

A photograph of a warehouse worker in a white hard hat and an orange safety vest pushing a yellow pallet jack. The jack is carrying a large stack of cardboard boxes wrapped in clear plastic. The background shows warehouse shelving and other boxes, slightly blurred to suggest motion. The top of the image has a solid blue background where the logo is located.

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How Ecommerce Creates Jobs and Reduces Income Inequality

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Summary

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In this paper we show how the expansion of ecommerce is creating jobs and reducing income inequality.

We estimate that ecommerce jobs in fulfillment centers and ecommerce companies rose by 400,000 from December 2007 to June 2017, substantially exceeding the 140,000 decline of brick-and-mortar retail jobs. We explain this job growth by showing that households are saving 64 million hours a week of shopping time because of ecommerce, and some of these unpaid household hours are being shifted into market work. One consequence is that productivity growth is being underestimated.

Based on a county-by-county analysis, we estimate that fulfillment center jobs pay 31% more than brick-and-mortar retail jobs in the same area. This suggests the shift to ecommerce jobs is reducing income inequality by raising the wages paid to high school graduates.¹

¹ We thank Michael Smith, Sophia Mietus and Elliott Long for excellent research assistance.

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Dr. Michael Mandel

How Ecommerce Creates Jobs and Reduces Income Inequality

SECTION 1. INTRODUCTION

The last retail revolution, the rise of the big box store, was not a good thing for the typical sales clerk or cashier.

“Warehouse clubs” and “supercenters” started popping up everywhere in the late 1980s. Retail productivity as measured by the government doubled from 1987 to 2007, as this new retail format was more efficient than traditional department stores and mom-and-pop operations, many of which were pushed out of business. Nevertheless, average real wages for retail workers actually fell from 1987 to 2007, and the pay gap between retail workers and the rest of the workforce widened.

Now comes the ecommerce revolution. Given the bad experience of workers with the last retail revolution, it’s only natural to worry that this one will have an equally bad effect. As of the new first quarter of 2017, ecommerce has less than 9% of retail sales. What will happen to brick-and-mortar retail workers as 10% or 20% of sales move onto the Internet? Are we facing a retail “apocalypse” that will destroy jobs that employ 15% of the American workforce, further depressing already-low wages?

In this paper we are going to argue that the labor market impact of ecommerce is totally misunderstood. In our view, ecommerce is primarily a machine for turning unpaid household hours shopping into paid market work. Americans spend 1.2 billion hours per week driving to the mall, finding a parking space, wandering around the aisles, checking out, and driving home. Some of those unpaid hours are now being shifted to fulfillment center workers, who do the “picking and packing” for customers, and truck drivers, who do the driving.

In our view, ecommerce is primarily a machine for turning unpaid household hours shopping into paid market work.

In other words, ecommerce is a net job creator, rather than a job destroyer. Our research shows that ecommerce created 400,000 jobs from December 2007, the last business cycle peak, to June 2017, while brick-and-mortar retail has lost 140,000 full-time-equivalent jobs over the same stretch. Many of these new ecommerce jobs are in fulfillment centers, which are typically counted in the warehousing industry, but bear the same relationship to ordinary warehouses as jet planes bear to bicycles. Whereas an ordinary retail warehouse is a stopping place for bulk shipments on the way to stores, a fulfillment center dynamically responds to orders from individual customers, integrating many different vendors.

Our research shows that ecommerce has created 400,000 jobs since December 2007, while brick-and-mortar retail has lost 140,000 full-time-equivalent jobs over the same stretch.

Fulfillment center jobs require only a high school diploma, but they are hard work, using a mix of cognitive and physical skills not dissimilar to industrial workers. In this paper we use a county-level analysis to show that fulfillment center jobs pay 31% more, on average, than brick-and-mortar retail jobs in the same area.

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In many areas, this 31% premium for fulfillment center work versus brick-and-mortar significantly closes the income gap, especially since real retail pay has been effectively flat for the past 30 years. **A bigger share for ecommerce has the effect of significantly reducing the income gap, not increasing it.**

SECTION 2. THE STATE OF RETAIL WORKERS BEFORE AMAZON

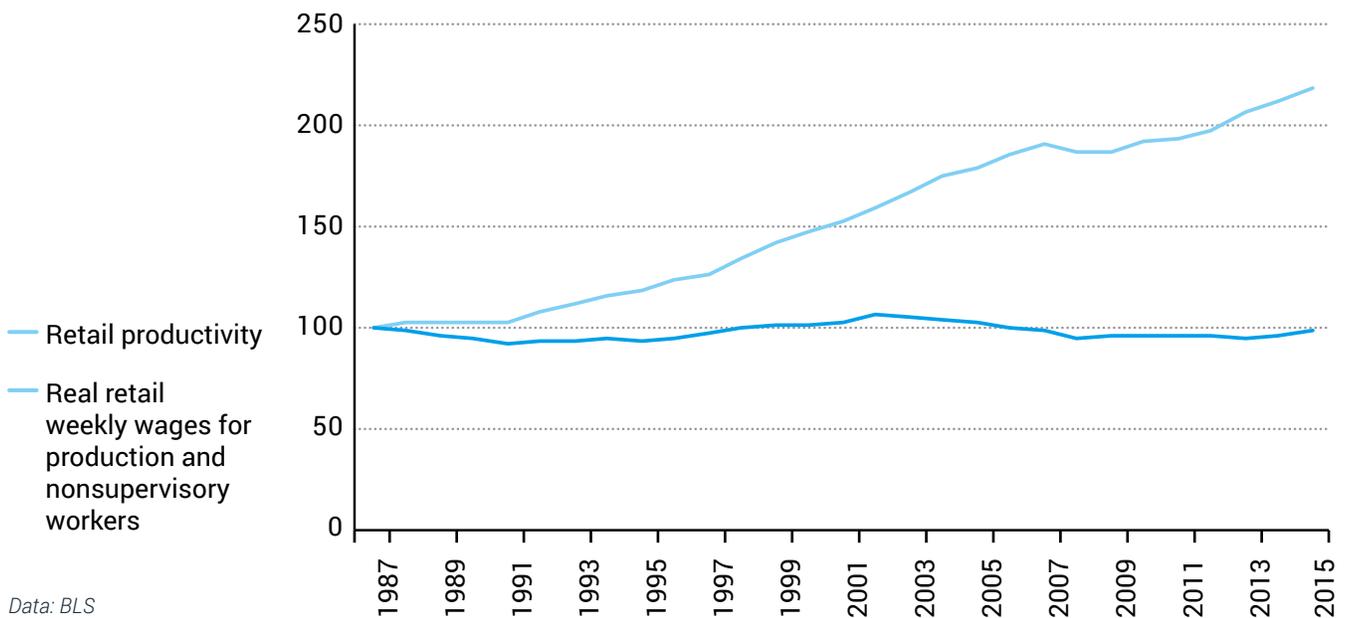
One can say that the era of the big box store truly began in 1988, when Walmart opened up its first Supercenter in Washington, Missouri. Over the next two decades, Walmart’s workforce went from 183,000, all in the United States, to 1.9 million employees globally at the end of fiscal 2007. Other big box retailers showed phenomenal growth as well.

As the new format expanded, retail productivity as measured by the Bureau of Labor Statistics nearly doubled. Academic studies suggest that most of the gains came because more productive rivals replaced the existing retailers.

....within-store productivity growth accounts for a relatively minor portion of sector-wide productivity growth in U.S. retail. Instead, the reallocation of activity across stores drives most of the gains in overall retail productivity, which in turn occurs both through the entry of new, more efficient firms replacing a set of less efficient exiting ones, as well as through successful firms adding new stores.²

But retail workers did not benefit from these productivity gains at all. As Figure 1 shows, real weekly pay in the retail sector was flat even as productivity soared.

FIGURE 1: Productivity vs Pay in the Retail Sector (1987 =100)



Data: BLS

The situation for retail workers was even worse than this figure shows. Retail jobs during the big box era became gig economy work, before the term was even coined. The average workweek in retail fell, and the typical cashier or sales worker often couldn't count on full workweeks or regular schedules.

