Effects of e-commerce on local labor markets

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Abstract

This paper studies how the expansion of e-commerce over the past decade affected labor markets. Utilizing the variation of state legislation on e-commerce sales tax collection -the Amazon Tax- which reduced out-of-state e-commerce retailers' price advantage, this paper finds declines in employment and wages in sectors complementary to e-commerce, such as warehousing and last-mile transportation. In the retail sector, there are observed declines in local employment and the number of establishments. Effects in retail are heterogeneous by sub-sector. While big box retail employment increases, other brick-and-mortar retail employment decreases. As the Amazon Tax may induce brick-and-mortar retailers to incorporate online channels, this paper analyzes changes in retail occupational structure. In non-urban areas, this paper finds an increase in the share of office and service occupations and a decrease in the share of sales and related occupations. Through a general equilibrium model, this paper finds that these results are consistent with an economy in which consumers substitute e-commerce purchases for big box purchases, which leads to the crowding out of other brick-and-mortar retail.

Keywords: E-commerce, Retail, Employment, Amazon Tax

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1 Introduction

In the last decade, the increase in the presence of online retailers (Amazon.com, eBay.com, Alibaba.com, Zappos, Newegg, Safeway, etc) has led to the rapid growth of e-commerce transactions from 4% of total sales in the first quarter of 2010 to 11% of total sales in the first quarter of 2019 in the United States.[1][2] Given that retail is a key local economic activity and that the retail workforce represents 11% of the total workforce in the US, changes in retail competition due to e-commerce growth may lead to distributional consequences on local firms and workers in retail and retail related sectors. In this sense, Gebeloff and Russell (2017), Kane and Tomer (2017) and Tomer and Kane (2021) suggest the expansion of e-commerce may harm the retail workforce, especially outside of metropolitan areas. On the other hand, Hortaçsu and Syverson (2015) casts doubt on e-commerce driving force due to its smaller size compared to Warehouse Clubs and Supercenters, while Mandel (2017) associates e-commerce with job creation and wage growth. Understanding the effects of e-commerce on local labor markets will allow us not only to predict future changes in employment but also to design policies to protect firms and workers at risk. In this paper, we evaluate the effects of e-commerce on local labor markets of related industries through the enactment of the Amazon Tax, a state legislation that reduces a price advantage for out-of-state online retailers.

The main identification challenge to evaluate the effects of e-commerce introduction in local labor markets is that e-commerce sales grow everywhere at a pace given by local economic conditions. Hence, it may not be possible to distinguish between e-commerce exposure and local economic conditions to differentiate treated and control areas. We exploit the fact that out-of-state e-commerce retailers were not required to collect sales tax, resulting in a price-advantage. Starting in 2008, state governments began pass legislation requiring sales tax collection by online retailers (the Amazon Tax), hence removing the price advantage.[3]

Using employment and establishment counts from County Business Patterns (CBP) as well as wages and occupation's employment shares from the American Community Survey (ACS), we examine the effects of the Amazon Tax enactment in four states in 2013: Maine, Minnesota, Missouri, West Virginia. We use a difference-in-differences design, exploiting the exogenous variation in the timing of enactment of the Amazon Tax to evaluate the changes in incentives for both in-state brick-and-mortar and e-commerce retailers. Since Baugh et al. (2018) shows that after Amazon Tax online sales decline, we focus on the effects on the labor market. First, we identify effects of the enactment of the Amazon Tax in employment rates and number of establishments for local retail and warehousing and transportation sectors at commuting-zone level. After the decline of online sales for out-of-state e-commerce retailers, one could expected that the demand of local sectors that complement e-commerce also declines. Hence, when looking at transportation and warehousing, a complementary sector of e-commerce, we find that after the Amazon Tax is enacted, local employment in this sector decreases on average by 35 employees per 100,000 working age population per year. The decline in employment represents a 10 percent decrease from its average pre-period mean, and it is

[1] See Figure 1

[2] Moreover, during the COVID-19 pandemic e-commerce has reach 15% of total retail sales according to the Quarterly Retail E-Commerce Sales report elaborated by the U.S. Census Bureau. This increase may be explained by both the growth of online sales and the decline of in-person sales due to state and local shut-down orders.

[3] State governments also signed voluntary collection agreements with major e-commerce retailers, like Amazon.com, Inc (Amazon) whose sales account for 50% of online retail sales by 2018 (Berg et al., 2019)

consistent with the decline of 9% in out-of-state online sales found by Baugh et al. (2018).

