easy returns—so customers return items that they might have otherwise kept. In 2016, I calculate that tactile shopping output was nearly half of total online retail margin—enough to substantially offset their reduced verbal shopping output and display shopping output. In other words, e-commerce companies are partially substituting in-home tactile shopping for in-store verbal and display shopping.

Valuing "Free" Consumer Shopping Experiences

Only a portion of the sales output shown in figures 1 to 3 provide "free" shopping experiences. Wholesalers and retailers spend significant resources preparing and practicing the sale pitch that they include in the verbal shopping experience and in the product placement nudges that they include in the display shopping experiences. Furthermore, merchandise damage from tactile shopping is calculated at retail prices, which may dramatically overestimate the true economic cost to retailers. To the best of my knowledge, no existing research tracks the production cost of "free" shopping experiences separately from the production cost of sales pitches. It might seem that occupational task data would be useful – but neither BLS's occupational requirements survey nor the O*net database split tasks related to "free" shopping

[11] 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)

experiences from tasks related to sales pitches. As a result, it is nearly impossible to empirically estimate production costs for "free" shopping experiences separately from production costs for sales pitches. For now, I assume that $0.50 out of every $1 in nominal sales output represents production costs for "free" shopping experiences.

I use class of customer data from the Economic Census to estimate the consumer share of "free" shopping experiences. For example, approximately 90 percent of the retail margin goes to consumers—so I assume that consumers enjoy 90 percent of the retail shopping experiences. Wholesalers almost never sell directly to consumers, but BEA's pre-existing supply-use tables show that approximately one third of wholesale margin is passed along to consumers by retailers. I assume that retailers pass along the same portion of "free" shopping experiences as well.

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 GDP before 1950 and faster than GDP after 1950. There also appears to be a growth acceleration in "free" consumer shopping experiences after 1995. The 1990's have previously been identified as a crucial turning point for the information technology (Jorgenson 2001), so it seems likely that information technology contributed to 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 before 1950 and modestly overestimated after 1995.

Section 3: Experience Price Indexes and GDP Quantity Indexes

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 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, is it an increase or decrease in sales output when a store puts out Christmas decorations for three months

rather than one month? Finally, additional information can sometimes reduce shopping experience quality. For example, shoppers may sometimes be insulted by accurate advice delivered in an insensitive manner. I will not attempt to measure output prices directly.

Instead, the paper constructs three separate input-based price indexes: one for verbal shopping experiences, one for display shopping experiences, and one for tactile shopping experiences. To be clear, the quality of an individual shopping experience is hard to predict in advance. One cheap design may be wildly popular, and an expensive design may flop. Nevertheless, retail stores have worked hard to create desirable shopping experiences since the 1800s (Leach 1994). As a result, it seems unlikely that there has been much technological progress in the production of "free" shopping experiences since 1929. Accordingly, output prices should track input prices reasonably well.

Verbal Shopping Experiences

Verbal shopping experiences are a very labor-intensive service with little productivity growth over time. 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. I use pre-existing labor cost data in the wholesale and retail sector (Jorgenson, Ho, and Samuels 2016) as my price index. This labor cost data is quality adjusted and covers all employees rather than just sales workers—so it might not match the sales staff perfectly. Long-term trends are similar if I use sales labor compensation from BLS's employment cost index and other sources, but the annual data is noisier.

Display Shopping Experiences

The main inputs to display shopping is multimerchandise shopping centers for shoppers to visit and store fixtures which hold merchandise for split. BLS publishes a producer price index for shopping center leasing (PCU5311205311201) that is available back to 1996. Before then, I use BEA's price deflator for hotel accommodation services (table 2.4.4, line 85) as a proxy to extrapolate shopping center lease rates.[12] BLS publishes a producer price index for

[12] I also explored using historical mall rental rates reported in the industry literature. Long-term results are similar.

store displays (WPU159A04) that is available back to 1986. 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.[13] Finally, I weight the shopping center lease price index and the store display price index by their cost shares to get a combined price index.[14]

Tactile Shopping Experiences

My price index for tactile shopping is simply an average of BEA's pre-existing price indexes for consumer goods in table 2.4.4, weighted by the estimated nominal value of tactile shopping for each item. Readers should note that this price index assumes that tactile shoppers benefit from quality improvement at the same rate as actual purchasers. For example, a crashed Ferrari is assumed to yield a better tactile shopping experience than a crashed Camry.

Combined Prices for "Free" Shopping Experiences

Figure 5 shows the three price indexes over time. The most important long-term result is that tactile shopping prices have been falling relative to overall GDP prices and that verbal shopping prices have been rising faster than overall GDP prices. It is now very cheap to design a new product line, outsource production to specialty manufacturers, and then put the product line in retail 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. As a result, it is not surprising that retail stores have steadily shifted from salespeople describing products to customers trying products themselves.

GDP Quantity Indexes with "Free" Shopping Experiences

Figure 6 recalculates overall GDP quantity using the nominal values in figure 4 and the price indexes in figure 5. Just like figure 4, I find a clear trend break in the early 2000s. Between 1929 and 2002, measured real growth falls very slightly. Between 2002 and 2016,

[13] I assign appliances a 33 percent weight and recreational books a 67 percent weight in my historical price index.
[14] Using a 7 percent discount rate, I calculate that structures account for approximately three quarters of total input costs. This cost share has been very stable over time.

measured real growth increases by 0.05 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.

Section 4: Sales Attention Prices and Total Factor Productivity

If there was only interest in real GDP, figure 6 would be enough to fully measure the impact of "free" shopping experiences. However, most policy-makers and researchers are interested in decomposing real GDP growth into the component parts of total factor productivity (TFP) growth for individual industries, quantity growth of capital, quantity growth of labor, and quantity growth of other inputs. Holding real experience output fixed, my experimental methodology treats more sales attention as an input increase and therefore a TFP reduction. All of the TFP calculations in this paper are based on productivity accounts previously created by Jorgenson, Ho and Samuels (2016). I then modified those accounts to include three new industry outputs and one new industry input.