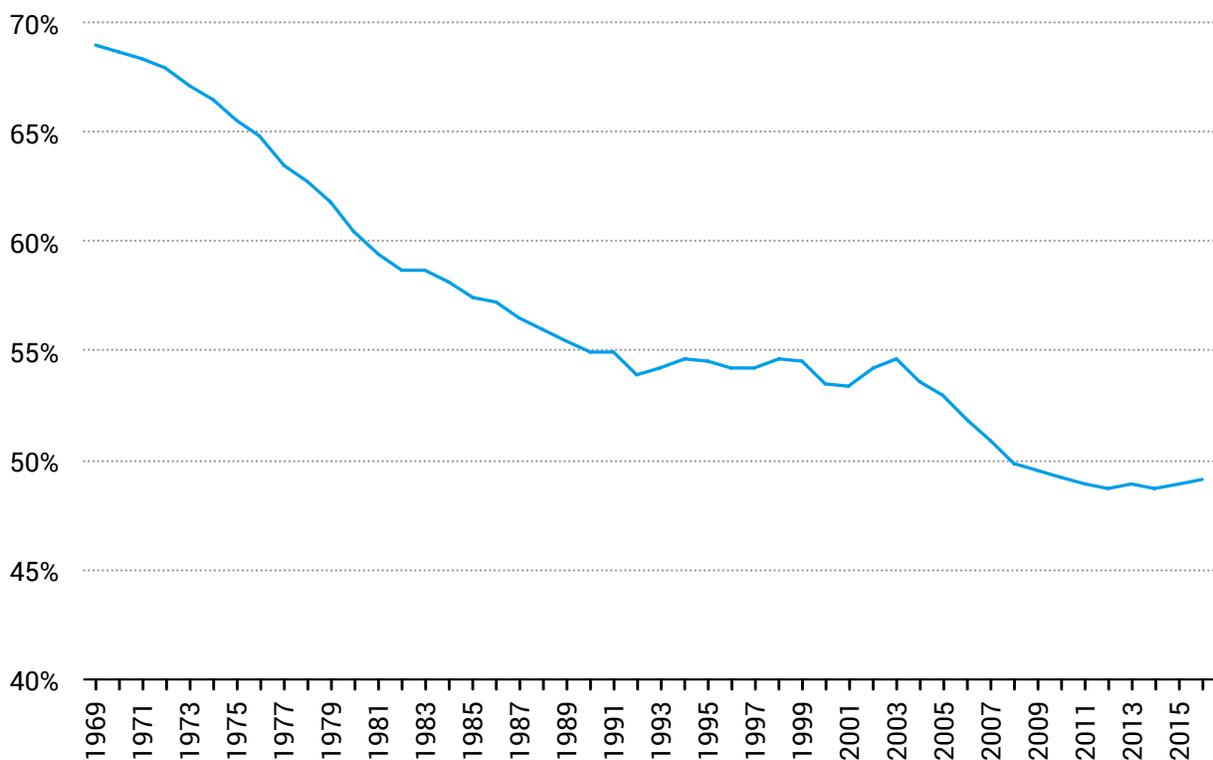
Figure 2 shows compensation per worker in retail, compared to compensation per work in

the private sector as a whole. Compensation includes wages plus a variety of benefits. We see that the compensation gap between retail workers and the rest of the economy has widened by 5 percentage points over 20 years. Indeed, the relative deterioration of retail jobs during this period contributed significantly to the growing inequality and income stagnation in the economy.

2 Ali Hortaçsu and Chad Syverson, "The Ongoing Evolution of US Retail: A Format Tug-of-War," Journal of Economic Perspectives Fall 2015

Indeed, the relative deterioration of retail jobs during this period contributed significantly to the growing inequality and income stagnation in the economy.

FIGURE 2: Retail Workers Lose Ground
(Compensation per worker in retail and food services as percent of compensation per worker in private sector)*



Data includes retail trade, food services and drinking places
Data: BEA, PPI

There are certain mysteries connected with this decline in the relative position of retail workers. One important question is why the shift to national chains and big box stores—which supposedly increased productivity—did not translate into higher relative wages for retail workers. Indeed, the increased productivity

of the U.S. retail sector was regularly cited as one of the important non-tech benefits of IT investment in the 1990s, and an important competitive advantage against Europe and Japan.³ But, if workers didn't get the productivity gains, where did they go?

³ See, for example, McKinsey Global Institute, "US productivity growth, 1995–2000," (2001) and "How IT enables productivity growth," (2002).

One important question is why the shift to national chains and big box stores—which supposedly increased productivity—did not translate into higher relative wages for retail workers.

One possibility is that the productivity gains went into building ever more ornate shopping malls rather than into the pockets of retail workers. Common wisdom has it that America is overstored compared to other countries.⁴

A second possible explanation for the deteriorating position of retail workers is that the productivity gains were not on the department store floor, but in other parts of the retail supply chain. Perhaps large retailers got better at sourcing from low-cost overseas suppliers, or managing inventories, or marketing, or making siting decisions. In that case, the productivity gains would go to the managers who negotiated the sourcing deals, rather than to the salespeople on the store floor, who are basically doing the same tasks salespeople have done since the beginning of the 20th century.

A third possible explanation is that retail sales is still one of the jobs that can be done by someone without any post-secondary training. So, as more and more jobs require a college degree, workers with only a high school degree crowd into retailing and drive down the wages, with only the minimum wage as a constraint.

A fourth possibility is that the retail productivity gains were overstated because they didn't account for increased household time to shop at big box stores. We'll discuss this more in Section 6.

But, whatever the reason, the collapse of relative retail pay is a key defining element of today's troubled economic landscape, especially outside of the coasts. Retail jobs are low paying, often part time and with limited benefits. As such, they contribute to the general economic malaise and inequality.

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SECTION 3. THE GROWTH OF ECOMMERCE JOBS

Now America is on the verge of another retailing revolution, or, more precisely, a distribution revolution. It started in the second half of the 1990s, when it occurred to many smart people simultaneously that people could order online and receive products on their doorsteps rather than making a trip to a store. Ecommerce startups such as Webvan and Pets.com (or, as their award-winning 2000 Super Bowl ad put it, "Because Pets Can't Drive!") raised hundreds of millions of dollars to put this insight into action.

But many of these initial ecommerce startups found that having a spiffy website was not enough to convince consumers to shift out of brick-and-mortar retailers. Ecommerce remained as a small share of total retail sales, and the number of brick-and-mortar retail workers rose by 10% from 1995 to 2005.

⁴ "America is 'over-stored' and Payless ShoeSource is the latest victim," Washington Post, April 5, 2017. <https://www.washingtonpost.com/news/morning-mix/wp/2017/04/05/america-is-over-stored-and-payless-shoesource-is-the-latest-victim>

However, ecommerce companies gradually realized that online shoppers cared about rapid delivery, which gave them an experience much closer to the immediate gratification of bricks-and-mortar buying. Amazon's introduction of Amazon Prime in February 2005 was a watershed event, guaranteeing two-day delivery at a fixed annual price.⁵

However, ecommerce companies gradually realized that online shoppers cared about rapid delivery, which gave them an experience much closer to the immediate gratification of bricks-and-mortar buying.

The promise of quick delivery required that Amazon build ecommerce fulfillment centers all around the country, with the big surge starting in 2010 and 2011, and then accelerating. According to one third-party source, Amazon now operates more than 100 fulfillment centers around the country, with 80 million square feet of space.⁶ The company itself went from 14,000 workers in 2007 to 180,000 workers in the United States in 2016, most of them in fulfillment centers.

High-tech warehouses, such as Amazon's fulfillment centers, offer a new set of capabilities that we have called "advanced distribution."⁷ The ability to ensure an order-delivery lag of one day or less represents a genuinely new advance that has the potential to generate spin-offs of its own. What's more, this distribution capacity is

capable of accepting merchandise from diverse sellers and delivering orders to their correct destinations.

High-tech warehouses, such as Amazon's fulfillment centers, offer a new set of capabilities that we have called "advanced distribution."⁷ The ability to ensure an order-delivery lag of one day or less represents a genuinely new advance that has the potential to generate spin-offs of its own.

It turns out that, despite worries about robots, these fulfillment centers are big employers. For example, Amazon's fulfillment center in Kenosha, Wisconsin, has more than 2,000 permanent employees, plus another 1,000 seasonal employees.⁸ The opening of this center in 2015 shows up clearly as a big jump in warehouse employment in the BLS QCEW county data.

