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Unfulfilled promises

Amazon fulfillment centers do not generate broad-based employment growth

Report • By Janelle Jones and Ben Zipperer • February 1, 2018

Economic Policy Institute • Washington, DC

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What this report finds: When Amazon opens a new fulfillment center, the host county gains roughly 30 percent more warehousing and storage jobs but no new net jobs overall, as the jobs created in warehousing and storage are likely offset by job losses in other industries.

Why it matters: State and local governments give away millions in tax abatements, credits, exemptions, and infrastructure assistance to lure Amazon warehouses but don't get a commensurate "return" on that investment.

What we can do about it: Rather than spending public resources on an *ineffective* strategy to boost local employment (luring Amazon fulfillment centers), state and local governments should invest in public services (particularly in early-childhood education and infrastructure) that are proven to spur long-term economic development.

SECTIONS

Update as of March 1, 2018: Since we ran our original analysis, additional data on fulfillment center openings has become available. We re-ran our analysis and found that the updated data confirms our previous results. See the Appendix for more information.

Introduction and key findings

Since its founding in 1994, Amazon's network of fulfillment centers has grown to nearly 100 across the country. In 2017, publicly available data identified 95 Amazon fulfillment centers in 25 states. Current estimates suggest that fulfillment centers occupy over three-fourths of the total square footage of Amazon's entire U.S. distribution infrastructure. (See **Appendix Table 3** and **methodology** for data sources).

The expansion of Amazon's physical distribution network has coincided with a strategic business plan of negotiating millions in tax abatements, credits, exemptions, and infrastructure assistance from state and local governments in the name of regional economic development. By the end of 2016, Amazon had likely received over $1 billion in state and local subsidies for its facilities, which would include not

only fulfillment centers but "sortation" centers that only sort packages, mailing centers, and other facilities.[1] In return for the incentives each of the fulfillment centers receives, Amazon claims to create hundreds of jobs with competitive pay and benefits.[2]

An analysis of these claims is timely. As Amazon looks to open a second headquarters in 2018, it is employing a similar strategy, on a much larger scale, exchanging tens of thousands of jobs for massive incentives in return. For example, the District of Columbia reportedly offered Amazon a permanent corporate tax rate cut as well as sales tax exemptions. According to *The Washington Post*, the announcement of the finalists in the running for hosting the new headquarters "also raised more difficult questions about the influence of large tech giants on cities and the possible unintended consequences of giving tax breaks and other benefits to an already successful corporate titan."[3]

Using tax and other incentives to lure businesses to state and local areas is a long-running economic development strategy pursued by subnational governments. In nearly every state, businesses can receive a significantly lighter tax burden for constructing a sports stadium, filming a movie, or building a manufacturing assembly plant. The results on whether these types of community development strategies have a positive impact on job creation and growth is highly debated in popular news outlets and among researchers. And as Amazon has grown, the debate in some cases has specifically focused on Amazon.[4]

Studying the employment effects of opening Amazon fulfillment centers is an excellent opportunity to provide evidence for this debate. Using publicly available data on the opening of these fulfillment centers, we undertook a rigorous statistical assessment of claims that the opening of an Amazon fulfillment center in a specific county will provide broad employment gains to that local area.

Our key findings show that luring Amazon fulfillment centers is an ineffective strategy for boosting overall local employment

- **The opening of an Amazon fulfillment center leads to an increase in warehousing and storage employment in the surrounding county**. Two years after an Amazon fulfillment center opens in a county, warehousing employment in the county is approximately 30 percent greater. This effect is robust to numerous statistical controls.
- **The opening of an Amazon fulfillment center does not lead to an increase in county-wide employment**. Two years after an Amazon fulfillment center opens in a county, overall private-sector employment in the county has not increased. It is possible that the jobs created in the warehousing and storage sector are offset by job losses in other industries, or that the employment growth generated by Amazon is too small to meaningfully detect in the data. This finding of no effect is also robust to a series of statistical controls.

- **The fact that some of our specifications show small reductions in county-wide employment—albeit not statistically robust—reinforces just how completely ineffective Amazon fulfillment center openings have been to providing any boost to overall local employment**. The exact sign of the overall employment effect of opening an Amazon fulfillment center in a county is actually negative in some of our specifications, indicating that small reductions in county-wide employment follow these openings. Because this effect is not statistically robust across all statistical specifications, we do not claim reductions in county-wide employment but do assert that this effect supports the finding of no job growth.

State and local policymakers seeking maximum long-term benefits should reconsider extending tax incentives to lure businesses

The promise of luring jobs is nearly always and everywhere a very hard one for policymakers to ignore. The jobs gained by one locality that lures an establishment from another locality may be zero-sum, but they're very visible and easy to point to. Jobs that are displaced by luring an establishment are more diffuse. And the specific jobs that could have been gained in the long-term by instead investing in education or other public goods are harder to celebrate—local officials can't easily organize a ribbon-cutting ceremony around those kinds of jobs. Nevertheless, our findings support other research suggesting that state and local policymakers should consider the following points when debating whether to extend incentives to lure businesses:

Tax incentives likely constitute an unneeded giveaway

At an intuitive level, offering tax incentives for firms to move businesses to particular locales may strike some as sensible. All else being equal, firms likely would prefer to locate in a particular area if doing so lowered tax costs and hence increased profits. However, there are other considerations that significantly influence location decisions, including access to customers, the quality of public services needed to run businesses (for example, the existence of reliable electricity and high-quality roads) and access to a pool of qualified workers.[5]

Research has shown that state and local taxes are on average less than 2 percent of the cost of doing business. This means that simply offering to cut taxes won't do that much to sway firms' location decisions. In short these incentives are likely ineffective or, at best, an inefficient use of resources. These incentives are largely a windfall to firms that were going to locate in that spot even without the incentives, all while sacrificing revenue that areas need to invest in public goods.[6]

Tax incentives may do little to boost overall employment

While luring an establishment of an existing national employer to a specific state will create jobs at that establishment, it will not necessarily create more jobs overall. If, for

example, labor supply in a particular locale is limited, job gains in the newly lured establishment could be offset by job losses among competitors. This is what happens when luring a Walmart into a county leads to shutdowns of local grocery stores—overall employment and economic activity is unaffected. Measuring the extent of this type of employment displacement is key to assessing the overall economic benefits of luring establishments of existing national chains. Our findings of the lack of overall job growth from opening an Amazon fulfillment center suggest that some sort of employment displacement is taking place, or that the growth in warehousing jobs is too limited to spill over into broad-based employment gains for the overall local economy. This is in keeping with a robust body of evidence indicating that reducing public services to provide tax cuts does not actually spur economic growth and job creation.[7]

Investments in public services are more effective than tax incentives at generating long-term economic growth

Another key downside of tax incentives is that they deprive states and localities of resources needed to invest in public goods, such as transportation or education. The research literature indicates that public spending and the expansion of public services increases local economic activity—and that such public investment is obviously hamstrung by policies (like offering tax incentives) that reduce resources available to state and local governments. Investments in public services (particularly in early-childhood education) and infrastructure are a much stronger recipe for spurring long-term economic development than providing tax increases to existing national employers.[8]

Amazon fulfillment centers

The expansive network of centers that store, pack, ship, and provide customer service for products is crucial to Amazon's business model, which requires quick delivery throughout the country. As displayed in **Figure A**, construction of Amazon fulfillment centers in the United States increased significantly around 2008. Amazon had under 10 centers through the mid-2000s and had nearly one hundred by the end of 2017.[9] The sharp rise in fulfillment centers corresponds with the 2005 introduction of Amazon Prime, in which subscribers pay an annual fee for two-day shipping and other benefits, and the 2006 launch of Fulfillment by Amazon, in which participating sellers have their items stored, packed, and shipped by Amazon.