Quantity Indexes for Sales Attention

Since 2003, the American Time Use Survey (ATUS) has tracked both activity and location for a large and representative sample of adults. I use non-work time spent at brick at mortar retailers as a quantity index for the consumer sales attention input used by brick and mortar stores. A few individuals report non-shopping activities in stores. For example, a woman might accompany her husband to a vehicle dealership and then nap while he examines cars. I include this non-shopping time, but results are similar if it is excluded. Unfortunately, the ATUS does not reliably report time spent shopping for work, time spent shopping online, time spent at home examining potentially returnable items, and other non-traditional shopping. For now, I assume that the sales attention price for those activities tracks the sales attention price for

consumer shopping at brick and mortar stores. Based on that assumption, I impute time spent shopping for work and time spent on non-traditional shopping.

Before 2003, time diary data is erratic and sometimes unrepresentative. Large microdata samples are available through the American Heritage Time Use Study for 1965, 1975, 1985, 1993, and 1995. I also use aggregate data from a 1954 Ward and Beecher time diary sample described in a later book (de Grazia 1964) and a small 1939 sample (Sorokin and Berger). Those two studies may be less reliable than the microdata microdata, but the shopping trends reported match well with other surveys focusing on suburban married women (Walker and Woods 1976). Each historical time diary sample focuses on a specific population or a specific month, so I use the ATUS microdata to adjust for the different focuses. Finally, I interpolate between samples to get an annual quantity index for brick and mortar sales attention.

Figure 7 shows average time spent shopping from 1929 onwards. Between 2003 and 2016, average non-work time spent in brick and mortar stores fell from 25 minutes per day to 21 minutes per day. Over the same time period, non-traditional shopping time rose by less than half a minute. Figure 7 also shows that non-work time spent in brick and mortar stores increased from 8 minutes per day in 1954 to 21 minutes per day in 1975. Over the same time period, non-traditional shopping time rose slightly. In other words, direct substitution from brick and mortar shopping to non-traditional shopping explains less than half of the recent decline in brick and mortar time and none of the historical rise in brick and mortar time.

Previous drafts of this paper speculated that the recent decline in brick and mortar time might be caused by competition from e-commerce. Consistent with the competition explanation, many brick and mortar stores explicitly claim they are making consumer returns easier to compete with e-commerce (Phillips 2017). In addition, food shopping has not yet felt much competitive pressure from e-commerce and has not yet seen significant speed shopping time. However, I tested that hypothesis using e-commerce fulfillment centers as an instrument. Chava et al. (2018) documents that brick and mortar sales fall when Amazon opens an e-commerce fulfilment center nearby, and the ATUS shows a matching rise in time spent shopping from home. Yet the ATUS does not show a consistent negative relationship between nearby Amazon fulfillment centers and in-store shopping time. This null result suggests that e-commerce does not necessarily have an immediate effect on local in-store shopping. Regardless of the cause,

this paper is primarily an accounting exercise and the decline in brick and mortar time remains economically important even if it is not directly caused by e-commerce.

Figure 8 shows ATUS data on self-reported emotions in selected years. Between 2010 and 2013, self-reported stress in retail stores fell 21 percent even as overall stress levels remained constant. This decrease in stress may indicate that stores are using fewer high pressure sales tactics. If so, then the time decrease shown in figure 7 may underestimate the recent decline in sales attention. 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 7 for self-reported stress. Similarly, I will not adjust the real shopping experiences shown in figure 6 for a rise in self-reported interaction.

Prices for Sales Attention

Figure 9 compares hourly "earnings" for sales attention with other input costs. I find a dramatic U-shaped pattern for sales attention relative to labor costs. In 1948, the typical wholesale and retail employee earned $1.46 per hour and the typical shopper "earned" $1.11 per hour for their sales attention. Over the next three decades, hourly "earnings" for shoppers grew much slower than market wages. By 1980, the typical employee earned $7.50 per hour and the typical shopper "earned" $2.25 per hour for their sales attention. After 1980, "earnings" for sales attention started growing more rapidly. By 2015, the typical employee earned $24.26 per hour and the typical shopper "earned" $12.82 per hour. 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, television commercial viewers only "earned" $0.69 per hour (Nakamura, Samuels and Soloveichik 2018). The higher "earnings" for sales attention 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 more compensation. On the demand side, shoppers currently in a store are much more likely to buy merchandise than individuals currently watching television at home—so a minute of sales attention has more impact than a minute of advertising.

The standard TFP calculations weight inputs by their market price, and so my TFP calculations give a higher weight to brick and mortar sales attention than television commercial viewership.

Recalculating TFP Using the Experimental Methodology

Figure 10 shows the changes in wholesale and retail TFP for each of the three experience categories. I find a large decline in TFP growth before 1975 that is primarily driven by deteriorating verbal shopping experiences, and a large increase in TFP growth after 2002 which is driven by all three categories together. This TFP acceleration is large enough to be economically meaningful. One recent paper documenting the productivity slowdown calculates that measured final output would be $3 trillion higher in 2015 if productivity growth had remained constant after 2004 (Syverson 2017). Between 2004 and 2015, I calculate that the real growth in "free" consumer shopping experiences shown in figure 6 accounts for $102 billion of 'missing output' and that the decline in consumer shopping time shown in figure 7 accounts for $71 billion of 'missing output'. In other words, excluding "free" shopping experiences from measured wholesale and retail output accounts for 6 percent of the observed slowdown.[15]

Bailey and Gordon (1988) argued that BLS's published statistics do not track improved retail amenities and therefore underestimate recent output growth in the retail sector. Contrary to their argument, figure 10 shows that my experimental methodology lowers measured productivity growth from 1972 to 1986 by 0.24 percentage points per year. However, my experimental methodology also lowers measured productivity growth between 1948 and 1972 by 0.53 percentage points per year. So, the experimental methodology ameliorates the historical growth slowdown without increasing growth in the time period studied.[16]

Figure 11 shows the changes to wholesale and retail TFP by industry sector. I find that brick and mortar retailers account for about three quarters of the TFP acceleration and wholesalers account for the remaining quarter. Despite recent growth, online retail is still very

[15]This 6 percent is a lower bound. The experimental methodology slightly lowers aggregate productivity growth before 2004 slightly, so the adjusted value of 'missing output' is under $3 trillion. Furthermore, many service sector businesses also provide "free" shopping experiences. For example, a software consultant might offer "free" open source software to promote their consulting services. These service sector businesses are not tracked in this paper, but anecdotal evidence suggests that they have been improving their shopping experiences recently.
[16]Readers should note that Bailey and Gordon's paper treats later shopping hours as a valuable amenity increase. In contrast, my experimental methodology treats longer shopping time as a retail input increase.

small and therefore has little impact on aggregate industry TFP. Of course, even brick and mortar retailers use the Internet to promote new products, train salespeople and communicate with customers. It is possible that this digital outreach might explain some of the growth in brick and mortar TFP shown in Figure 11.