It turns out that, despite worries about robots, these fulfillment centers are big employers.

The fulfillment center in Ruskin, Florida, opened in 2014, employs 2,500-3,000 permanent workers and many more seasonal workers.⁹ As of December 2016, the Amazon fulfillment center in Shakopee, Minnesota, was planning to hire another 1,000 fulltime workers to double its workforce.¹⁰

Other companies—both pure ecommerce companies and retailers with existing brick-

5 <https://www.amazon.com/p/feature/zh395rdnqt6b8ea>

6 www.mwpvl.com/html/amazon_com.html

7 We coined the term 'advanced distribution' in a blog post "Ecommerce job gains are much larger than retail job losses: Here's why." (April 7, 2017). <http://www.progressivepolicy.org/blog/ecommerce-job-gains-much-larger-retail-job-losses-heres/>

8 "Amazon's Kenosha plant is on the clock as Christmas arrives," Milwaukee Journal-Sentinel, December 22, 2016.

<http://www.jsonline.com/story/money/business/2016/12/22/amazons-kenosha-plant-clock-christmas-arrives/95756654/>

9 <http://www.tbo.com/news/business/amazon-provides-tour-of-ruskin-distribution-center-for-scott-local-officials-20160330/>

10 <http://minnesota.cbslocal.com/2016/12/06/amazon-jobs/>

and-mortar operations—have been opening ecommerce fulfillment centers are well.

Chewy.com, an online pet supply retailer, just opened its fifth ecommerce fulfillment center in Hanover Township, Pennsylvania, just outside of Wilkes-Barre, Pennsylvania, in coal country.¹¹ The company is hiring 700 workers. Walmart just opened a new ecommerce fulfillment center in Davenport, Florida, that will hire 1,500 workers over the next year.

The opening or expansion of new fulfillment centers can be tracked, with some fuzziness to preserve confidentiality, in government data. They are large projects, generally opening in less densely-populated areas, which are reported in the press.

In general, this county-level analysis, applied over the whole country, shows that permanent jobs at fulfillment centers are generally reported in either the warehouse industry (NAICS 493) or the electronic shopping and mail order industry (NAICS 4541). The central offices of ecommerce companies—like Etsy in Brooklyn or Amazon in King County, Washington—are generally reported in the electronic shopping industry.

Moreover, the timing of the Great Recession makes it relatively easy to distinguish ecommerce fulfillment centers from ordinary warehouses. Immediately after 2007, warehouse construction plummeted by 65%, as did mall construction. Given the collapse of consumer spending, there was no reason for conventional retailers to build new warehouses. Then, by the time the economy began to recover, the importance of ecommerce was becoming clear, and it still wasn't a high priority for retailers to build new warehouses to service their brick-and-mortar stores.

According to the Bureau of Labor Statistics (BLS), from the last business cycle peak in December 2007 to June 2017, the warehouse industry added 273,000 jobs, while the electronic shopping industry added 132,000 jobs. In total, that comes to 405,000 jobs. As noted above, we associate the entire change in warehouse employment with ecommerce fulfillment centers. If we measure by full-time-equivalent workers (assuming 40 hours per week), the gain in jobs comes to 400,000 FTE.

According to the BLS, from the last business cycle peak in December 2007 to June 2017, the warehouse industry added 273,000 jobs, while the electronic shopping industry added 132,000 jobs.

¹¹ <https://timesleader.com/news/667216/growing-pet-supply-firm-still-has-jobs-open-in-hanover-twp>

TABLE 1: Change in ecommerce and brick-and-mortar retail jobs since 2007

	CHANGE, DEC 07 - JUNE 17	CHANGE, DEC 07 - JUNE 17
	EMPLOYEES (THOUSANDS)	FTE EMPLOYEES*** (3-MONTH MOVING AVERAGE, THOUSANDS)
BRICK-AND-MORTAR RETAIL*	159	-140
ECOMMERCE JOBS**	405	401
WAREHOUSE (FULFILLMENT CENTERS)	273	274
ELECTRONIC SHOPPING	133	126
BRICK-AND-MORTAR + ECOMMERCE	564	261

*Brick-and-mortar retail is equal to retail minus nonstore retail.

**Warehouse and electronic shopping jobs as reported by BLS, before recategorization

***Assumes 40-hour week.

Source: BLS, PPI

What about brick-and-mortar retail? The brick-and-mortar retail sector is the retail sector minus nonstore retail (NAICS 454). It includes everything from motor vehicles to electronics to groceries to department stores.

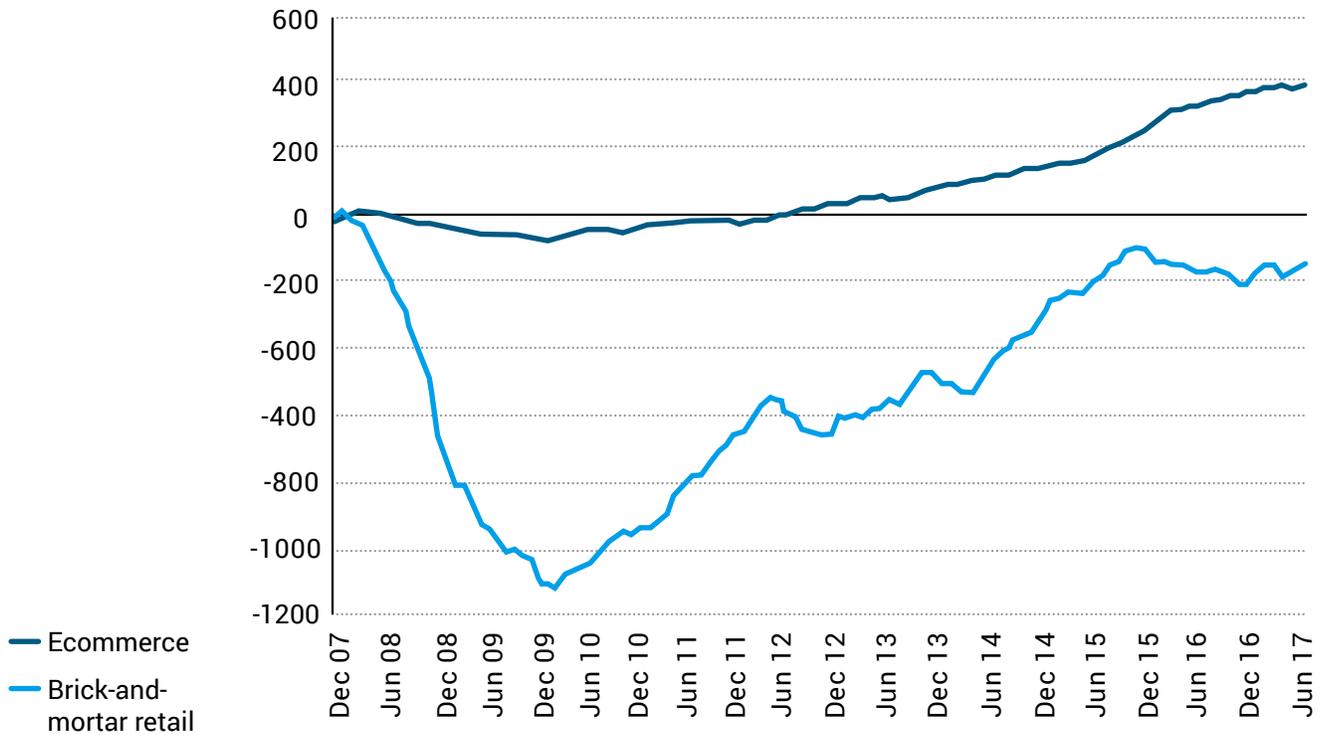
Measured by the number of jobs, brick-and-mortar retail employment has actually increased. That's why we also calculate an alternative measure, using the number of hours worked per week by all employees and dividing by 40 to get full time equivalents. By that measure, the number of FTE workers in brick-and-mortar retail has dropped by 140,000 since 2007, which seems more accurate.¹² So net, ecommerce has

generated 261,000 more FTE jobs than brick-and-mortar retail has lost since 2007.