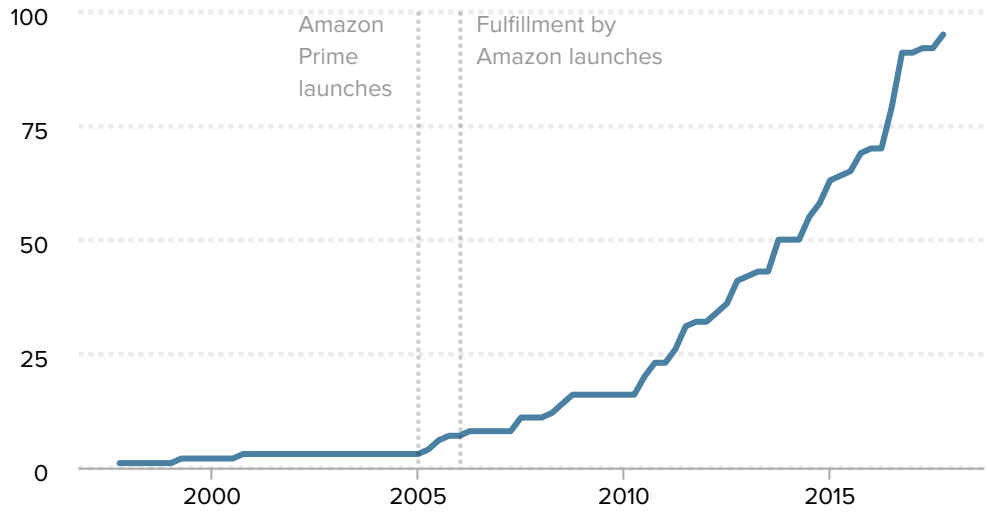
In 2017, these centers were in 25 states across the country, from California to New Hampshire. According to consulting firm MWPVL International, fulfillment centers account for over three-quarters of the square footage of Amazon's entire distribution infrastructure.[10] (In addition to fulfillment centers, Amazon operates sortation centers that handle only already-packaged goods.)

Because these openings are spread widely across geography and time, they provide a potentially powerful statistical tool to assess their effect on regional employment growth. Creating more jobs is a key reason why state and local governments often try to entice

Figure A

Total number of Amazon fulfillment centers

Cumulative openings, 1997—2017



Source: Fulfillment center opening dates compiled from Avalara ("Amazon Fulfillment Center Locations," accessed October 2017), Guided Imports ("The Complete List of Every Amazon Warehouse and Distribution Center in the World," last updated April 2017) and MWPVL International ("Amazon Global Fulfillment Center Network," accessed October 2017).

Economic Policy Institute

firms to open operations in their regions, and the history of Amazon fulfillment center openings provides a very good case study of whether job creation benefits really do emerge.

Empirical methodology

In this report, we look at the effect of opening an Amazon fulfillment center in a county on that county's warehousing industry employment as well as overall private-sector employment. For fulfillment center locations and opening dates, we use the publicly downloadable database from Guided Imports, a part of Procu International LLC, a sourcing company headquartered in Shenzhen, China. This database was cross referenced with available data from Avalara, a Seattle-based company providing tax compliance advice to businesses, and consulting firm MWPVL International.[11] The sample contains all fulfillment centers listed in each of the three sources during our reference period.

For employment, we use data from the Quarterly Census of Employment and Wages (QCEW), a program of the Bureau of Labor Statistics.[12] Because it is based on employment data that state unemployment insurance programs are required to maintain, the QCEW is perhaps the best source of local area employment statistics, covering approximately 95 percent of all employment in the United States and available every quarter.

In addition to overall private-sector employment, the QCEW contains data on the

warehousing and storage industry. We limit our sample to the 1,161 counties for which we have warehousing employment information for the entire 2001–2015 period.[13] By 2015, there were 69 Amazon fulfillment centers open across the United States in a total of 45 counties. Our balanced sample of 1,161 counties includes 54 fulfillment centers in 34 counties, meaning that it applies to more than three-fourths of the known fulfilment center locations overall in 2015.

To estimate the employment effect of opening a fulfillment center, we examine whether employment rose in a county after it opens a fulfillment center, relative to employment trends in counties that did not receive a fulfillment center. We focus specifically on warehousing employment and total private-sector employment in each county. To account for population changes, we calculate county-level employment-to-population ratios for warehousing and total private-sector employment from Census Bureau estimates of county population, and we use these employment-to-population ratios as our outcomes of interest.[14]

For robustness, we also control for multiple factors that may be correlated with employment outcomes and fulfillment center openings. For example, counties that open fulfillment centers may have higher warehousing employment in general (regardless of the opening). In addition, warehousing employment and employment overall around the time of a fulfillment center opening may also be affected by national events such as a national recession, or regional or state-specific economic changes or "shocks" to local employment, due to changes in regional labor demand or specific policies that affect employment.

When we estimate the effects of opening a fulfillment center, we use a variety of specifications to control for these permanent differences in employment between counties, and to control for time-varying economic shocks that may occur when fulfillment centers are being opened. Specifically we control for national, regional, and state-specific shocks with three different statistical models: a common time fixed effects model, a Census division–specific time fixed effects model, and a state-specific time fixed effects model. All regressions also include controls for permanent differences in county employment (county fixed effects). Depending on the specification, we also control for a measure of predicted private-sector employment (based on industry shares in the 1996–2000 period), and for different employment trends among counties (county-specific linear time trends).

We also want to make sure that we account for any employment effects that take time to develop after a fulfillment center opening, and that any changes in warehousing and overall employment we see are not simply continuations of existing trends. Therefore we also include lagged indicators of openings in order to capture up to two years of lagged employment effects that may develop after an opening, and directly control for differences in employment up to two years prior to the opening of a fulfillment center.[15]

Warehousing employment is a larger share of private-sector employment in counties that opened a fulfillment center. In counties that never opened a fulfillment center, warehousing employment was about 0.5 percent of total private-sector employment. In

counties that opened a fulfillment center, county warehousing employment averaged about 1.0 percent of total private-sector employment prior to opening a center and 1.4 percent after opening a center. We use county fixed effects to control for persistent differences in the level of warehousing employment between counties that did or did not open a fulfillment center.

Results

We find that warehousing employment rises substantially in counties after an Amazon fulfillment center opens. At the same time, total private sector employment generally does not change after an Amazon fulfillment center opens. In some specifications we find that private-sector employment falls significantly after a center opens but these negative employment findings are not robust across most specifications or time periods. The increases in warehousing employment after a fulfillment center opens do not seem to generate any employment benefits beyond the warehousing and storage sector.

First we examine how warehousing employment changes after a fulfillment center opens in a county. For brevity, the top panel of **Figure B** reports, for the model using state-specific time fixed effects and county-specific linear trends, the cumulative percent change in warehousing employment due to the opening of a fulfillment center over a period of four years, beginning two years prior to the opening and continuing through two years after the opening. **Appendix Figure A** reports the cumulative change in warehousing employment for three models: the top panel controls for common national shocks, the middle panel controls for Census division–specific time shocks, and the bottom panel controls for state-and-time-specific shocks. All of the models in the appendix figures (A, showing warehousing employment, and B, showing overall employment) control for county fixed effects and county-specific linear time trends.