If consumers substitute online purchases out of state by purchasing from local brick-and-mortar retailers, one could expect that increases in sales lead to increases in local employment and the recovery of local brick-and-mortar retailers. However, if consumers reduce their total consumption as response of the increase of sales taxes, that might give local retailers the opportunity to adapt their occupational structure to start selling online. In that case, one could expect a change in the composition of employment dominating changes in the level of employment. We test both hypothesis by studying the effect of Amazon Tax on local employment. Surprisingly, we observe a decline in retail employment in commuting zones in states that enacted the Amazon Tax on average of 75 retail employees per 100,000 working age population per year compared with retail employment in commuting zones that did not enact the Amazon Tax. This decline represents more than one percent of the average retail employment in commuting zones before the year of enactment. Given that this result was unexpected, we explore the effects by sub-industry, distinguishing between big-box retailers (warehouse clubs and supercenters) and the remaining local brick-and-mortar retailers. We find a differential effect for the aforementioned sectors. After the Amazon Tax is enacted, employment in warehouse clubs and supercenters increases on average by 6 percent each year in commuting zones in treated states, while employment in other brick-and-mortar retailers decreases on average by 2 percent from its baseline pre-period mean. All observed effects on employment are driven by urban commuting zones.

We also find a small decrease in the number of establishments of a yearly average of 4 fewer establishments per 100,000 population in urban commuting zones, which represents a decline of 1 percent from the baseline mean. Moreover, we do not observe a statistically significative change in the number of establishments in the transportation and warehousing sector.

As the price advantage is removed, now retailers have incentives to reorganize their labor structure to regain market share from e-commerce retailers. One could expect that now brick-and-mortar retailers start engaging or preparing for online sales, hence they could adapt their occupational structure by reducing the share of employees in sales occupations while increasing the share of employees in service, office, professional and managerial occupations. In light of the new incentives, and following the same methodology, we evaluate possible changes in wages in both retail and retail related sectors, as well as the occupational structure of the retail sector using the American Community Survey (ACS). We find that after the Amazon Tax is enacted annual wages and hourly wages of employees in transportation and warehousing both decrease by 8%. Finally, while we do not find statistically significant changes in retail occupational shares of all commuting zones, we observe that in non-urban commuting zones the sales and related occupational share in retail decreased on average by 3 percentage points, and office and service occupational share in retail increased on average by 2 percentage points after the Amazon Tax enactment.

These results imply that when out-of-state e-commerce retailers' price advantage is reduced, last-mile transportation and warehousing employment and wages decline. Additionally, in urban commuting zones, intensified competition between warehouse clubs and supercenters and general brick-and-mortar leads to an increase in employment for warehouse clubs and supercenters and a decrease in employment for the remaining general brick-and-mortar, which results in a decline of overall retail employment. Last but not least, while the level of retail employment does not change in non-urban areas, its composition does. The increase in office and service occupations and the decline in sales and related occupations suggest that retailers could be turning to a hybrid production model, selling

both in-person and online.

To investigate the potential channels leading to the decline in retail employment, we also provide a conceptual framework. Through a four-sector general equilibrium model analysis, we find that the empirical results could be explained by consumers' decisions being more responsive to price changes than workers' and by consumers decisions being more responsive to price changes from big-box retail than from e-commerce retail when compared to brick-and-mortar retail. The first condition is derived from the relative difference in consumption preferences for different types of retail being larger than the relative difference in labor preferences for working in different retail sectors or last-mile transportation and warehousing. The second condition is derived from two separate assumptions: First, how much consumers substitute between big-box and e-commerce being bounded by how much consumers substitute between brick-and-mortar and big-box retail and how much consumers substitute between brick-and-mortar and e-commerce retail. Second, how much workers substitute between being employed at big-box and at last-mile transportation and warehousing being bounded by how much workers substitute between being employed at brick-and-mortar and at big-box retail and how much workers substitute between being employed at brick-and-mortar and at last-mile transportation and warehousing. Through the use of a general equilibrium model, we recognize which substitution patterns can predict different changes in employment, which in turn helps to identify employers and employees more likely to be affected by future growth of e-commerce. Hence, with the use of the model, once could potentially predict future unemployment patters by looking at consumption and workers preferences.