Figure 12 compares the economy-wide impact of "free" shopping experiences with "free" digital content studied earlier (Nakamura, Samuels, and Soloveichik 2018).[17] In aggregate, "free" shopping experiences shrink the post-2002 TFP slowdown from 0.44 percentage points per year to 0.31 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 spending share. It may be true that Americans spend hours surfing the web—but the production cost of "free" digital content is relatively low. As a result, the dramatic growth in "free" digital content has little impact on aggregate TFP.

Conclusion

To start out, this paper outlined an experimental methodology that values "free" shopping experiences consistently with other wholesale and retail output and sales attention consistently with other industry inputs. The paper then calculates that the post-2002 slowdown in wholesale and retail productivity growth shrinks from 0.98 percentage points to only 0.08 percentage points. Across the aggregate private business sector, the post-2002 slowdown shrinks from 0.44 percentage points to 0.31 percentage points. These TFP impacts are large enough to be economically meaningful, and suggest that brick and mortar retail is still a vibrant sector.

[17] This section calculates industry-level TFP 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 the sum of each component. My exact calculations are based on internal numbers collected for research purposes.

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Figure 1: Sales Output for Brick and Mortar Retailers

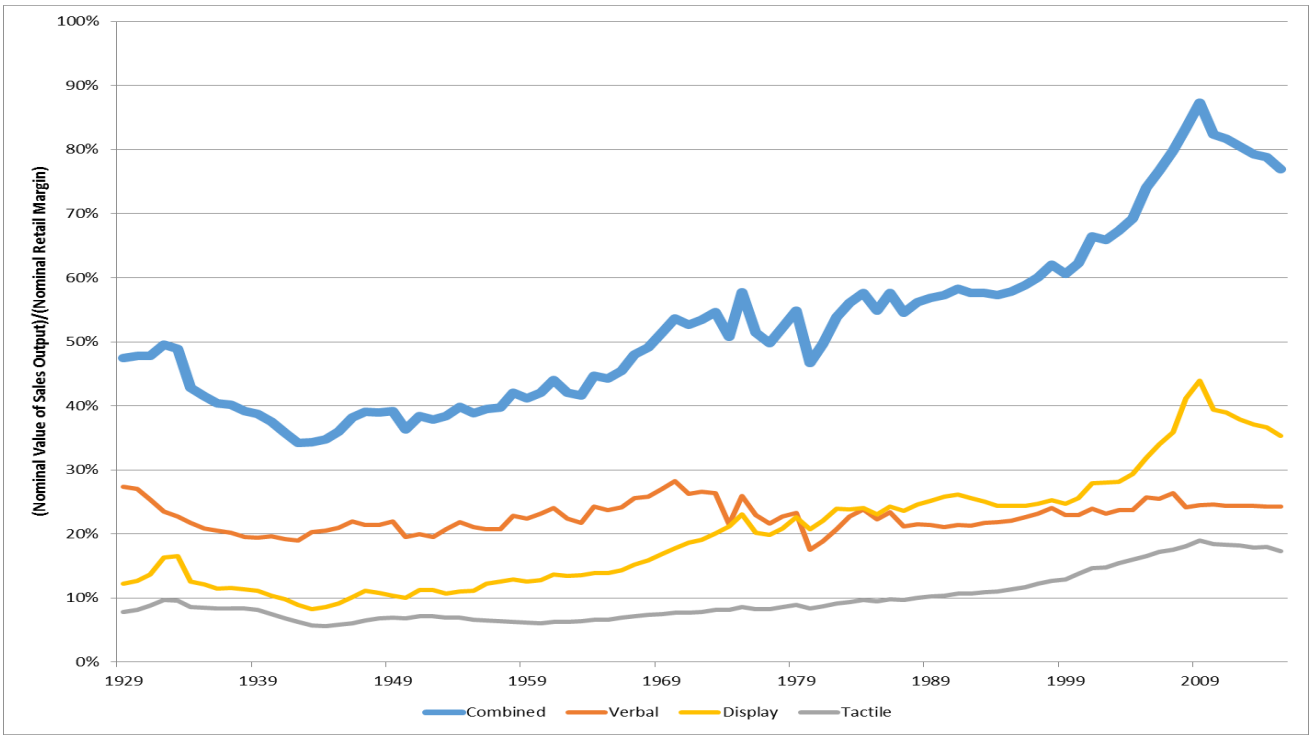

Figure 2: Sales Output for Online and Mail Order Retailers

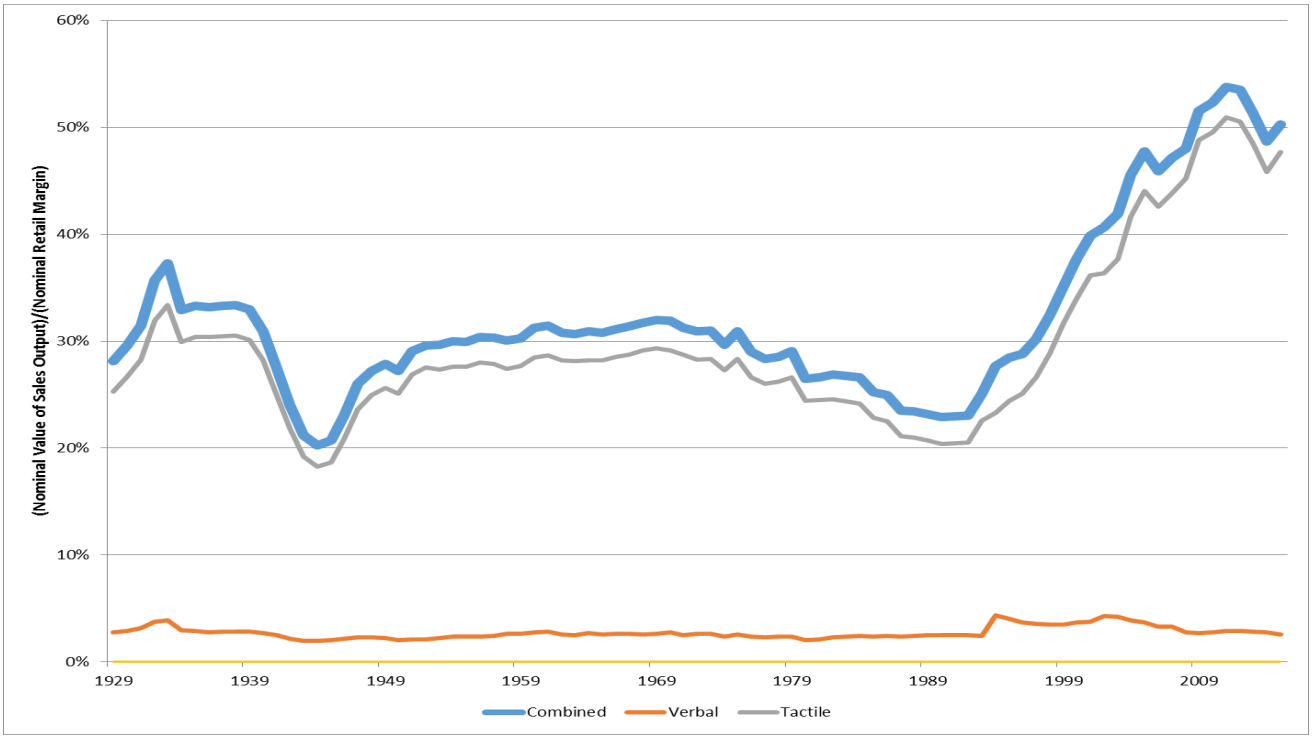