The solid line in Figure B shows our estimate of the cumulative effect of Amazon fulfillment center openings, with the shaded area around this solid line showing the 95 percent confidence interval of this estimate (The confidence interval reflects our uncertainty around this estimate: we cannot statistically distinguish the estimate in the solid line from any estimate between the two dotted lines forming the confidence interval). This solid line shows that warehousing employment is relatively flat in the two years prior to the opening of a fulfillment center—the solid line is close to zero and zero is always included in the confidence interval. This is obviously reassuring, as it would be odd to pick up an effect of fulfillment centers on employment before they were constructed. However, we show the two years prior precisely to insure we're not merely attributing the effect of a preexisting trend to the opening of a fulfillment center.

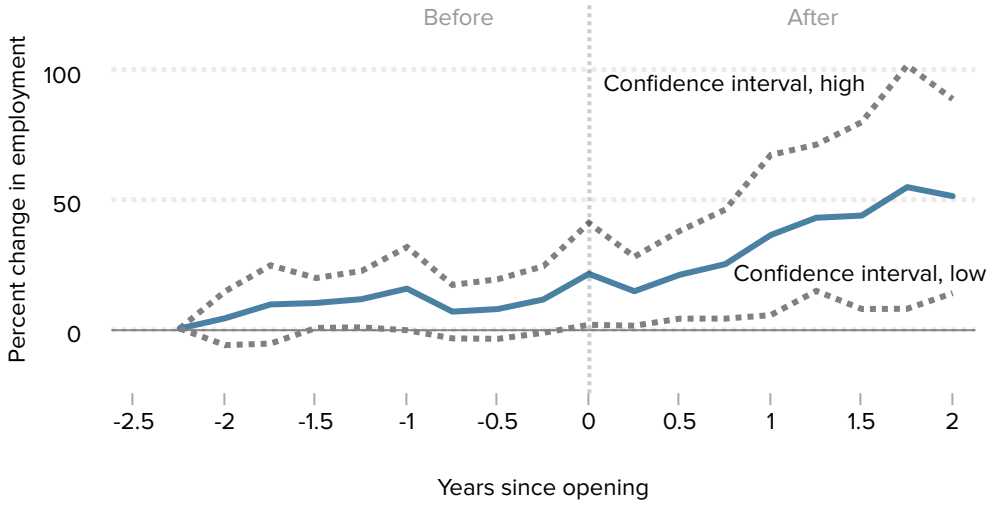
At the time of a fulfillment center opening (t=0), warehousing employment begins to grow substantially. The solid line pulls up from zero, and zero is generally no longer part of the confidence interval.

Averaging the findings from our three specifications, we find that by two years after an opening, county warehousing employment has grown by more than 30 percent. Based on

Figure B

Amazon fulfillment centers increase county warehousing employment

Change in county warehousing employment before and after opening an Amazon fulfillment center, using state-specific time fixed effects model



Notes: Cumulative employment effects are from a regression of warehousing county employment per capita on leads and lags of a count of fulfillment centers in that county, in which the other controls are county fixed effects, state-specific time fixed effects, and county-specific linear time trends. See the Appendix for results from other specifications. Regressions are weighted by mean county population, standard errors are clustered at the county level, and the figure shows 95 percent confidence intervals. We convert the marginal effects and standard errors into percent changes in employment by dividing coefficients by the sample mean employment-to-population ratio.

Sources: Authors' calculations from Quarterly Census of Employment and Wages employment data, Census population counts, and fulfillment center openings data described in the text.

Economic Policy Institute

average warehousing employment in counties before they open an Amazon fulfillment center, that percentage growth in employment translates to an addition of roughly 1,300 jobs in the warehousing sector. This large gain in warehousing employment seems plausible given that our source data indicate that several fulfillment centers employ 1,000 or more workers.[16]

Theoretically, Amazon could open a fulfillment center in a county without increasing warehousing employment in the county. For example, the new fulfillment center may simply replace other warehouses that have gone out of business. However, if we had found no effect of fulfillment centers on warehousing employment over all counties we analyzed, it would have meant either that this sort of displacement effect was occurring, or that the statistical tools we are using are simply incapable of capturing the economic effect of opening a fulfillment center. Given the latter possibility, it is reassuring that we find growth in warehousing employment after an opening, as this provides additional confidence that our statistical tools are able to identify a clear signal from these openings.

We also investigated how a fulfillment center opening affected the earnings of

warehousing workers, but we found an opening led to little to no change in these workers' average wages. Estimates varied depending on the specification, but for the most credible specifications that had the smallest preexisting trends (using county-specific linear time trends) the effect of Amazon on warehousing workers' earnings ranged from negative 1.7 percent to positive 0.5 percent (**Appendix Table 1** shows the results for all specifications). None of these preferred estimates was distinguishable from zero at conventional levels of statistical significance.

These results differ from the findings reported in *The Economist*, which found that the earnings of warehousing workers rose prior to the opening of a fulfillment center and fell afterward, and that warehousing workers in counties with fulfillment centers in December 2017 earned 10 percent less than warehousing workers in counties without centers.[17]

While both our study and the analysis in *The Economist* investigate what happened to employment and wages in counties that opened fulfillment centers, our study actually estimates the counterfactual outcome of what would have happened to the labor market in counties with an Amazon presence had Amazon not opened a fulfillment center. We do this by controlling for economic factors (like regional economic shocks or different wage trends among counties) that may affect wage trends in counties that opened a fulfillment center even if that county had never opened a fulfillment center. For this reason, the *Economist*'s figure simply comparing wages between counties with and without fulfillment centers in December 2017 does not definitively show the effect of opening fulfillment centers.

For example, many of the counties that had fulfillment centers in December 2017 may have only had them for a short time, and may even have seen different wage growth trends in the periods before attracting Amazon warehouses. We account more precisely for these preexisting differences by using the precise timing of a fulfillment center opening, comparing outcomes in counties with and without fulfillment centers around the time of an opening, and by accounting for regional shocks and county-specific trends, as described in the "Empirical methodology" section. The limited wage effect we find in our analysis suggests that some of the wage differences found by *The Economist* would have occurred regardless of the opening of a fulfillment center.

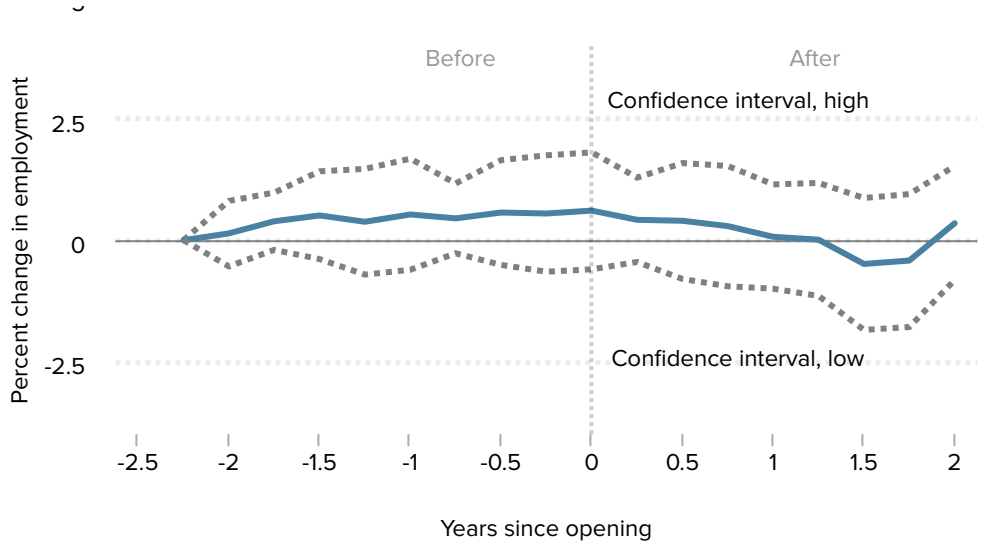
Additionally, both our wage analysis and the analysis conducted by *The Economist* use wage data based on total quarterly earnings per worker, as opposed to hourly wages. Our estimates are consistent with reports that Amazon fulfillment centers reduce the hourly wages of warehousing workers, if these employees earning lower hourly wages were to work longer hours, producing a minimal net effect on total quarterly earnings per worker.[18]