Note that some of the decline in brick-and-mortar retail FTE jobs may have been caused by the sharp slowdown in real spending on consumer goods rather than the rise in ecommerce. From 1996 to 2006, real spending on consumer goods rose by 61%, compared to a much smaller 24% gain between 2006 and 2016. That earlier boom in spending may have driven excess store expansion, and the subsequent slowdown may help explain why brick-and-mortar retail FTE employment has struggled to regain its pre-recession peak.

12 This is based on a three-month moving average, because hours estimates bounce around a lot from month to month.

FIGURE 3: Ecommerce vs Brick-and-Mortar Retail
(change since December 2007, thousands of FTE jobs)*



*Three-month moving average. Assumes 40-hour work weeks.
Source: BLS, PPI

Are these reasonable numbers? The ecommerce and brick-and-mortar calculations are conceptually separate. So let's do ecommerce first. Obviously electronic shopping jobs belong in ecommerce, so the gain of roughly 130,000 is solid. And there's also no doubt there's massive hiring in ecommerce fulfillment centers, based on newspaper reports and Amazon's growth alone. So the question is whether the fulfillment centers are already being counted in electronic shopping, or in another industry such as warehousing.

A county-by-county look at QCEW data leaves no doubt that many of the new fulfillment centers are being reported in the warehousing industry (see methodology appendix). For example, in Riverside County, California, where Amazon

and Neiman Marcus, among others, have built multiple fulfillment centers, warehousing employment has soared but there has been no gain in electronic shopping employment at all since 2007. Similarly, in Cumberland County, Pennsylvania—where Amazon and Chewy have built fulfillment centers—warehousing employment had gone up by roughly 3,000 since 2007, but electronic shopping employment has actually gone down.

Is it possible some of the gains in warehousing jobs are non-ecommerce? Yes, it's possible. But it's equally likely that some of the fulfillment center jobs are being miscategorized in either brick-and-mortar retail or temporary help. So, all in all, I'm comfortable with the estimates above.

The brick-and mortar retail jobs estimates are equally interesting. According to the BLS published statistics, brick-and-mortar retail employment has fallen only by 7,000 from June 2016 to June 2017. One issue, of course, is that these numbers could simply be revised down over time. Leaving that aside, it's also possible that, when a brick-and-mortar retailer builds an ecommerce fulfillment center, it's being categorized within the original retail industry rather than either electronic shopping or warehousing. For example, Walmart opened an ecommerce fulfillment center in 2015 in Plainfield, Indiana (Hendricks County), employing 300 people.¹³ In the 2015 QCEW data for Hendricks County, warehousing employment jumps by a lot more than employment in warehouse clubs and supercenters.

Nevertheless, one cannot categorically rule out the possibility that the opening of the Walmart facility is masking a decline in other retail employment.

SECTION 4. WHY ECOMMERCE IS CREATING PAID JOBS

It may be surprising that ecommerce employment is rising much faster than brick-and-mortar retail employment is falling. Since ecommerce companies are supposedly more productive than traditional retailers, people think they must therefore employ fewer people.

But the increase in paid employment can be best understood by considering that the economic activity "shopping for goods" actually combines two labor inputs: paid market work by retail

employees, and unpaid time by households, in the form of driving to the store, parking, wandering through the aisles, checking out, and driving home.

Ecommerce potentially reduces the number of unpaid household hours devoted to shopping. Moreover, some of these unpaid hours are now shifted to the market sector. Paid fulfillment center associates and truck drivers now perform shopping tasks that consumers formerly did for free—such as transportation and retrieval of items within the store, as well as returning unwanted items back to the seller. Indeed, "reverse logistics"—the ability to handle flows of goods from consumers to fulfillment centers—is one of the striking innovative capabilities of the new distribution systems.

Paid fulfillment center associates and truck drivers now perform shopping tasks that consumers formerly did for free—such as transportation and retrieval of items within the store.

In this section we will make an initial start at quantifying the size of this shift. According to the American Time Use (ATU) Survey from the Bureau of Labor Statistics, in 2016 Americans aged 15 and over spent 4.55 hours per week shopping for consumer goods or travelling for purchases of goods and services. Since there are 262 million Americans aged 15 and over, that translates to almost 1.2 billion hours per week.

¹³ http://corporate.walmart.com/_news_/news-archive/2015/08/12/walmart-opens-new-e-commerce-fulfillment-center-in-plainfield

TABLE 2: Paid and Unpaid Hours in Distribution: Retail, Wholesale, Transportation and Warehousing (millions of hours per week)

	PAID	UNPAID
BRICK-AND-MORTAR RETAIL TRADE	471.0	
NONSTORE RETAIL (INCLUDING ELECTRONIC SHOPPING)	19.5	
WAREHOUSING AND STORAGE	38.4	
WHOLESALE TRADE	227.6	
TRUCKING	60.6	
ALL OTHER TRANSPORTATION AND WAREHOUSING	132.8	
HOUSEHOLD SHOPPING		1,192.8
TOTAL	950.0	1,192.8
RETAIL AND WAREHOUSING	528.9	

Source: BLS, PPI

On the other hand, the entire distribution and transportation sector—comprising retail, wholesales transportation, and warehousing—had 950 million hours per week of paid work in 2016, substantially less than unpaid household hours for shopping. What’s more, a substantial portion of those paid hours are actually devoted to supplying nonretail businesses or personal transportation.

So we can think of ecommerce as a machine for converting unpaid household hours into paid market hours, if the productivity gains are high enough. Let’s suppose β is the rate at which unpaid household hours can be converted into paid market hours. For example, suppose it takes a household two hours to drive to the

mall, pick up a shirt, and drive home. Now let’s suppose it takes a fulfillment center worker an hour to do 30 orders, and a truck driver five hours to deliver 30 orders. Then 30 orders take 60 hours of unpaid household time, but only six hours of paid market time, for a β of 10.

Whether it’s economically sensible to shift hours from the household sector to the market sector depends on V , the value that households put on their time; W , the market wage for ecommerce workers; N , the nonlabor cost of converting the marginal hour of unpaid household work into paid market work; and β , the ecommerce productivity ratio.

$$V > N + W/\beta$$

It's clear that, as ecommerce productivity β rises and N falls, it becomes economically attractive to move more hours out of the unpaid household sector into the paid market sector.

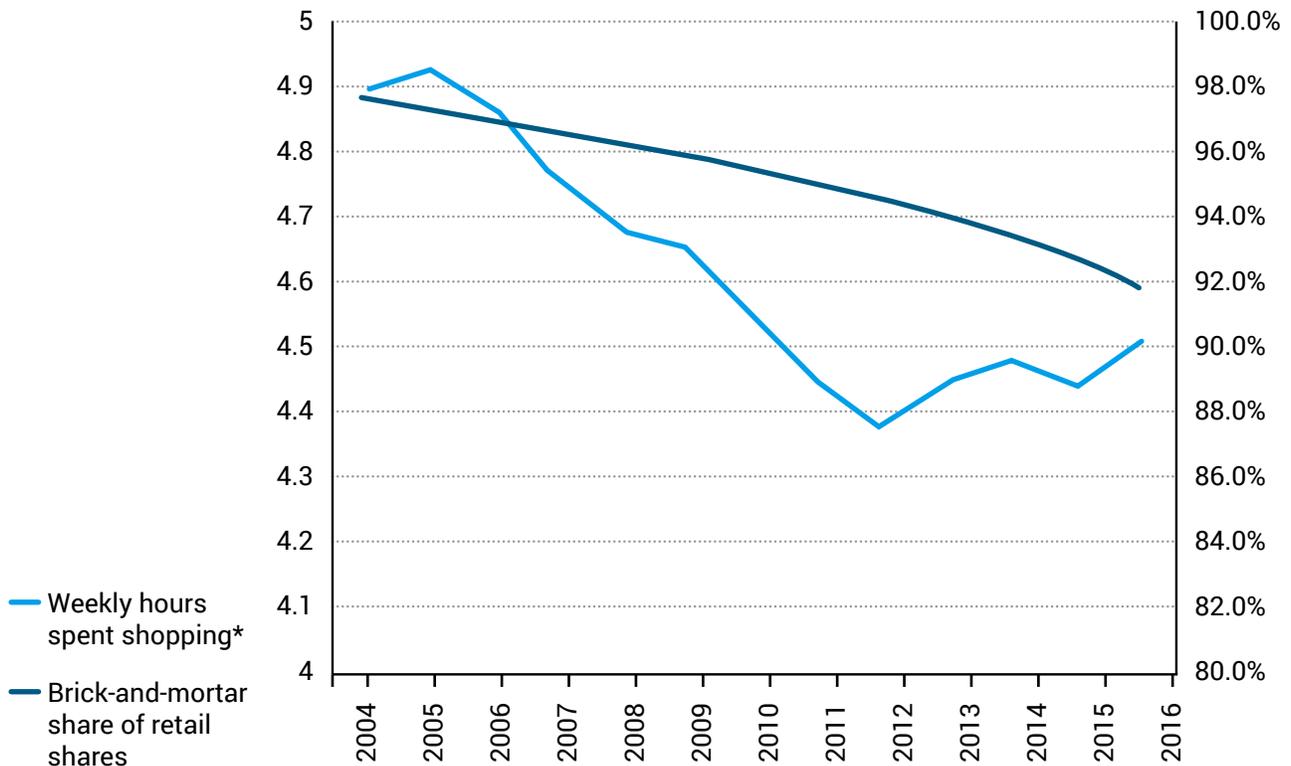
So we can think of ecommerce as a machine for converting unpaid household hours into paid market hours, if the productivity gains are high enough.