Figure 3: Sales Output for Wholesalers

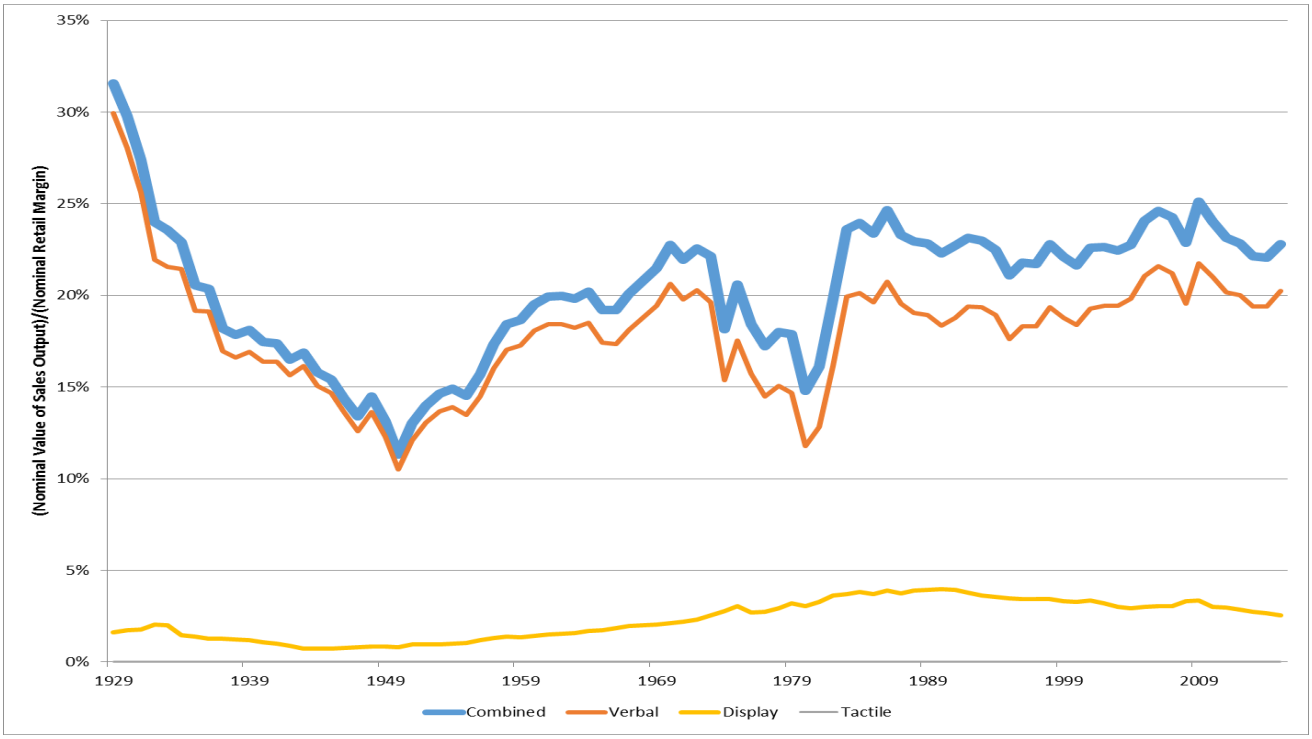

Figure 4: Value of "Free" Consumer Shopping Experiences

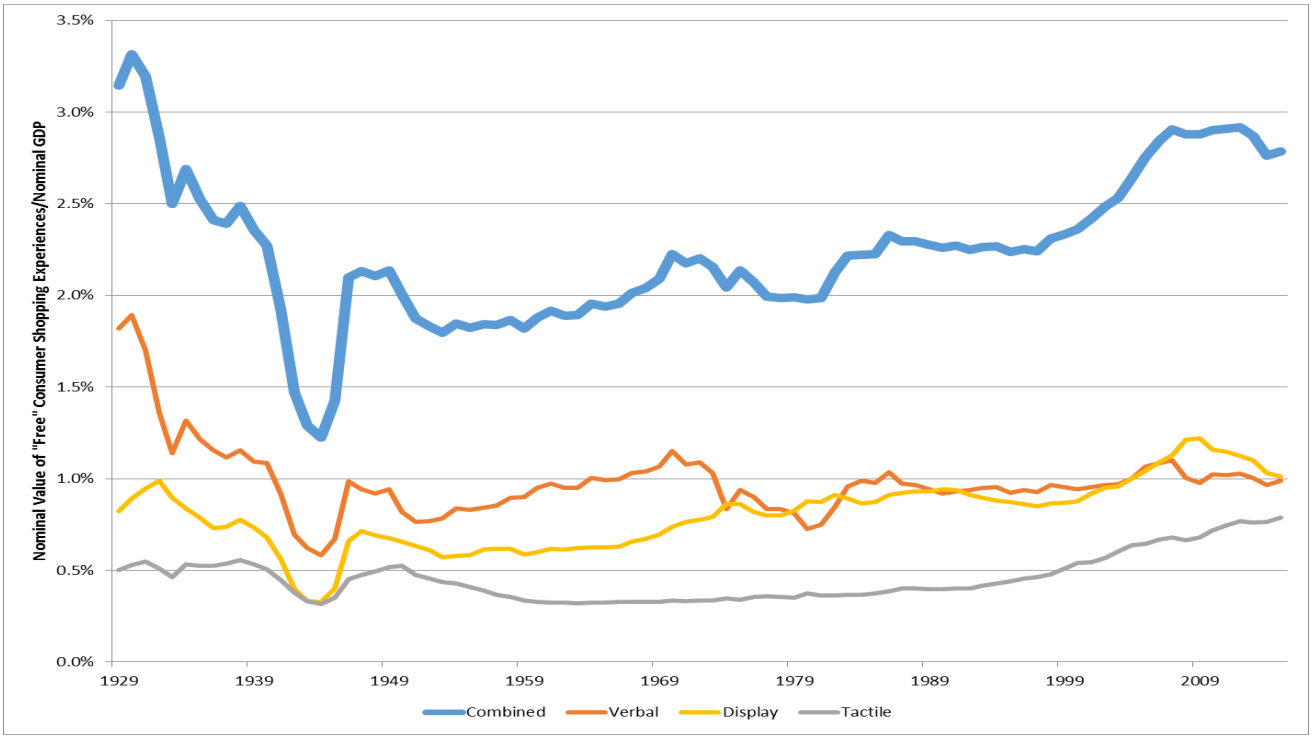

Figure 5: Prices for Shopping Experiences

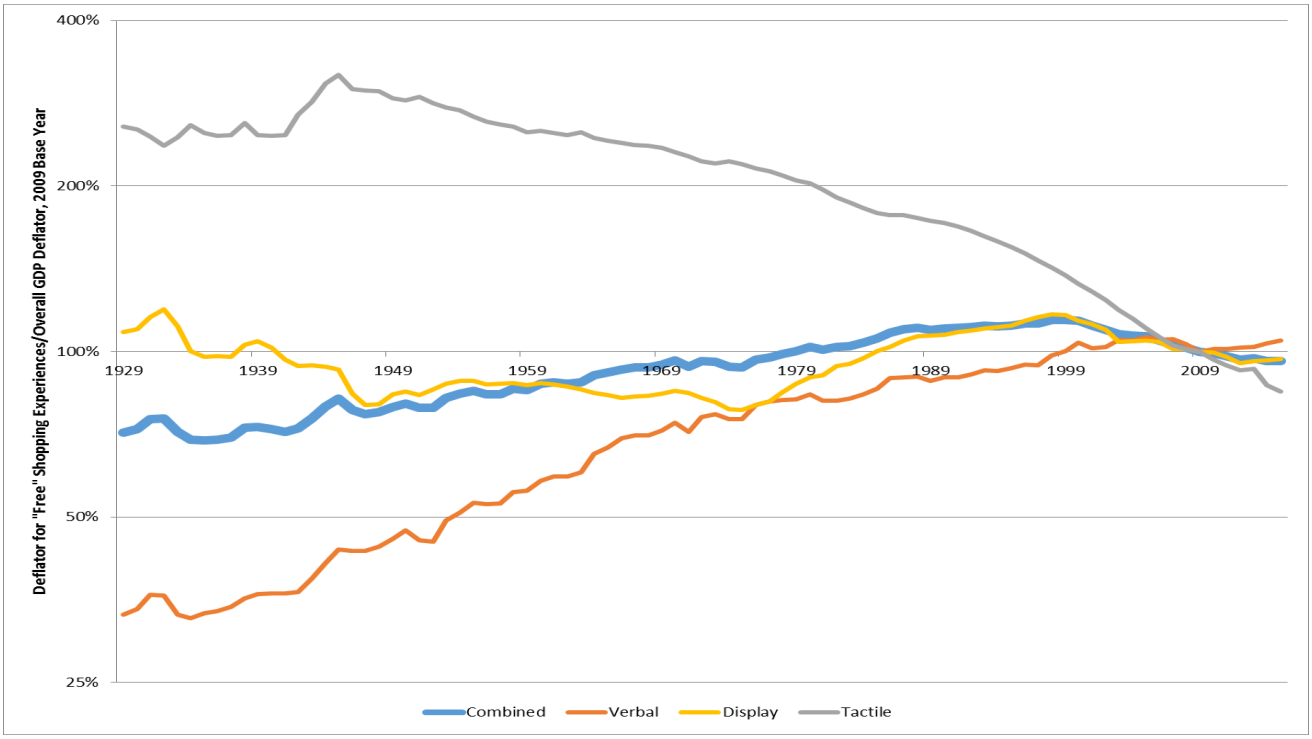

Figure 6: GDP Quantity Index Changes from "Free" Stuff

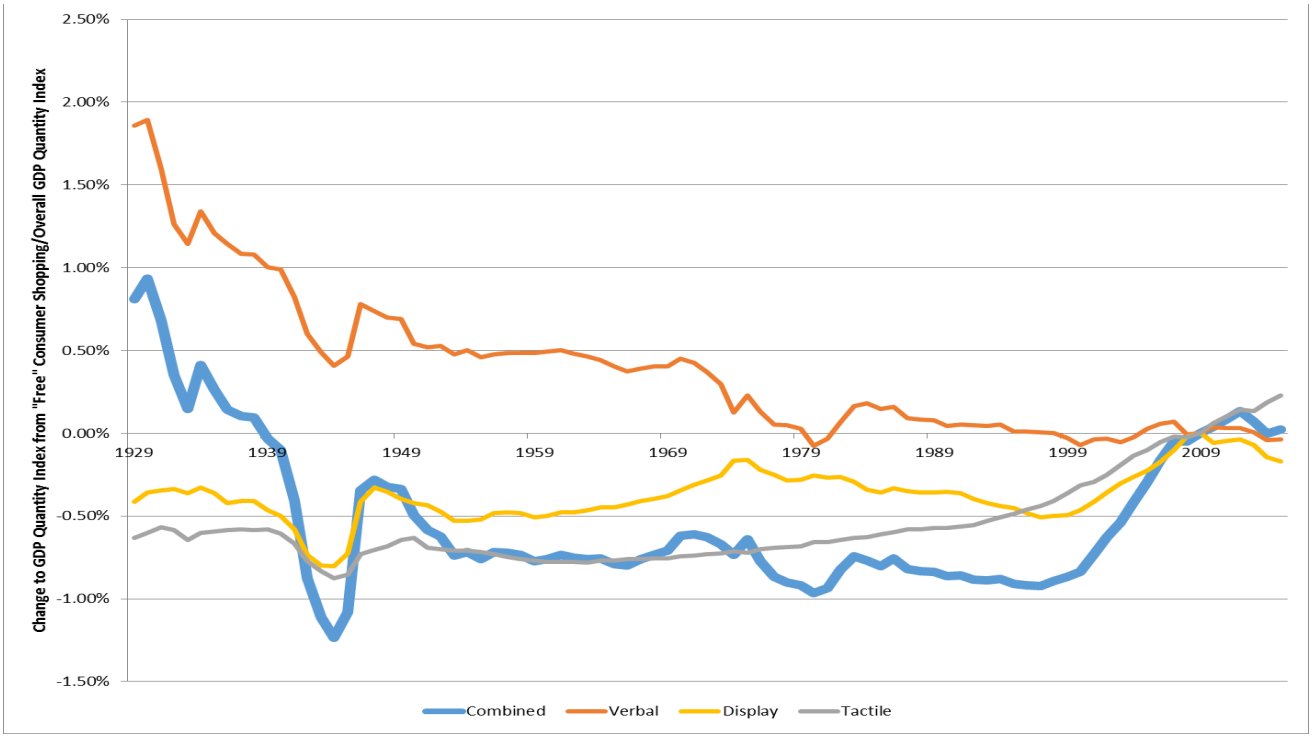

Figure 7: Sales Attention Over Time

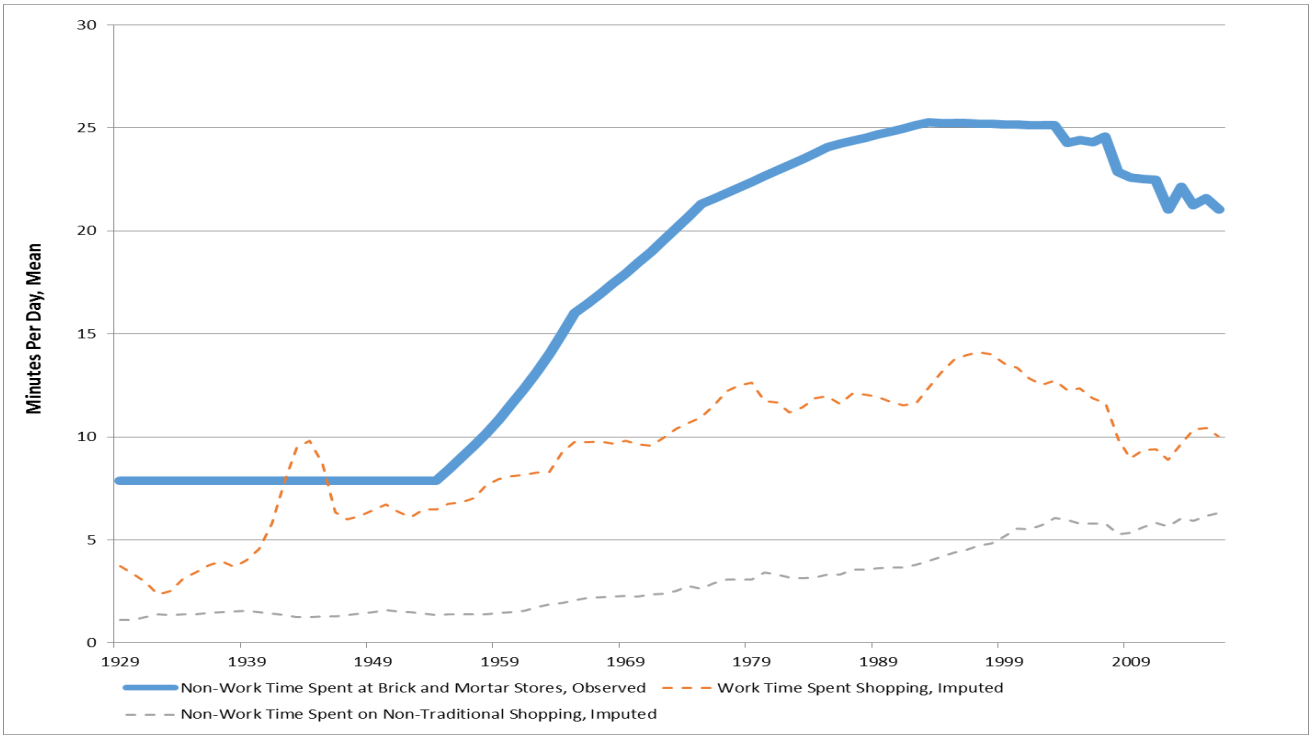