Although we find consistent evidence that fulfillment centers lead to substantial gains in warehousing employment, the new centers do not clearly increase total private-sector employment in the county, as shown in **Figure C**. Instead, after the fulfillment center opens, private-sector employment remains at relatively the same level, with none of the changes in employment statistically distinguishable from no change in employment at all. Appendix Figure B reports the cumulative change in private-sector employment for three models: the top panel controls for common national shocks, the middle panel controls for

Figure C

Amazon fulfillment centers do not increase overall county employment

Change in overall county employment before and after opening an Amazon fulfillment center, using state-specific time fixed effects model



Notes: Cumulative employment effects are from a regression of county private-sector employment per capita on leads and lags of a count of fulfillment centers in that county, in which the other controls are county fixed effects, state-specific time fixed effects, and county-specific linear time trends. See the Appendix for results from other specifications. Regressions are weighted by mean county population, standard errors are clustered at the county level, and the figure shows 95 percent confidence intervals. We convert the marginal effects and standard errors into percent changes in employment by dividing coefficients by the sample mean employment-to-population ratio.

Sources: Authors' calculations from Quarterly Census of Employment and Wages employment data, Census population counts, and fulfillment center openings data described in the text.

Economic Policy Institute

Census division–specific time shocks, and the bottom panel controls for state-specific time shocks. All of the models in **Appendix Figure B** show similar results.

In general, we do not find any evidence that the warehousing employment gains a county experiences after an Amazon fulfillment center opens translate into economically meaningful increases in the total number of jobs in the overall private sector.

One concern with the timing of the estimates in Figure B and the appendix figures is that total private-sector employment is already abnormally high in counties about to open a fulfillment center, relative to areas where fulfillment centers are not about to open.

We adopt three strategies to account for this potential problem and report the results in **Table 1** and **Appendix Table 2**. First, instead of just the three models we discussed above, we examine a total of nine statistical models, which differ depending on whether they control for common national, Census division-specific, or state-specific time shocks; whether they include a control for industry-share predicted employment; and whether they include county-specific linear time trends. Second, for robustness and in case employment

Table 1

Change in county private-sector employment before and after opening an Amazon fulfillment center

Percent employment changes in the two years before and the two years after an opening

	2001–2015 sample			2008–2015 sample		
	(1)	(2)	(3)	(4)	(5)	(6)
Cumulative percent change two years before the opening	**0.1%**	**0.4%**	**0.4%**	**0.3%**	**0.0%**	**0.0%**
	(0.4%)	*(0.6%)*	*(0.5%)*	*(0.3%)*	*(0.3%)*	*(0.3%)*
Cumulative percent change two years after the opening	**-1.4%*****	**-1.3%*****	**-0.2%**	**-0.0%**	**0.2%**	**0.3%**
	(0.4%)	*(0.5%)*	*(0.4%)*	*(0.4%)*	*(0.4%)*	*(0.4%)*
Controls						
County fixed effects	Y	Y	Y	Y	Y	Y
Common time fixed effects	Y	Y				
Division-specific time fixed effects			Y	Y		
State-specific time fixed effects					Y	Y
Predicted employment	Y					Y
County-specific linear time trends		Y	Y			

Notes: This table shows the three models from the 2001–2015 and 2008–2015 sample periods that have the smallest pre-treatment effects. The results from all models are shown in Appendix Table 2. Each column shows cumulative employment effects in the pre-opening or post-opening time period from a regression of county private-sector employment per capita on leads and lags of a count of fulfillment centers in that county as well as county fixed effects. Other controls are indicated at the bottom of the table. See the Appendix for results from other specifications. Regressions are weighted by mean county population, standard errors are clustered at the county level, and the figure shows 95 percent confidence intervals. We convert the marginal effects and standard errors into percent changes in employment by dividing coefficients by the sample mean employment-to-population ratio.

Sources: Authors' calculations from Quarterly Census of Employment and Wages employment data, Census population counts, and fulfillment center openings data described in the text.

Economic Policy Institute

trends changed dramatically in some areas after the recession beginning in 2008, we present results for both the full 2001–2015 time period, as well as the 2008–2015 period. Third, we directly control for preexisting trends by subtracting them from the cumulative effect of the fulfillment center opening; and in **Table 1**, we present the three models for each sample for which the preexisting trend was smallest in magnitude. (Appendix Table 2 shows the results for all models.)

Overall we continue to fail to find robust evidence that fulfillment centers increase private-sector employment. This lack of increase in overall employment may be due to such a small increase that it is not accounted for, or that there is a shift away from other jobs outside of warehousing as these non-warehousing jobs are displaced by the introduction

of a fulfillment center. Reassuringly, the first row of Table 1 shows that for our selection of best-performing models, we do not find significant preexisting trends in employment prior to a county opening a fulfillment center. The second row shows the cumulative effects of opening a fulfillment center on private-sector employment, and we confirm that there is no significant evidence that private-sector employment rises after an opening. The lack of a significant positive employment response is true in both the full 2001–2015 time period and the shorter 2008–2015 period.

Conclusion

State and local governments have many tools and strategies to spur economic growth. One tool proven particularly effective by research is public investment that increases the efficiency and attractiveness of local amenities such as transportation and the quality of local education. Public investment opportunities are obviously curtailed if state and local governments willingly forfeit revenue in the name of attracting businesses. Given this sharp trade-off with public goods provision, the benefits of tax incentives should be *exceedingly* strong to be pursued as good development policy. So far, the best research has not identified such strong benefits.

This paper bolsters these findings for the most politically salient economic indicators used to assess state and local development policies: the total number of jobs in a locality. We use a high-quality dataset that provides cross-locale variation to assess the effect of opening an Amazon fulfillment center on county-level employment. We find that opening an Amazon fulfillment center does lead to gains in warehouse jobs in a county, but does not lead to gains in overall county-level employment. These findings are consistent with theories arguing that luring establishments from existing national employers to a particular locale may just displace incumbent jobs. This seems to add evidence to an already-strong research base indicating that the zero-sum strategy of attracting existing employers away from other regions does not guarantee good economic outcomes.

It is this lack of broader development benefits that has led to many advocacy organizations, including Good Jobs First, to call for "turning the tables." Specifically, they argue that firms themselves, not taxpayers, should foot the bill of locating in a community and beginning to draw on the community's infrastructure. Instead of committing to giving away public funds to attract existing employers from other regions in a zero-sum contest, communities should demand concrete actions that ensure that an employer's arrival will make their region a more prosperous place—or that at least offset some of the harms the arrival could create.

Good Jobs First lays out what such concrete demonstrations from Amazon (and by extension other employers) could include: an impact fee to offset lost tax revenues if existing retailers lose business or close and a Community Benefits Agreement (CBA) that ensures a range of benefits. The CBA could require that the employer provide jobs with living wages and benefits, hire disadvantaged workers, evaluate the environmental impact of the facility, and provide other benefits.[19] Good Jobs First has also weighed in on what Amazon should offer to cities bidding to become the home of Amazon's next

headquarters. In an open letter, Good Jobs First calls on Amazon president Jeff Bezos to provide affordable housing supports, transit investments, and a commitment to strengthen small business.[20]

Appendix

Update as of March 1, 2018: Since we ran our original analysis, additional data on fulfillment center openings has become available. Using the same analysis with updated data confirms our previous findings that fulfillment center openings in a county do not significantly add to overall private sector employment in that area. Details of our analysis of the updated data are described below.