Let's see what has actually been happening. We have two ways of measuring the decline in household hours—either directly through the ATU survey, or indirectly through the declining share of brick-and-mortar retail sales. Luckily for us, both methods give us roughly the same answer.

On the left-hand axis of Figure 4, we plot the two-year moving average of weekly household shopping time. For example, in 2006-2007 Americans spent 4.75 hours per week shopping for consumer goods or travelling to shopping. By 2015-2016, that amount had dropped to 4.5 hours, a 5.1% decline. (The mild pickup in shopping hours after 2011 likely reflects macro factors such as increased consumer spending).

On the right-hand axis of Figure 4, we plot the brick-and-mortar share of retail sales, which drops from 96.6% in 2007 to 92.0% in 2016, a 4.8% decline. The similarity of the two measures can be seen in the figure, because the two axes are scaled the same.

FIGURE 4: How Ecommerce Affects Household Shopping Hours



*Two-year moving average. Shopping for consumer goods plus travel related to shopping.
Source: Census Bureau, Bureau of Labor Statistics

So, as a first approximation, the data seems to be telling us that the evolution of ecommerce since 2007 means households are spending 5% fewer hours shopping than they otherwise

would.¹⁴ That comes to a decline of roughly 64 million hours per week, or the equivalent of 1.6 million full-time jobs.

TABLE 3: Change in Paid and Unpaid Hours in Distribution, 2007-2016: Retail, Wholesale, Transportation and Warehousing (millions of hours)

	PAID	UNPAID
BRICK-AND-MORTAR RETAIL TRADE	-6.0	
NONSTORE RETAIL (INCLUDING ELECTRONIC SHOPPING)	+4.2	
WAREHOUSING AND STORAGE	+10.5	
WHOLESALE TRADE	-1.6	
TRUCKING	+3.1	
ALL OTHER TRANSPORTATION AND WAREHOUSING	+5.2	
HOUSEHOLD SHOPPING		-64
TOTAL	+15.4	-64
RETAIL AND WAREHOUSING (BRICK-AND-MORTAR RETAIL PLUS ECOMMERCE)	+8.7	

Source: BLS, PPI

One important implication: Productivity growth is being significantly undermeasured, because the BLS is not counting the fall in household hours.

How much is productivity growth being underestimated? One simple approach is to compare the drop in unpaid household shopping

hours since 2007 with the increase in total private sector work hours. From 2007 to 2016, paid private sector weekly work hours increased by 212 million, or 5.3%. Taking into account the 64 million drop in household hours reduces the total hours increase to only 3.7% over nine years. That's a difference of 0.2 percentage points annually.

¹⁴ Actually, there are several alternative ways I could have done this calculation, which give a wide array of different answers. But, for the purposes of this paper, this is the simplest.

This preliminary calculation would suggest that overall annual productivity growth since 2007 is being underestimated by 0.2 percentage points because of the rise of ecommerce and the reduction in household hours. Note that similar reasoning would suggest that retail productivity gains during the big box era may have been overestimated, since studies show that household shopping hours increased during that period.

SECTION 5. ECOMMERCE VS RETAIL PAY

In the previous two sections, we showed how ecommerce jobs are increasing faster than brick-and-mortar jobs are declining. And we offered an explanation based on higher ecommerce productivity leading to a shift of hours from the unpaid household sector to the paid market sector.

But what are those jobs being paid? In this section, we will be primarily focused on establishing the facts about ecommerce wages relative to retail jobs. We will find that the average weekly earnings of fulfillment centers are 31% higher than average weekly earnings in brick-and-mortar retail jobs in the same county. This suggests the expansion of ecommerce has the possibility of reversing the years of deteriorating relative wages in the retail sector, which did so much to drive the rising inequality.

First, a warning. This section is a bit like a detective story, where we build a case step by step. There's no rushing ahead. First, note that the ecommerce sector includes both electronic shopping establishments and fulfillment

centers. Electronic shopping establishments are predominantly heavy in management, business operation and computer-related occupations that require college degrees. Jobs at fulfillment centers, by contrast, generally require only a high school diploma.

We will find that the average weekly earnings of fulfillment centers are 31% higher than average weekly earnings in brick-and-mortar retail jobs in the same county. This suggests the expansion of ecommerce has the possibility of reversing the years of deteriorating relative wages in the retail sector, which did so much to drive the rising inequality.

Pay is excellent at electronic shopping establishments. But, because our primary focus is the effect of ecommerce on inequality, especially for less educated workers, we will be mainly concerned with fulfillment centers. On a national level, the average annual earnings for private sector workers are \$53,500. This figure includes bonuses and other intermittent pay. The average annual earnings for brick-and-mortar retail workers are \$29,300, which includes a difference in hourly wages and a difference in hours worked. Electronic shopping establishments pay an average of \$65,600 per employee, while the warehousing industry pays \$42,400 on average. These figures are based on QCEW data.

TABLE 4: National Annual Earnings in Retail and Ecommerce, 2016

INDUSTRY	AVERAGE ANNUAL EARNINGS (THOUSANDS)	PERCENTAGE DIFFERENCE RELATIVE TO PRIVATE SECTOR AVERAGE
PRIVATE SECTOR	\$53.5	--
BRICK-AND-MORTAR RETAIL	\$29.3	-45%
ELECTRONIC SHOPPING*	\$65.6	+23%
WAREHOUSING	\$42.4	-21%

*NAICS 4541

Source: BLS QCEW

Based on these figures, warehousing jobs pay about 45% more than brick-and-mortar retail on a national level, which would be a significant jump in pay.

However, these national figures do not establish the true wage difference between fulfillment centers and brick-and-mortar retail. First, the overall average warehouse wage figure may not accurately reflect fulfillment center wages, which are only a subset of the warehouse category. Second, these are national averages, when we are concerned with comparing fulfillment center wages with local retail earnings.

Based on these figures, warehousing jobs pay about 45% more than brick-and-mortar retail on a national level, which would be a significant jump in pay.

Redoing the analysis at a state level doesn't change much. Averaging over 49 states (Hawaii and District of Columbia don't report warehouse

wages) shows that, on average, warehouse jobs pay 50% more than brick-and-mortar retail jobs in the same state. But still, in most states, fulfillment centers are only a share of overall warehouse jobs.

Averaging over 49 states (Hawaii and District of Columbia don't report warehouse wages) shows that, on average, warehouse jobs pay 50% more than brick-and-mortar jobs in the same state.