Figure 8: Self-Reported Emotions in Brick and Mortar Stores

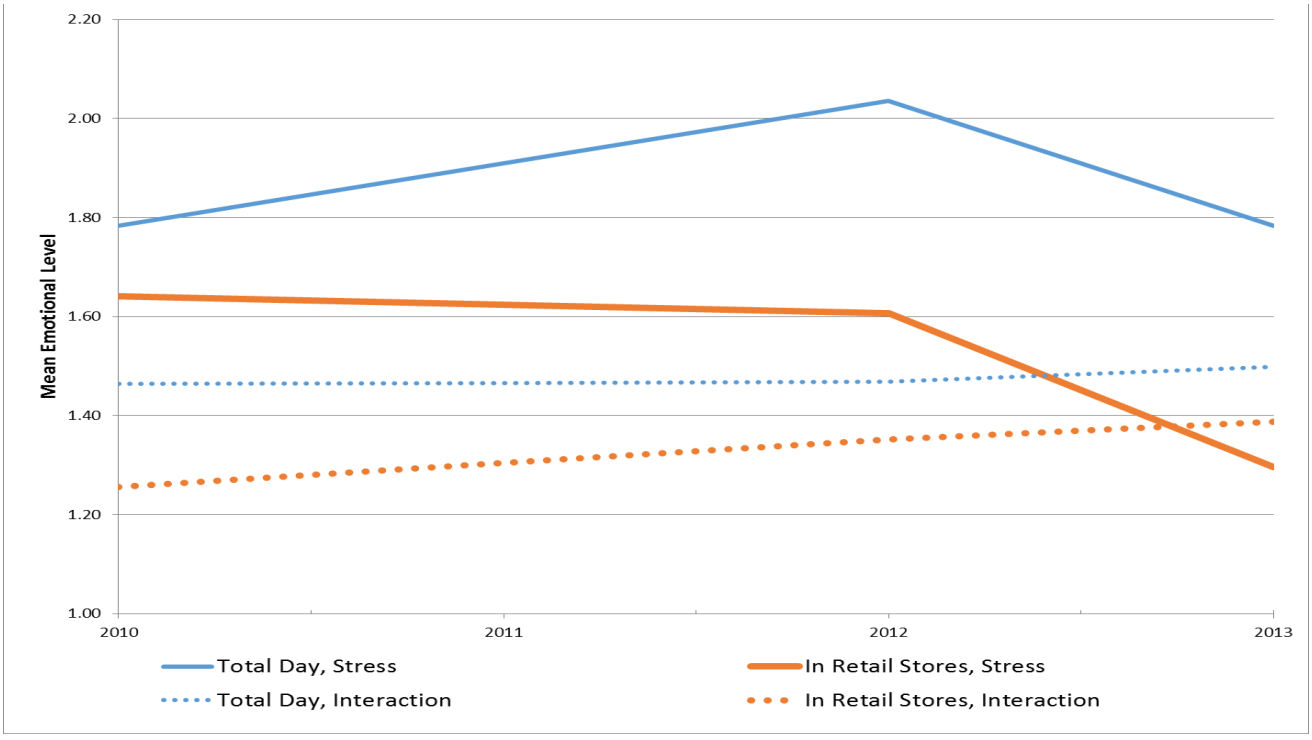

Figure 9: Relative Input Prices for Wholesale and Retail

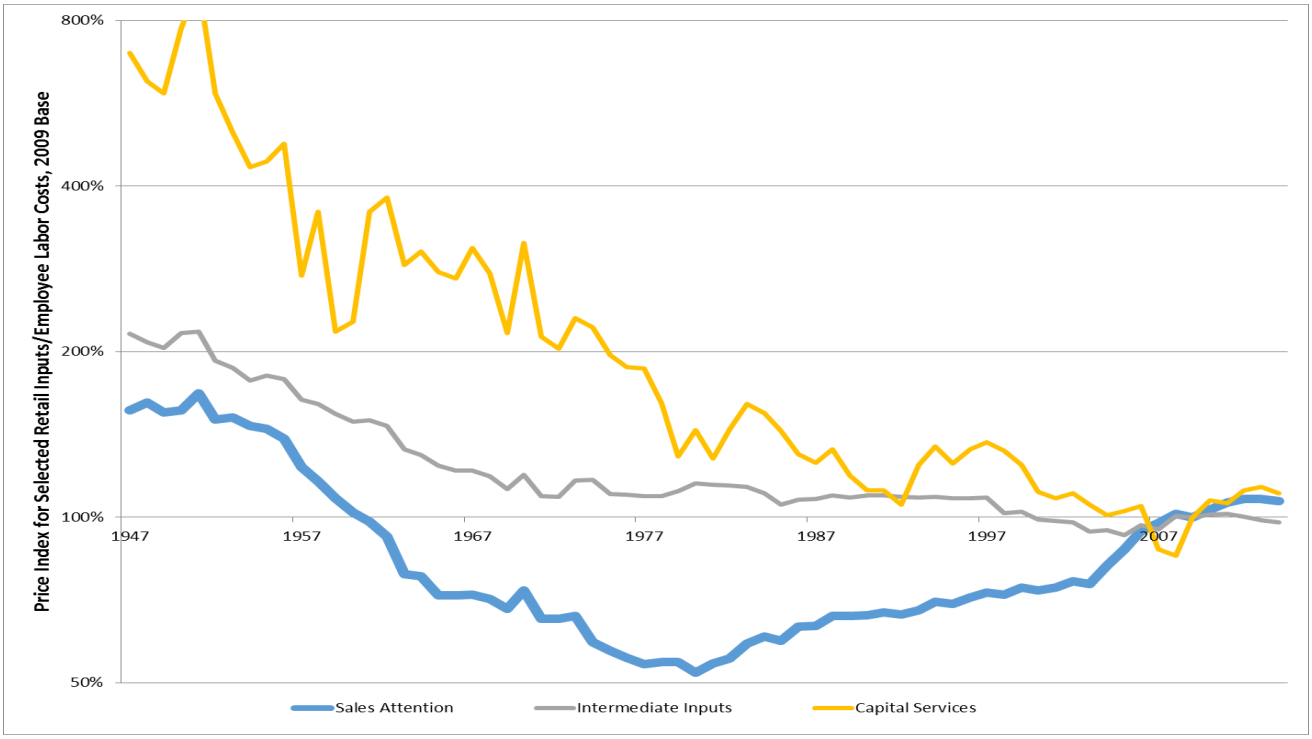

Figure 10: TFP Impact By Shopping Experience Category

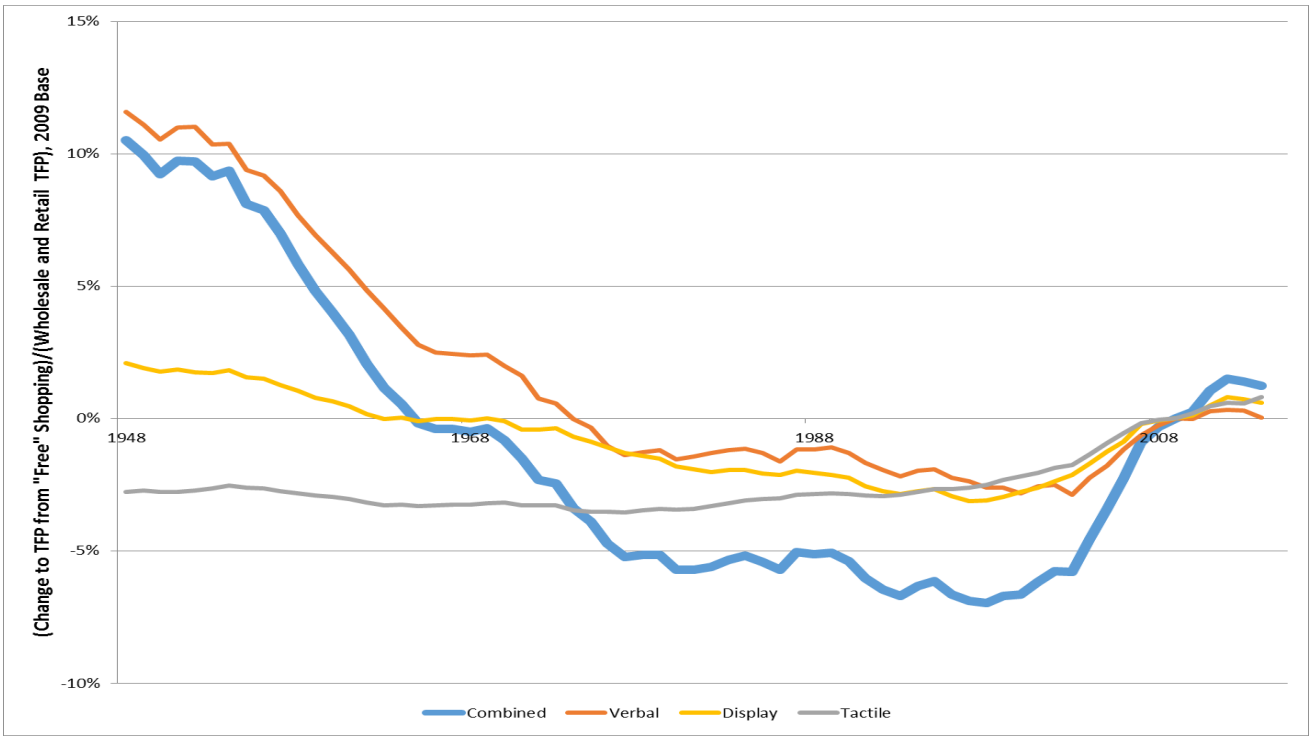

Figure 11: Change to TFP by Industry Sector

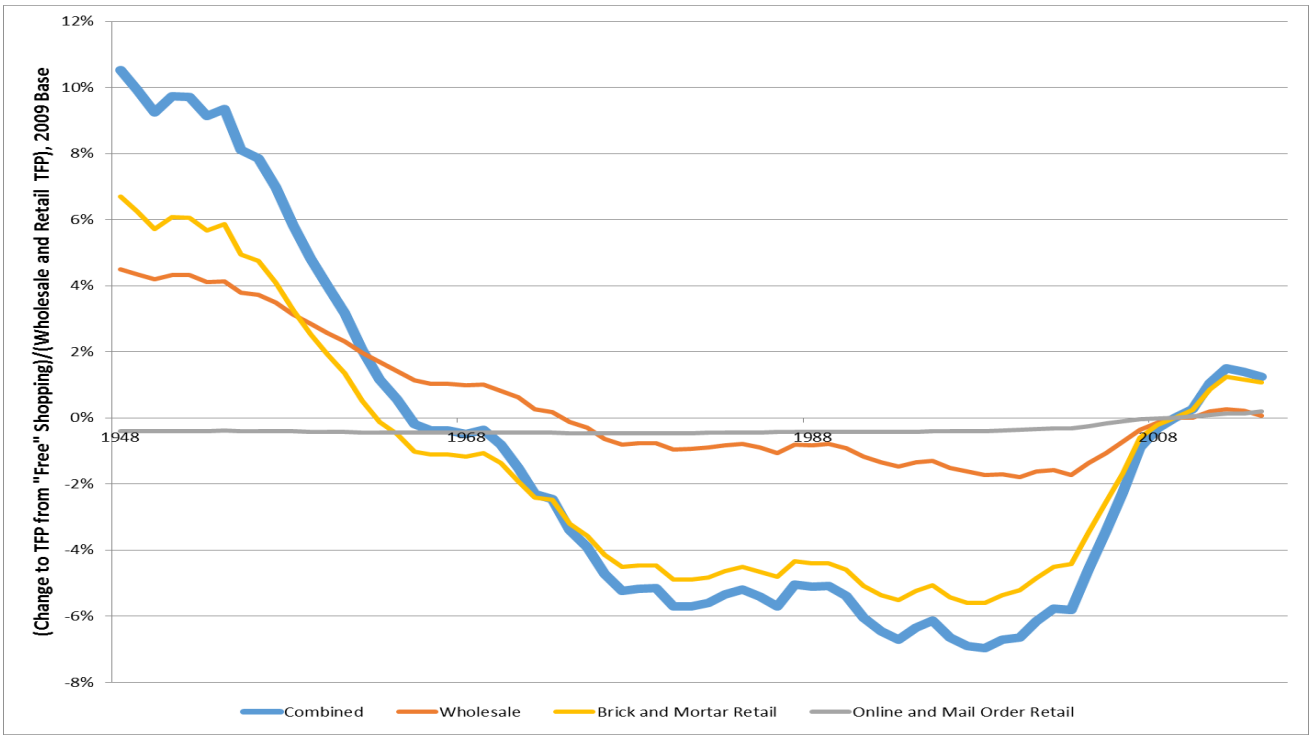

Figure 12: Aggregate TFP Impact of "Free" Services