As of February 28, 2018, the list of MWPVL fulfillment center openings contains some openings that we did not include in our original estimates.[21] The openings data we use in the original study indicate 69, 91, and 95 fulfillment center openings by the end of 2015, 2016, and 2017, respectively. After we incorporate all additional fulfillment center openings reported in the updated MWPVL data that contained quarterly or monthly dates of opening, the number of fulfillment center openings increases to 75, 100, and 120 openings by 2015, 2016, and 2017, respectively.

These additional openings do not meaningfully affect our results. Using nine models over two sample periods, for a total of 18 specifications, we previously found that a fulfillment center opening affected total private-sector employment by somewhere between -1.5 percent and +0.3 percent (see Appendix Table 2). Running the same analysis but with the new, updated data, we find that the effect on private-sector employment ranges between -1.4 percent and +0.2 percent. In both cases, most results are not statistically distinguishable from zero. In no case do we find positive overall employment effects that are statistically significant.

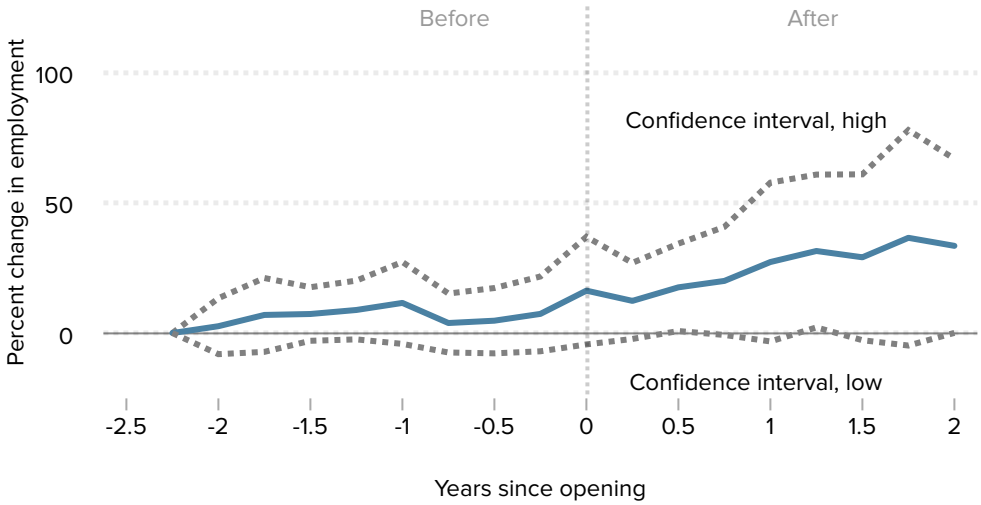
The current paper and the appendix tables and figures continue to report the estimates that we originally published.

Appendix Figure A

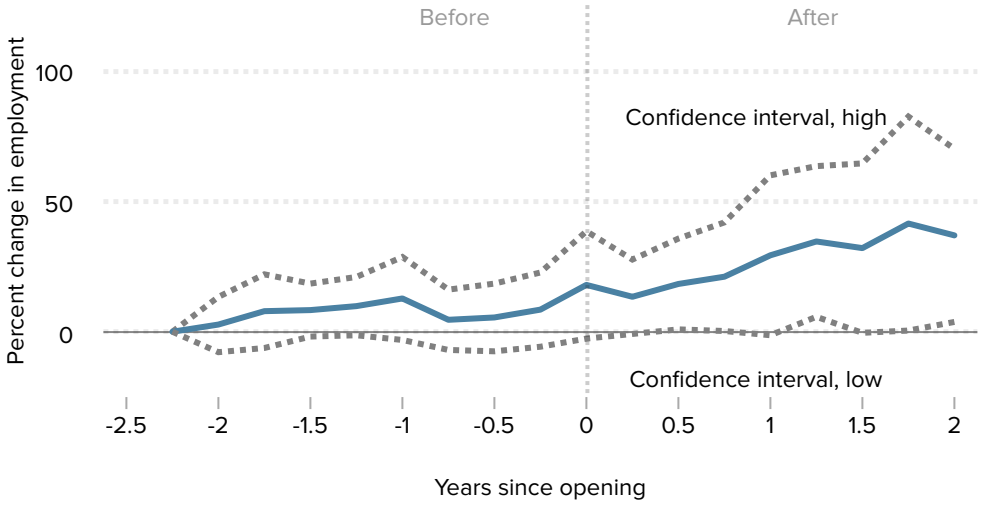
Effect of opening an Amazon fulfillment center on county warehousing employment

Percent change in employment two years before and after the opening

Common time fixed effects

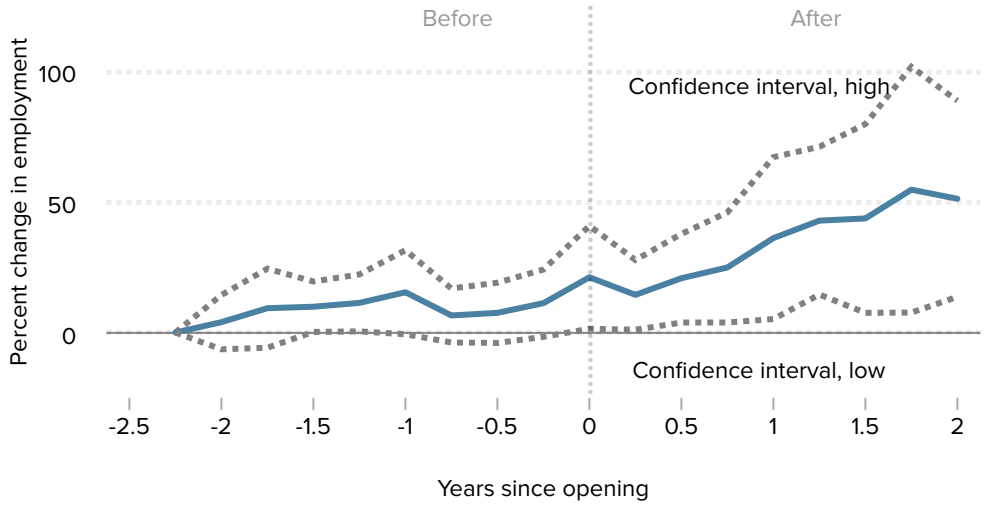


Division-specific time fixed effects



Appendix Figure A (cont.)

State-specific fixed effects



Notes: Cumulative employment effects are from a regression of county warehousing employment per capita on leads and lags of a count of fulfillment centers in that county as well as county fixed effects and county-specific linear time trends. The top, middle, and bottom panels, respectively, show specifications with common, Census division–specific, and state-specific time fixed effects. See the Appendix tables for results from other specifications. Regressions are weighted by mean county population, standard errors are clustered at the county level, and the figure shows 95 percent confidence intervals. We convert the marginal effects and standard errors into percent changes in employment by dividing coefficients by the sample mean employment-to-population ratio.

Sources: Authors' calculations from Quarterly Census of Employment and Wages employment data, Census population counts, and fulfillment center openings data described in the text.