This paper contributes to a growing literature that explores the role of e-commerce in the economy with a new identification strategy. By exploiting the enactment of the Amazon Tax as source of exogenous variation, this paper evaluates how the removal of a price advantage changes incentives for both e-commerce and brick-and-mortar retailers which may lead to changes in the retail market structure. In that sense, this paper extends the literature evaluating e-commerce effects on market structure, competition, prices, entrance and exit, and spatial distribution (Goldmanis et al., 2010; Bar-isaac et al., 2012; Cavallo, 2017; Vitt, 2020; Pozzi, 2013; Wu, 2020; Fang and Policy, 2020). As this literature is mostly descriptive and theoretical, by incorporating the Amazon Tax as the identification strategy, this paper is the first to explore e-commerce causal effects.

Furthermore, this paper adds to the recent literature studying the effects of e-commerce on labor markets. By instrumenting the geographic variation in online spending with the age distribution and online penetration rates, Chun (2019) finds that increases in online spending leads to local retail employment decline. However, Chun (2019) does not take into account unobserved economic conditions that may affect online penetration rates at the same time than employment. Chava et al. (2018) finds declines in employment and wages of employees at brick-and-mortar retailers when fulfillment centers from a major e-commerce retailer are established in the same county. One major drawback of this approach is that a fulfilment center opening in a state may lead to spillover effects over neighbour counties.[4] While both Chun (2019) and Chava et al. (2018) introduce innovative strategies to evaluate e-commerce effects in employment, both strategies rely on economic retail market conditions. My contributions to this literature are twofold: First, by exploiting exogenous variation in the

[4]Spillovers may occur not only due to sales tax collection but also due to the reduction of waiting times and delivery costs for all consumers, leading to a bias in the estimations as counties considered as controls may also be affected by the treatment.

timing of the enactment of sales tax legislation, the Amazon Tax, we causally identify changes in the local labor market due to a reduction in e-commerce retailers' price advantage. Second, we extend the analysis of local labor market effects of e-commerce by exploring changes in the way retail is done, through the occupational requirement.

Lastly, this paper contributes to the literature that studies the effects of the Amazon Tax. Baugh et al. (2018) finds that the Amazon Tax reduces online sales, while Afonso (2019) shows that it increases tax revenue. Kaçamak and Wilking (2020) shows that the Amazon Tax leads to the presence of a pass-through to consumers as well as to a reduction in online expenditure. This paper is the first to evaluate the Amazon Tax effects on the local retail labor market and explore the mechanisms behind these changes with a general equilibrium model.

In the next section, we explore the institutional background regarding the changes in the retail sector and retail labor market as well as the history of the Amazon Tax. In the third section we discuss the direct and indirect channels through which e-commerce could affect local labor markets. In the fourth section, we describe the two main sources of data, CBP and ACS, define commuting zones as the unit of observation, and introduce event study difference in difference in this context. In the fifth section, we present the effects of Amazon tax on employment in retail and complementary sectors of e-commerce, distinguishing between retail subsectors and urban/non-urban areas. In the sixth section, we introduce a conceptual general equilibrium framework that investigates the potential channels leading to the observed effects. In the last section, we review how retail employers and employees are affected by e-commerce.

2 Institutional Background

2.1 The Retail Sector and the Retail Labor market

The retail industry is present in almost all local markets within United States, but it has experienced three main changes over the last thirty years.[5] First, the decline of small family owned stores due to the entrance of big-box stores has been widely studied as the "Wal-mart effect". Second, department stores have experienced a sharp decline in their number of establishments, that the media has denominated as "Retail apocalypse". Finally, the development of new technologies has made not only possible but also safe to buy online with the emergence of e-commerce retailers.

In this section we document changes in retail and in the retail labor market using data from the American Community Survey, the Annual Retail Trade Survey and the Occupational Employment and Wages Survey. The North American Industry Classification System (NAICS) identifies as e-commerce retailers as those retailers that do not have a store, perform most of their sales online, and are included into "Electronic Shopping and Mail Order Housing (NAICS 4541)". The remaining retailers, also known as brick-and-mortar retailers, may also sell online, but are classified according to their primary business activity.

Before exploring labor market outcomes, it is important to note that the retail labor market is highly responsive to changes in retail sales. Figure 2 presents e-commerce and brick-and-mortar retail trends for both employment, measured as employees in hundred thousands, and total sales, mea-

[5] According to County Business Patterns data 99.81 % of the U.S. counties had at least one retail establishment in 2003.

sured as sales in hundred thousands in 2014 us dollars. There is a high correlation between sales and employment in both sectors up to 2017.