Getting a good read on fulfillment center wages requires us to get down to the county level. For example, consider Bradley County, Tennessee, just outside Chattanooga. Amazon opened a fulfillment center in Charleston, in Bradley County, in 2011.¹⁵ The QCEW data shows warehouse employment in the county jumping sharply that same year. The site had more than 1,000 full-time workers as of 2016, according to news reports, with the QCEW data showing just over 1,200 workers in the warehousing industry.¹⁶

¹⁵ <http://www.timesfreepress.com/news/business/aroundregion/story/2014/sep/10/amazon-gets-ready-for-holiday-hiring-ramp-up/266718/>

¹⁶ <http://www.timesfreepress.com/news/business/aroundregion/story/2016/oct/11/amazon-has-over-4200-full-time-workers-chattanooga-charleston/391337/>
<http://clevelandbanner.com/stories/amazon-marks-5-year-anniversary,44637>

So clearly the great majority of workers in the warehouse industry in Bradley County are employed in the Amazon fulfillment center. The average annual earnings in the warehouse industry in Bradley County in 2016, according to the QCEW, were \$36,350, compared to \$27,243 for brick-and-mortar retail in the county. That corresponds to a wage premium of 34% for the fulfillment jobs.

It's worth noting that, in 2016, the average annual pay in the private sector in Bradley County was \$38,781, only 6% more than the fulfillment center pay. So, in that county, ecommerce reduces inequality by employing workers who make close to the annual average for the private sector.

This example maps out our analysis strategy. We look for counties where

- a. BLS provides data on 2007 and 2016 employment in the warehousing industry
- b. Employment in warehousing has risen by at least 1,000 jobs over that period
- c. At least two-thirds of the warehousing jobs in 2016 were created since 2007

Sixty counties nationwide fit the first two criteria. These do not include all counties where Amazon has built fulfillment centers, because, for confidentiality reasons, the BLS censors data where it would clearly reveal the operations of a single company.

So, in Bradley County, ecommerce reduces inequality by employing workers who make close to the annual average for the private sector.

There are 19 counties nationwide that fit all three criteria—that is, a big jump in warehouse employment, where the new jobs account for at least two-thirds of the 2016 employment. Most of these counties contain Amazon fulfillment centers. The remaining mostly contain ecommerce fulfillment centers belonging to companies such as Nordstrom or Kohl's.

We find that warehouse wages in these counties exceed brick-and-mortar retail wages by 31%, on average. Just focusing on the counties containing Amazon fulfillment centers gives us a slightly higher ecommerce-to-brick-and-mortar wage premium of about 33%.

One note about scope: The approach in this section relies on pay reported to the government for unemployment insurance purposes, so it is accurate under penalty of law. It does include both nonsupervisory and supervisory personnel for both fulfillment centers and retail. However, this data does not include employer payments for health insurance, and certain other benefits such as educational assistance up to a certain amount. For example, Amazon's program for offering tuition assistance for training in fields such as nursing and robotics is almost certainly not being picked up by our data.

We find that warehouse wages in these counties exceed brick-and-mortar retail wages by 31%, on average. Just focusing on the counties containing Amazon fulfillment centers gives us a slightly higher ecommerce-to-brick-and-mortar wage premium of about 33%.

SECTION 6: A DIFFERENT APPROACH TO WAGES

We must take note here of a different approach to the analysis of fulfillment center wages. In a recent report on Amazon, the Institute for Local Self-Reliance (ILSR), a Washington-based nonprofit organization, estimated average pay at Amazon's fulfillment centers using wage reports from Glassdoor.com.¹⁷

Drawing on more than 1,300 wage postings on Glassdoor.com, we found that Amazon's fulfillment center positions pay an hourly mean wage of \$12.32.

They then compared their estimate of Amazon wages with BLS data based on government surveys. In particular, the report notes that:

The average hourly pay for the nation's 7.5 million retail sales workers was \$11.72 in 2015, according to BLS data; adjusted for inflation to 2016, that means Amazon paid just 3% more.

However, ILSR's comparison of Glassdoor wage data with BLS wage data is comparing apples and oranges. Glassdoor mainly collects data on "annual base or hourly pay," which explicitly

excludes variable compensation such as commission and bonuses, as well as overtime.¹⁸ Their survey does ask for variable compensation data, but the field is optional and a much smaller percentage of people reply.

As a result, Glassdoor's "headline" wage figure is for base pay:

Salary estimates in job listings display a range for annual base or hourly pay and are specific to job title, company and location. They do not factor in variable compensation, such as bonuses, commissions, tips, stock, benefits or other components.

By contrast, the BLS estimates, as drawn from the Occupational Employment Statistics Survey, **explicitly** include commissions and some types of bonuses, including incentive bonuses and production bonuses.¹⁹

For these well-documented reasons, BLS OES wage estimates are systematically higher than Glassdoor wage estimates across a range of selected high-skill and low-skill occupations, as Table 5 shows.

17 "Amazon's Stranglehold: How the Company's Tightening Grip Is Stifling Competition, Eroding Jobs, and Threatening Communities," November 2016. ILSR

18 <http://help.glassdoor.com/article/What-are-Salary-Estimates-in-Job-Listings>

19 <https://www.bls.gov/respondents/oes/faqs.htm#19>

TABLE 5: Comparing Glassdoor and BLS Wage Estimates: Selected Occupations

OCCUPATION	ANNUAL EARNINGS		PERCENTAGE DIFFERENCE
	GLASSDOOR ESTIMATE	BLS ESTIMATE	
MARKETING MANAGER	\$81,114	\$144,740	78.4%
DENTIST	\$132,125	\$179,820	36.1%
EDITOR	\$49,679	\$66,330	33.5%
REPORTER	\$38,176	\$49,830	30.5%
MAID	\$18,562	\$23,820	28.3%
CHILDCARE	\$17,540	\$22,080	25.9%
COOK	\$20,000	\$24,270	21.4%
DENTAL HYGIENIST	\$61,625	\$73,600	19.4%

Glassdoor estimates are base pay only, with no variable compensation or overtime. BLS OES estimates include commissions and some types of variable compensation, such as incentive and production bonuses. Source: Glassdoor.com, BLS

These systematic differences shouldn't be a surprise. Glassdoor wage estimates are a wonderful example of "organic" data, collected in the course of doing business rather than through government surveys. The information contained in Glassdoor wage estimates is tremendously useful, both to job seekers and researchers, providing data that government surveys cannot.

However, it is well known that comparisons between organic data and government survey data must be made very carefully, because there are often important conceptual differences.²⁰

In the case of Glassdoor wage data, those differences are fully explained on the site.

Now let's turn to the particular comparison ILSR used. Amazon fulfillment center workers are eligible for overtime and performance bonuses, which are not counted in the Glassdoor base pay figures.²¹ Conversely, many retail jobs in the ILSR sample get commissions and incentive bonuses, which are counted in the BLS figures. For example, their 7.5 million retail workers include auto sales workers, who typically get 25-30% commissions. High-end department stores often utilize a commission-based pay structure, as do jewelry stores and many furniture stores.²²

20 For example, the author has extensively studied online job postings, an important form of organic data about the labor market. In this context, any analysis must account for key conceptual differences between the number of online job postings, as reported by a job search engine such as Indeed.com, and the number of job openings, as reported by the Bureau of Labor Statistics. For further discussion, see Michael Mandel and Judith Scherer, "A Low-Cost and Flexible Approach for Tracking Jobs and Economic Activity Related to Innovative Technologies," NESTA Working paper 15/11, 2015.

21 <https://www.bizjournals.com/denver/news/2017/07/13/amazon-now-hiring-1-000-people-for-its-aurora.html>

22 <http://www.seattlepi.com/business/article/Nordstrom-salesman-s-million-dollar-secret-is-in-1140669.php>.
<https://www.indeed.com/cmp/Nordstrom/faq/what-is-the-pay-structure-like-for-a-sales-associate-how-does-commission-work?quid=1ab8e38r5as0lclc>

According to one report:

Most furniture stores pay salespeople a salary and commission, with heavy volume retailers giving 4% to 8% and some upscale retailers offering 10% or more.²³

To sum up, ILSR appears to be using Glassdoor base pay data for Amazon wages, which omit overtime and performance bonuses, and are comparing those numbers to BLS figures for retail wages, which include commissions and performance bonuses. In other words, the comparison is biased against Amazon because of a misunderstanding of how to use organic data.

In a situation like this, it would have been methodologically sounder to compare Glassdoor base pay data for Amazon warehouse associates with Glassdoor base pay data for major brick-and-mortar retailers.