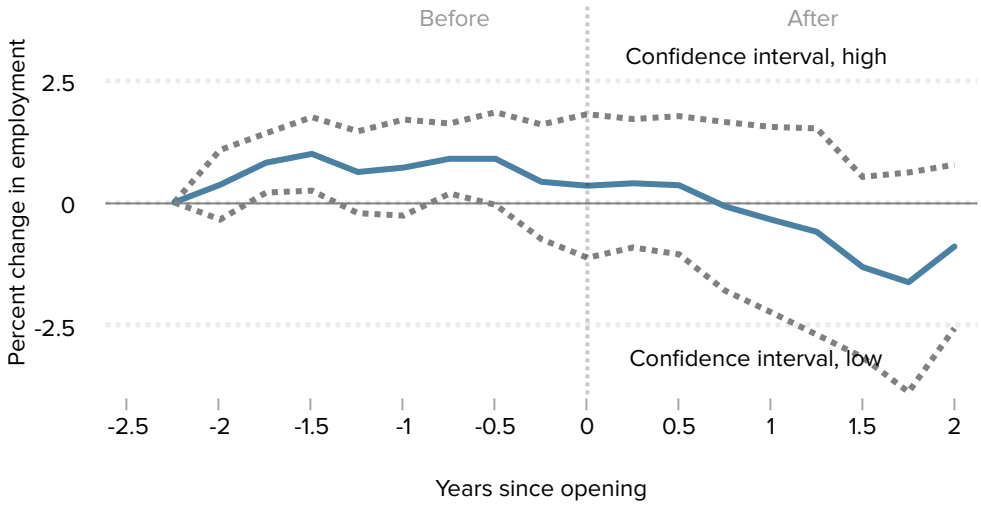
Economic Policy Institute

Appendix
Figure B

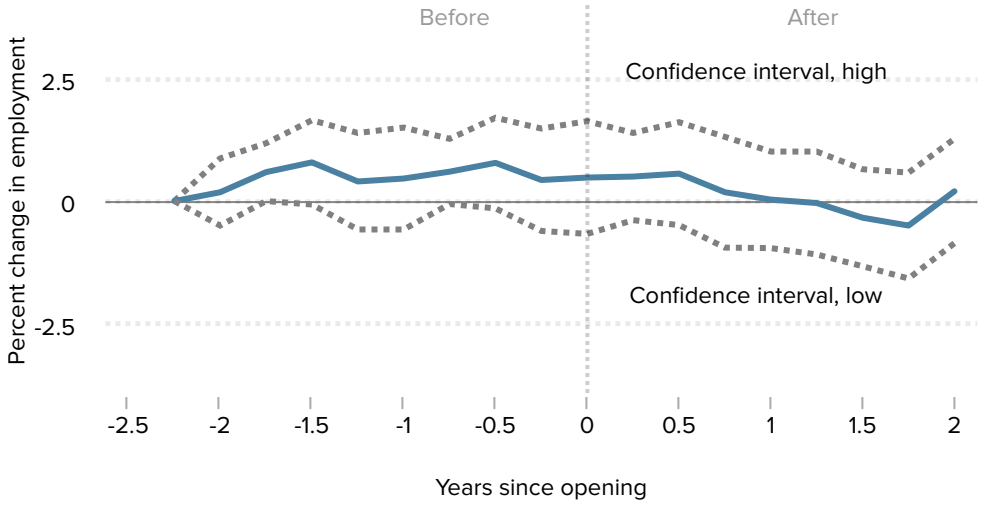
Effect of opening an Amazon fulfillment center on county private-sector employment

Percent change in employment two years before and after the opening

Common time effects

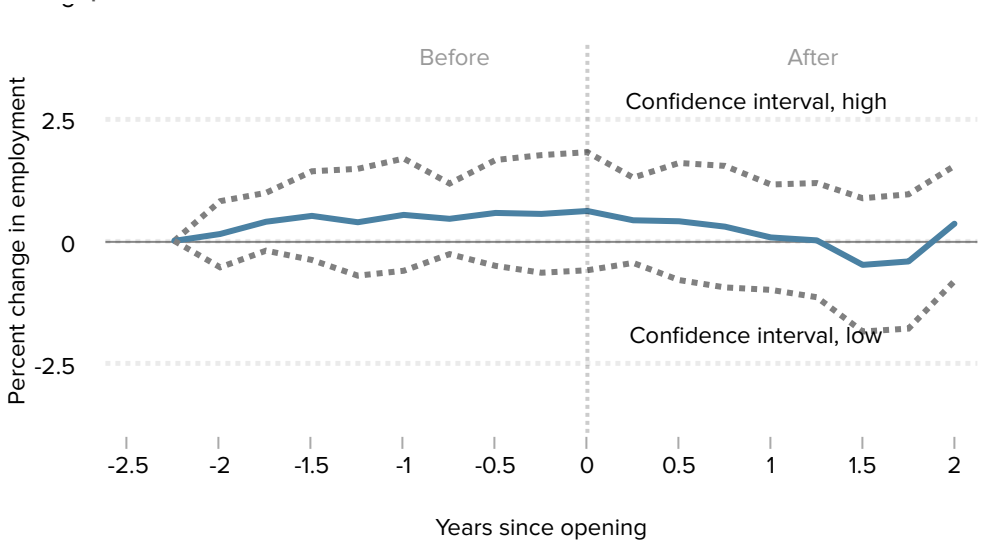


Division-specific time fixed effects



Appendix Figure B (cont.)

State-specific time fixed effects



Notes: Cumulative employment effects are from a regression of county private-sector employment per capita on leads and lags of a count of fulfillment centers in that county as well as county fixed effects and county-specific linear time trends. The top, middle, and bottom panels, respectively, show specifications with common, Census division–specific, and state-specific time fixed effects. See the Appendix tables for results from other specifications. Regressions are weighted by mean county population, standard errors are clustered at the county level, and the figure shows 95 percent confidence intervals. We convert the marginal effects and standard errors into percent changes in employment by dividing coefficients by the sample mean employment-to-population ratio.

Sources: Authors' calculations from Quarterly Census of Employment and Wages employment data, Census population counts, and fulfillment center openings data described in the text.

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Appendix Table 1

Change in county warehousing earnings before and after opening an Amazon fulfillment center

Percent earnings changes in the two years before and the two years after an opening

	Common time fixed effects			Division-specific fixed effects			State-specific time fixed effects		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2001–2015									
Cumulative percent change two years before the opening	-3.1%***	-3.2%***	-0.5%	-3.3%**	-3.4%**	-0.0%	-4.0%***	-4.2%***	-0.3%
	(1.1%)	*(1.1%)*	*(1.2%)*	*(1.4%)*	*(1.4%)*	*(1.4%)*	*(1.2%)*	*(1.2%)*	*(1.6%)*
Cumulative percent change two years after the opening	-1.0%	-1.1%	-1.4%	2.5%	2.5%	-0.9%	5.8%***	5.5%**	-1.7%
	(1.1%)	*(1.0%)*	*(1.4%)*	*(1.7%)*	*(1.7%)*	*(1.5%)*	*(2.1%)*	*(2.1%)*	*(1.9%)*
2008–2015									
Cumulative percent change two years before the opening	-2.4%*	-2.5%*	-1.3%	-2.9%**	-2.8%**	-0.9%	-3.1%**	-3.0%**	-0.8%
	(1.3%)	*(1.3%)*	*(1.5%)*	*(1.3%)*	*(1.3%)*	*(1.6%)*	*(1.3%)*	*(1.4%)*	*(2.0%)*
Cumulative percent change two years after the opening	-1.8%*	-2.0%**	-1.4%	0.7%	0.7%	0.4%	3.0%	2.7%	0.5%
	(1.0%)	*(1.0%)*	*(1.5%)*	*(1.5%)*	*(1.5%)*	*(1.8%)*	*(2.3%)*	*(2.3%)*	*(1.5%)*
Controls									
County fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Predicted employment		Y			Y			Y	
County-specific linear time trends			Y			Y			Y

Notes: Each column shows cumulative earnings effects in the pre-opening or post-opening time period from a regression of county warehousing quarterly earnings per worker on leads and lags of a count of fulfillment centers in that county as well as county fixed effects. Other controls are indicated at the bottom of the table. Regressions are weighted by mean county population, standard errors are clustered at the county level, and the figure shows 95 percent confidence intervals. We convert the marginal effects and standard errors into percent

Appendix Table 1 (cont.)

changes in earnings by dividing coefficients by the sample mean quarterly earnings per worker.

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Appendix Table 2

Change in county private-sector employment before and after opening an Amazon fulfillment center

Percent change in employment two years before and after opening

	Common time fixed effects			Division-specific fixed effects			State-specific time fixed effects		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2001–2015									
Cumulative percent change two years before the opening	-0.5%	0.1%	0.4%	-0.8%*	-0.5%	0.4%	-0.8%*	-0.6%	0.5%
	(0.4%)	*(0.4%)*	*(0.6%)*	*(0.4%)*	*(0.3%)*	*(0.5%)*	*(0.5%)*	*(0.4%)*	*(0.6%)*
Cumulative percent change two years after the opening	-1.5%***	-1.4%***	-1.3%***	-0.2%	-0.0%	-0.2%	-0.4%	0.1%	-0.2%
	(0.5%)	*(0.4%)*	*(0.5%)*	*(0.5%)*	*(0.4%)*	*(0.4%)*	*(0.5%)*	*(0.5%)*	*(0.5%)*
2008–2015									
Cumulative percent change two years before the opening	0.7%*	0.7%**	0.9%	0.3%	0.3%	0.9%	0.0%	0.0%	0.7%
	(0.4%)	*(0.4%)*	*(0.7%)*	*(0.3%)*	*(0.3%)*	*(0.6%)*	*(0.3%)*	*(0.3%)*	*(0.7%)*
Cumulative percent change two years after the opening	-1.1%***	-1.1**	-0.8%	-0.0%	-0.0%	-0.2%	0.2%	0.3%	-0.2%
	(0.4%)	*(0.4%)*	*(0.9%)*	*(0.4%)*	*(0.4%)*	*(0.6%)*	*(0.4%)*	*(0.4%)*	*(0.7%)*
Controls									
County fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Predicted employment		Y			Y			Y	
County-specific linear time trends			Y			Y			Y

Notes: Each column shows cumulative employment effects in the pre-opening or post-opening time period from a regression of county private-sector employment per capita on leads and lags of a count of fulfillment centers in that county as well as county fixed effects. Other controls are indicated at the bottom of the table. Regressions are weighted by mean county population, standard errors are clustered at the county level, and the figure shows 95 percent confidence intervals. We convert the marginal effects and standard errors into percent changes in employment by dividing coefficients by the sample mean employment-to-population ratio.

Appendix Table 2 (cont.)

Sources: Authors' calculations from Quarterly Census of Employment and Wages employment data, Census population counts, and fulfillment center openings data described in the text.

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Appendix Table 3

Amazon fulfillment centers by state and county

State	County	Year opened
Arizona	Maricopa County	Third quarter 2007
Arizona	Maricopa County	Second quarter 2008
Arizona	Maricopa County	Fourth quarter 2010
Arizona	Maricopa County	Third quarter 2011
California	Riverside County	Third quarter 2014
California	Riverside County	Third quarter 2014
California	Riverside County	Fourth quarter 2016
California	San Bernardino County	Fourth quarter 2012
California	San Bernardino County	Fourth quarter 2014
California	San Bernardino County	Third quarter 2016
California	San Bernardino County	Fourth quarter 2015
California	San Joaquin County	Fourth quarter 2013
California	San Joaquin County	Fourth quarter 2016
California	San Joaquin County	Fourth quarter 2013
California	Stanislaus County	Fourth quarter 2013
Connecticut	Hartford County	Second quarter 2015
Delaware	New Castle County	Fourth quarter 1997
Delaware	New Castle County	Fourth quarter 2012
Florida	Duval County	Fourth quarter 2017
Florida	Hillsborough County	Fourth quarter 2014
Florida	Miami-Dade County	Fourth quarter 2017
Florida	Polk County	Third quarter 2014
Georgia	Douglas County	Fourth quarter 2015
Georgia	Fulton County	First quarter 2015
Georgia	Jackson County	Fourth quarter 2016
Illinois	Madison County	Third quarter 2016
Illinois	Madison County	Third quarter 2016
Illinois	Will County	Fourth quarter 2015
Illinois	Will County	Fourth quarter 2016
Illinois	Will County	Fourth quarter 2016
Illinois	Will County	Fourth quarter 2017
Indiana	Boone County	Third quarter 2008

Appendix Table 3 (cont.)

State	County	Year opened
Indiana	Boone County	Fourth quarter 2013
Indiana	Clark County	Fourth quarter 2012
Indiana	Hendricks County	Fourth quarter 2008
Indiana	Hendricks County	Third quarter 2011
Indiana	Marion County	Second quarter 2011
Indiana	Marion County	Third quarter 2016
Kansas	Johnson County	Fourth quarter 2016
Kansas	Johnson County	Fourth quarter 2016
Kentucky	Boone County	Third quarter 2015
Kentucky	Boone County	Second quarter 2005
Kentucky	Boone County	Fourth quarter 2005
Kentucky	Boone County	Third quarter 2007
Kentucky	Bullitt County	Third quarter 2005
Kentucky	Bullitt County	Second quarter 2012
Kentucky	Bullitt County	Second quarter 2012
Kentucky	Bullitt County	Fourth quarter 2013
Kentucky	Fayette County	Fourth quarter 2000
Kentucky	Fayette County	Second quarter 2006
Kentucky	Jefferson County	Third quarter 2005
Kentucky	Taylor County	Second quarter 1999
Maryland	Baltimore County	First quarter 2015
Massachusetts	Bristol County	Fourth quarter 2016
Michigan	Wayne County	Fourth quarter 2014
Minnesota	Scott County	Third quarter 2016
Nevada	Clark County	Fourth quarter 2008
Nevada	Storey County	Fourth quarter 2010
Nevada	Washoe County	First quarter 2015
New Hampshire	Hillsborough County	Third quarter 2007
New Jersey	Burlington County	Third quarter 2016
New Jersey	Mercer County	Third quarter 2014
North Carolina	Mecklenburg County	Fourth quarter 2016
Ohio	Franklin County	Third quarter 2016
Ohio	Licking County	Third quarter 2016
Pennsylvania	Cumberland County	Third quarter 2010

Appendix Table 3 (cont.)

State	County	Year opened
Pennsylvania	Cumberland County	Third quarter 2010
Pennsylvania	Cumberland County	Second quarter 2013
Pennsylvania	Cumberland County	First quarter 2015
Pennsylvania	Lackawanna County	Fourth quarter 2010
Pennsylvania	Lehigh County	Third quarter 2010
Pennsylvania	Lehigh County	Second quarter 2011
Pennsylvania	Luzerne County	Third quarter 2008
Pennsylvania	Luzerne County	Fourth quarter 2016
Pennsylvania	Northampton County	Fourth quarter 2016
Pennsylvania	York County	Third quarter 2010
South Carolina	Lexington County	Fourth quarter 2011
South Carolina	Lexington County	Second quarter 2017
South Carolina	Spartanburg County	Third quarter 2012
Tennessee	Bradley County	Third quarter 2011
Tennessee	Hamilton County	Third quarter 2011
Tennessee	Rutherford County	Third quarter 2012
Tennessee	Wilson County	Third quarter 2011
Tennessee	Wilson County	First quarter 2013
Texas	Dallas County	Fourth quarter 2015
Texas	Dallas County	Fourth quarter 2016
Texas	Denton County	Fourth quarter 2013
Texas	Hays County	Third quarter 2016
Texas	Tarrant County	Fourth quarter 2013
Texas	Tarrant County	Third quarter 2014
Virginia	Chesterfield County	Fourth quarter 2012
Virginia	Dinwiddie County	Fourth quarter 2012
Washington	King County	First quarter 2016
Washington	Pierce County	Second quarter 2011
Washington	Pierce County	First quarter 2015

Source: Avalara ("Amazon Fulfillment Center Locations," accessed October 2017), Guided Imports ("The Complete List of Every Amazon Warehouse and Distribution Center in the World," last updated April 2017) and MWPVL International ("Amazon Global Fulfillment Center Network," accessed October 2017).