Table 6 below does a simple version of that analysis. All samples were drawn in late July and early August 2017. We see that base pay

at Amazon for warehouse associates is roughly one-third higher than base pay for major retailers such as Macy's, Walmart, Target, and Ann Taylor. That matches the results we got from the analysis in the previous section.

Glassdoor also offers some total compensation data based on a much smaller sample. That shows roughly the same result. For example, as reported by Glassdoor, the total compensation of an Amazon warehouse associate, including cash bonus and profit sharing, is 34% more than the total compensation of a Macy's retail associate, including cash bonus and commission.

Still, we believe the wage analysis of the previous section is a better approach for examining inequality because it systematically includes all forms of income, including overtime, commissions, and incentives. However, Glassdoor-type organic data has an important role to play as well, if used correctly. The key is to compare apples to apples, or to adjust for the difference in pay concepts.

TABLE 6: Ecommerce/Retail Wage Comparisons Using Glassdoor Data

COMPANY	JOB TITLE	HOURLY WAGE ESTIMATE REPORTED BY GLASSDOOR
AMAZON	WAREHOUSE ASSOCIATE – HOURLY	\$12.53
MACY'S	SALES ASSOCIATE – HOURLY	\$9.40
MACY'S	RETAIL SALES ASSOCIATE – HOURLY	\$9.40
WALMART	SALES ASSOCIATE	\$9.79
WALMART	CASHIER	\$9.34
TARGET	SALES FLOOR TEAM MEMBER – HOURLY	\$9.50
TARGET	CASHIER – HOURLY	\$9.44
ANN TAYLOR	SALES ASSOCIATE – HOURLY	\$9.98

Source: Glassdoor.com. Samples drawn on late July and early August 2017.

23 <http://www.marketwatch.com/story/10-things-furniture-stores-wont-tell-you-1296850666159>

SECTION 7: ECOMMERCE AND INEQUALITY

So far the information revolution has been missing good jobs for high-school-educated workers. It has produced plenty of jobs for knowledge workers, but high-school-educated workers have seen their job opportunities contract. The result has been a rise in inequality, as has been repeatedly documented.

The U.S. needs decent paying jobs in the tech sector for high school graduates that utilize a mix of cognitive and physical skills. That's exactly the description of fulfillment center jobs—decent pay for a high school graduate, in a fast-growing tech-related industry, which requires a mixture of physical and cognitive skills.²⁴ Many of them are full-time jobs with full benefits. They aren't easy jobs, for sure—but neither are manufacturing jobs.

The U.S. needs decent paying jobs in the tech sector for high school graduates that utilize a mix of cognitive and physical skills. That's exactly the description of fulfillment center jobs—decent pay for a high school graduate, in a fast-growing tech-related industry, which requires a mixture of physical and cognitive skills.

By contrast, brick-and-mortar retail jobs not only pay less, but also tend to be low-hour jobs, often with fewer benefits. Indeed, by our calculations, even though retail is less than 8% of the economy, it has been responsible for 20% of the decline in labor share since 1987.

So shifting jobs from brick-and-mortar retail to ecommerce fulfillment centers will have the effect of lifting earnings for low-income workers. The exact impact on inequality will depend on the relative educational mix of the two industries. For example, if it turns out that fulfillment center workers have a higher level of education on average than retail workers, then some of the pay premium is due to characteristics of the workers rather than higher pay by ecommerce companies.

So shifting jobs from brick-and-mortar retail to ecommerce fulfillment centers will have the effect of lifting earnings for low-income workers.

However, according to analysis of the Current Population Survey, workers in the retail sector on average have significantly better than a high school education. Out of 16.8 million workers employed in the retail sector, 22% have a bachelor's degree or better, while another 10% have an associate's degree.²⁵ Only 10% have less than a high school diploma. Note that, despite this education distribution, the average weekly wage in retail is only \$583, or \$30,297 annually.²⁶

There is also some tentative evidence that the shift from retail to ecommerce is benefiting black and Hispanic workers. First, the common conception is that the retail workforce is "disproportionately people of color."²⁷ However, that's not what BLS statistics show. According to the latest figures, 11.9% of all workers identify

24 Indeed, at least one company offers an Order Selector Certification for ecommerce fulfillment center workers.

<http://www.prologistix.com/employees/certifications/>

25 Author tabulations of CPS data for year ending June 2017.

26 This figure is based on QCEW data. The CES data gives a lower estimate of \$23,276 annually. BEA reports average wage and salary payments of \$30,529 in 2015 for retail employees.

27 <https://www.racked.com/2017/6/20/15817988/retail-workers-unions-american-jobs>

as black or African-American, compared to 12% of retail workers.²⁸ Similarly, 16.7% of all workers identify as Hispanic or Latino, compared to 17% of retail workers.

By contrast, workers in the fast-growing warehousing industry—which includes fulfillment centers—are more likely to be black or Hispanic. In 2016, 24.3% of warehousing workers were black, up from 18.5% in 2010. Then 30.3% were Hispanic, up from 28.8% in 2010. Thus, over the period of rapid fulfillment center expansion, the government data apparent show that the warehouse industry has been hiring black and Hispanic workers at a rapid pace.

Thus, over the period of rapid fulfillment center expansion, the warehouse industry has been hiring black and Hispanic workers at a rapid pace.

We should also note that past research from Demos and the NAACP found that, in retail, blacks and Hispanic/Latinos tend to be sorted into lower-paid positions and underrepresented in supervisory positions.²⁹ Of those lower-paid positions, black and Hispanic/Latino retail sales workers are overrepresented in cashier positions that are the absolute lowest paid.

The shift away from brick-and-mortar retail to ecommerce will present challenges for those communities that rely on entry-level retail jobs as a gateway into the labor market. Will ecommerce offer more or fewer opportunities for blacks and Hispanics to build wealth and create long-term careers? Which areas of the country will be helped and which hurt? Much more research needs to be done on these and related questions.

SECTION 8. THE FUTURE

Retail is going through an evolution, rather than a revolution. The ecommerce share of retail sales is increasing at about one percentage point annually. In the first quarter of 2017, ecommerce had 8.5% of retail sales, compared to 7.8% a year earlier.

So, for the near-term future, we expect current trends to continue. Brick-and-mortar retail jobs will continue to shrink, at a slow-to-moderate pace, especially if the slow growth of consumer spending continues. And ecommerce jobs will continue to expand, as more and more unpaid household shopping hours are moved into the market sector. Amazon has said it plans to expand domestic employment by 100,000 jobs by mid-2018.³⁰ Meanwhile, incumbent retailers will continue to compete with Amazon by building fulfillment centers of their own, or hiring companies that are specializing in ecommerce fulfillment.

Brick-and-mortar retail jobs will continue to shrink, at a slow-to-moderate pace. And ecommerce jobs will continue to expand, as more and more unpaid household shopping hours are moved into the market sector.

Longer-term, will the job expansion of ecommerce continue? It's hard to tell. Some people worry that fulfillment center workers are going to eventually be replaced by robots, which automatically pick, pack and sort. That's impossible to assess at this point.

28 <https://www.bls.gov/cps/cpsaat18.htm>

29 The Retail Race Divide (Demos, NAACP 2015)

30 <http://www.reuters.com/article/us-amazon-com-inc-jobs-idUSPKBN14W21G>

But, in my view, the real question is what new business models will be enabled by the advanced distribution capabilities we are currently developing. Rather than distribution being a one-way bulk operation with long lead times, we now have the ability to deliver goods quickly—and, perhaps more importantly, accept returns.

But, in my view, the real question is what new business models will be enabled by the advanced distribution capabilities we are currently developing.

We can imagine new business models for custom manufacturing that make use of these advanced distribution capabilities. Imagine you can go into a store, see a style of furniture or clothing you like, order it from a custom manufacturer set up next to a fulfillment center, and have it delivered the next day. That's much better than waiting two weeks or two months for delivery from China. Indeed, a flexible and rapid local distribution system may provide a durable competitive advantage against overseas rivals.

We can imagine new business models for custom manufacturing that make use of these advanced distribution capabilities.

Methodology Appendix

The analysis of income inequality relies on county-level data from the BLS Quarterly Census of Employment and Wages (QCEW) program. However, because of some classification errors, the data requires some work before it's useful.