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Endnotes

1. A December 2016 report from Good Jobs First counts "at least $241 million in subsidies to Amazon facilities" since the start of 2015 on top of "some $600 million in subsidies during the previous decade, a substantial portion of which was tied to deals involving sales tax collection." And "there are likely more subsidies that can't be quantified here due to lack of disclosure," the report said. A March 2017 article in *Bloomberg Daily Tax Report* said that Amazon "is expected to vault past a record for state and local tax subsidies held for many years by Wal-Mart Stores Inc." which has "captured more than $1.2 billion in tax abatements, credits, exemptions, infrastructure assistance and financing deals during four decades of rapid expansion." See Thomas Cafcas and Greg LeRoy, *Will Amazon Fool Us Twice? Why State and Local Governments Should Stop Subsidizing the Online Giant's Growing Distribution Network*, Good Jobs First, December 2016 and Michael J. Bologna, "Amazon Close to Breaking Wal-Mart Record for Subsidies," *Bloomberg Daily Tax Report*, March 20, 2017.

2. Jessica Bruder, "With 6,000 New Warehouse Jobs, What Is Amazon Really Delivering?" Reuters, June 17, 2015; Chris Isidore, "Amazon Hiring 7,000 Workers" *CNN Money*, July 29, 2013; "We're Hiring: Amazon Creating 120,000 Seasonal Jobs in Customer Fulfillment and Customer Service This Holiday Season," Amazon Press Release, October 13, 2016; "Amazon Announces Ninth Fulfillment Center in Texas; New Robotics Site Will Create 1,000-Plus Full-Time Jobs," Amazon Press Release, January 18, 2017.

3. See Brian Fung, "Amazon Releases List of Metro Areas Being Considered for Its Second HQ," *The Washington Post*, January 18, 2018, which links to the District of Columbia bidding proposal.

4. *Los Angeles Times* Editorial Board, "Do Tax Incentives Really Create Jobs?" *Los Angeles Times*, September 10, 2014; Carl Davis, *Tax Incentives: Costly for States, Drag on the Nation*, Institute on Taxation and Economic Policy, 2013; David Seiden, "Do State Tax Incentives Really Work?" *Huffpost*, November 22, 2013. For the pro and con debate about Amazon specifically see Mark Vandevelde, "Amazon Is Creating More Jobs than It Destroys," *Financial Times*, July 29, 2017, and Jon Swartz, "Amazon Is Creating 100,000 U.S. Jobs, But at What Cost?" *USA TODAY*, January 13, 2017.

5. Robert G. Lynch, *Rethinking Growth Strategies: How State and Local Taxes and Services Affect Economic Development*. Economic Policy Institute, 2004.

6. Davis, *Tax Incentives*, 2013.

7. Lynch, *Rethinking Growth Strategies*, 2004.

8. Lynch, 2004 and Timothy J. Bartik, *The Economic Development Benefits of Universal Preschool Education Compared to Traditional Economic Development Programs*, W.E. Upjohn Institute for Employment Research, 2006. Recent research also finds state economic development incentives have little correlation with unemployment levels, income levels, or future economic growth. See Timothy J. Bartik, *A New Panel Database on Business Incentives for Economic Development Offered by State and Local Governments in the United States*, W.E. Upjohn Institute for Employment Research, 2017.

9. Our data on Amazon fulfillment centers comes from publically available sources described in the "Empirical methodology" section.

10. Estimates from MWPVL tabulations find that fulfillment centers account for 92.8 million out of 121.6 million square feet in Amazon's distribution network. See "Amazon Global Fulfillment Center Network," MWPVL, updated January 2018.

11. See "Amazon Fulfillment Center Locations," Avalara TrustFile, accessed October 2017; "The Complete List of Every Amazon Warehouse and Distribution Center in the World," [downloadable Excel files], Guided Imports, last updated April 2017; MWPVL International, http://www.mwpvl.com/html/amazon_com.html, accessed October 2017.

12. QCEW data are available at https://www.bls.gov/cew/datatoc.htm.

13. The public-use QCEW data suppresses some county-industry-level aggregations in order to protect employer identities. Our sample begins in 2001 because prior to that date it is not possible to distinguish between whether county-industry employment was truly zero or suppressed. Our sample ends in 2015 because our regressions specifications require two years of data after fulfillment center openings, and openings data were only available through 2017 when we conducted our analyses. We identify the warehousing industry as NAICS (North American Industry Classification System of the Census Bureau) 493. QCEW data are available at https://www.bls.gov/cew/datatoc.htm.

14. County population data that we accessed are available at United States Census Bureau, "County Population Totals and Components of Change: 2010–2016," [online data tables] and https://www2.census.gov/programs-surveys/popest/tables/2000-2010/intercensal/county/

15. We regress the industry-level employment-per-capita on an indicator for presence of a fulfillment center in that quarter. In addition to the contemporaneous fulfillment center indicator, we include eight quarters of leads and eight quarters of lags of the indicator. All regressions include county fixed effects. In the table and some of the figures described in the text, we include several additional controls, depending on the specification: common time fixed effects, Census division–specific time fixed effects, or state-specific time fixed effects; a predicted employment-to-population ratio; and county-specific linear trends. For specifications with a control for predicted employment-to-population, predicted employment is an industrial shift-share prediction from the sum of mean 1996–2000 county-level 3-digit NAICS shares of national employment multiplied by contemporaneous national industry-level employment. All regressions are weighted by the mean population in the county and standard errors are clustered at the county level. We convert the percentage-point employment-to-population ratio marginal effect and standard errors into a percent change in employment by dividing coefficients by the sample mean employment-to-population ratio.

16. For the three specifications shown in Appendix Figure A, the average cumulative effect over the two-year post-treatment period is 26.0, 28.4, and 40.0 percent (these values are the difference between the cumulative effect in the post-treatment period minus the pre-treatment period). A simple average of these estimates is a 31.5 percent increase in warehousing employment growth. The average warehousing employment in counties that open fulfillment centers, prior to the opening, is about 4,200 jobs.

17. See *The Economist*, "Unfulfillment Centres: What Amazon Does to Wages," January 20, 2018.

18. Olivia LaVecchia and Stacy Mitchell, "Amazon's Stronghold: How the Company's Tightening Grip Is Shifting Competition, Eroding Jobs, and Threatening Communities," Institute for Local Self-Reliance, November 2016.

19. Greg LeRoy, "Memo to Politicians: Bargaining for an Amazon Warehouse? Turn the Tables!"

Bloomberg BNA *Daily Tax Report*, July 25, 2017.

20. "'Not Your Grandparents' Deal': Good Jobs First Issues Statement on Amazon HQ2 "Short List" Announcement," press release, Good Jobs First, January 19, 2018.

21. "Amazon Global Fulfillment Network," MWPVL, accessed February 28, 2018.