The QCEW is based on required unemployment insurance reports submitted by businesses, where they report the number of workers by county and by industry, as well as the amount of wages and salaries paid out.

In terms of categories, the Bureau of Labor Statistics tracks employment by establishment, not by company. An establishment, as defined by the BLS, is:

An establishment is commonly understood as a single economic unit, such as a farm, a mine, a factory, or a store, that produces goods or services. Establishments are typically at one physical location and engaged in one, or predominantly one, type of economic activity for which a single industrial classification may be applied.

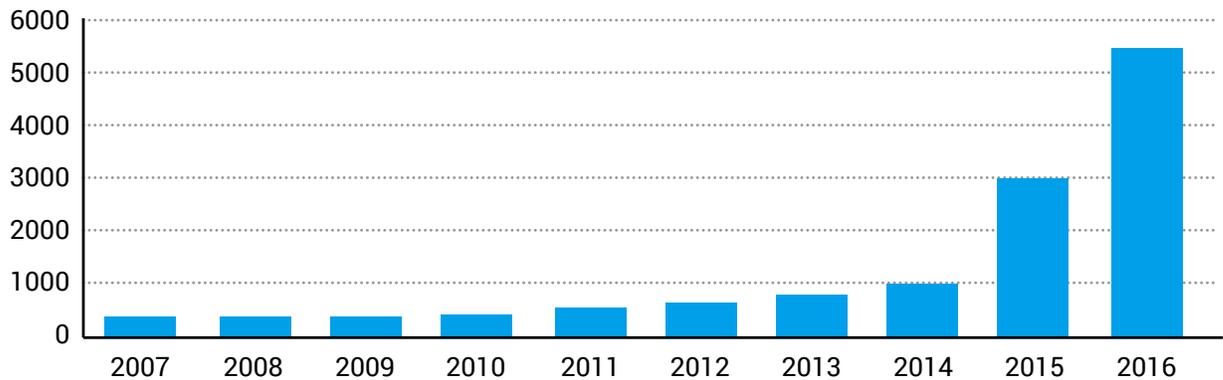
So a company with multiple physical locations typically—but not always—reports each of its physical locations in a different industry than the company itself is in.

Moreover, the QCEW program of the BLS publishes data down to the county level, subject to confidentiality requirements. So, if there are too few employers of a particular type in a county, that data may not be published.

Fulfillment centers typically are counted in the “warehousing and storage” industry (NAICS 493). Because fulfillment centers are often located in relatively low-density areas, they often stand out very clearly in the BLS data. For example, Amazon opened a fulfillment center in Kenosha, Illinois, in June 2015.³¹ Figure 5 shows employment in the warehousing industry in Kenosha County.

31 http://journaltimes.com/news/local/amazon-to-hire-more-at-kenosha-center/article_9518ffa6-112c-5ed1-b002-5b0c094fe493.html

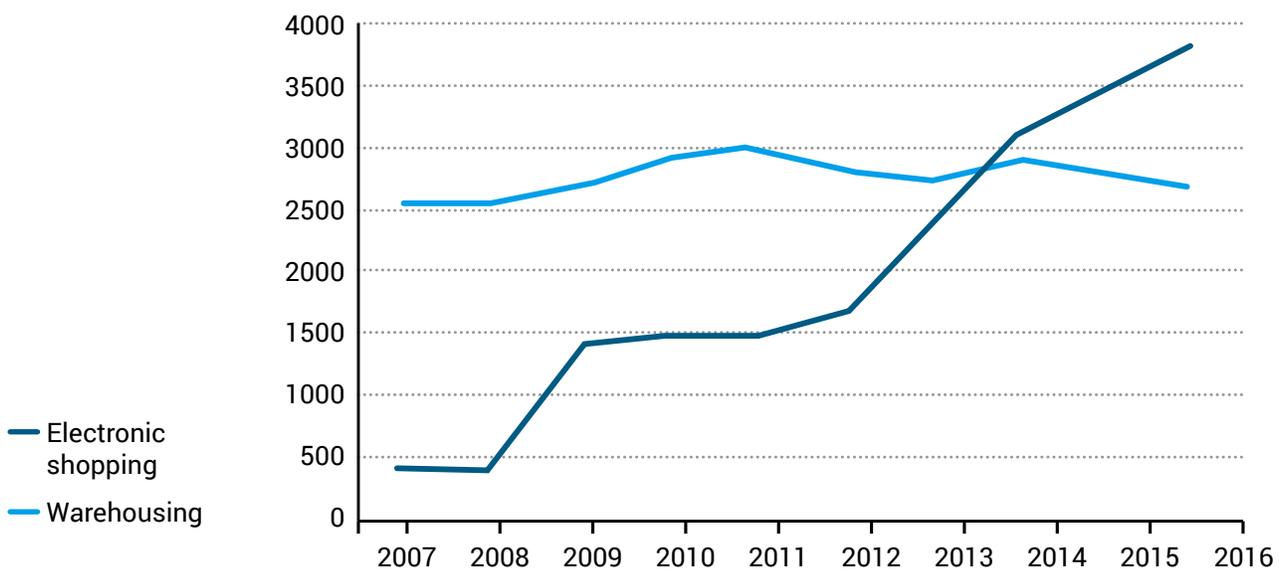
FIGURE 5: Employment in Warehousing Industry: Kenosha County, Wisconsin



However, a small number of states—notably Arizona, Florida, Indiana, and Ohio—assign some fulfillment centers to the “electronic shopping and mail order” industry instead (NAICS 4541). Consider Butler County, Ohio, located north of Cincinnati. Butler is a hotbed of ecommerce. For example, Kohl’s runs an ecommerce distribution center in Monroe, Ohio, located in Butler County. According to news reports, Kohl’s expanded its distribution center employment significantly in 2014.³² Hayneedle, an online retail company

based in Omaha, Nebraska, and recently acquired by Walmart, opened its first fulfillment center operations in the county in 2010, and has expanded several times since then.³³ Trade Global, a Cincinnati-based subsidiary of Singapore Post LTD that provides ecommerce fulfillment services for fashion and beauty brands such as Hugo Boss, opened a fulfillment center in West Chester, Ohio, in Butler County (though it recently announced layoffs).

FIGURE 6: Jobs in Butler County, Ohio



32 <http://www.daytondailynews.com/business/kohl-hiring-640-for-local-commerce-distribution-center/ExJnZzBdWQ8D3X0mDILvRP/>

33 <http://www.journal-news.com/news/online-retailer-massive-monroe-expansion-create-over-100-new-jobs/1HY4g8fJQMjnyS2ZuHW15K/>

However, if we look at the QCEW data, as graphed in Figure 6, it's clear that employment in the electronic shopping industry has expanded in Butler County, while the warehousing industry has been flat. This suggests that the fulfillment centers in that county are being assigned to the electronic shopping industry.

This conclusion is supported by looking at wage data. The average annual wage for electronic shopping jobs in Butler County in 2016 was only \$35,000, putting it more in line with warehouse jobs in the same county rather than higher-paying software jobs.

Looking at wage data helps us identify other cases of misclassification. For example, Hillsborough County, Florida (where Tampa is located), shows an increase of more than 4,000 jobs in the electronic shopping industry from 2007 to 2016. However, over that time period, pay in the electronic shopping industry dropped from \$50,000 to \$33,000 (compared to an average brick-and-mortar pay of \$30,866).

This strongly suggests these new jobs are likely to correspond to fulfillment centers rather than electronic shopping hubs. Indeed, in 2014 Amazon opened a fulfillment center in Ruskin, located in Hillsborough County, and then expanded again in 2016. Similarly, the Indianapolis MSA has added roughly 9,500 jobs in the electronic shopping industry between 2007 and 2016. But, since average pay in that industry in 2016 was only \$37,619, these are likely to be fulfillment center jobs.

For the purposes of this study, we use annual pay of \$50,000 as the measure for distinguishing between electronic shopping jobs that should be categorized in the warehouse/fulfillment center category and those that properly belong to electronic shopping hubs. For example, densely populated Hudson County, New Jersey, just across the river from New York City, showed a jump of roughly 3,000 electronic shopping jobs from 2007 to 2016. At an average pay of \$64,000, these are not likely to be fulfillment center jobs.



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