While the origins of e-commerce can be traced to the early 1980s, it was not until the mid 1990s with the launching of the first web browsers that companies started developing e-commerce platforms. Moreover, the first e-commerce companies like Book Stacks Unlimited and Amazon.com, Inc. focused on the online book market. Figure 3 shows the share of online sales with respect to total sales for e-commerce (NAICS 4541). Online sales reach more than half of the total sales of the sector in the year 2009, reaching up to 80% in the year 2018. Not only online sales had an immense growth in the e-commerce sector, but also the share of the e-commerce sector as part of retail experienced an a substantial growth. In 2005 the Electronic Shopping and Mail-Order Houses (NAICS 4541) sector represented 5% of the total retail sales, but by 2016 e-commerce retailers represented more than 10% of total retail sales. The increasing importance of e-commerce is also observable through the growth rate of sales. Figure 1 shows that, for the period 2005-2017, the growth rate of sales of e-commerce retailers is several times the growth rate of sales of brick-and-mortar retailers.

Despite employment and sales being highly correlated for e-commerce and brick-and-mortar retailers, e-commerce retailers employ fewer employees and a different occupational structure than brick-and-mortar retailers for the same amount of sales. Figure 4 shows the number of employees per 100,000 usd in sales for both sectors for years 2010-2017. While in 2010 e-commerce retailers required 1.19 employees per 1 usd in sales, brick-and-mortar retailers required 2.98 times the number of employees that e-commerce retailers required. By the year 2017, that difference has grown to 3.48 times. Not only does e-commerce employ fewer employees in its own sector that brick-and-mortar retail as well as relies on employees from last-mile warehousing and transportation sector, but also e-commerce and brick-and-mortar retail require different types of employees. Figure 6 Panel A presents the occupational structure in retail, grouped for the main three sectors, in the year 2007 using OEWS data. Both E-commerce (NAICS 4541) and Warehouse clubs and supercenters (NAICS 4529) employ more employees from office and service occupations that general brick-and-mortar sectors.[6] However, in order to sell goods, e-commerce retailers employ less employees of sales and related occupations and requires from the last-mile transportation and warehousing sector (NAICS 49). Figure 5 shows how the growth rate of e-commerce retail sales is highly correlated to the growth rate of employment in last-mile transportation and warehousing in the period studied.

Finally, there is also evidence that the retail sector is moving to a hybrid retail model: an increase in brick-and-mortar online sales combined with changes in the retail occupational structure. First, the shares of online sales from brick-and-mortar retailers have more than double between 2005 and 2016. Even when those shares remain small, the changes preempt the COVID-19 pandemic.[7] Second, the occupational structure of the retail sector also has experienced several changes. Panel B in Figure 6 presents the changes in occupational shares for the 5 major occupational groups in retail with respect to the corresponding shares in 2005. The retail sector in 2005 represents around 10% of the total employed population, and the share of sales and related occupation is 53% of the retail employees. Hence, a reduction in the share of sales and related occupations in retail of 5% from 2005 to 2017 represents 1% less employees in sales and related occupations, or more than 1M employees not

[6] We split retailers into warehouse clubs and supercenters (NAICS 4529), e-commerce retailers (NAICS 4541) and other general brick-and-mortar retailers (remaining NAICS)

[7] See Figure 7

working in sales and related occupations anymore. Together, this evidence suggests that brick-and-mortar retailers may have made some adjustments to sell online and adopt a hybrid model.

In order to explain these changes in the retail sector and in the retail labor market, first and foremost, we consider the evolution of retail competition. The first indicator of the type of competition is that prices from websites and physical stores are similar in US 69% of the time (Cavallo, 2017). However, Cavallo's (2017) analysis of US prices does not include tax rates or contemplate tax rates differences due to state legislation. As out-of-state online retailers are exempt from collecting sales taxes, they have a price advantage over brick-and-mortar retailers. With a sufficient price advantage, more consumers may choose buying online. Hence, the price advantage could have accelerated the growth of e-commerce and could have lead the changes in the retail labor market. Leveling the playing field, as out-of-state e-commerce retailers are being required to collect sales taxes by new state legislation, results a reduction of out-of-state online sales documented by (Baugh et al., 2018; Einav et al., 2014). In the next sections, we introduce the details of what the legislation change entailed, to later focus on the effects of the Amazon Tax on local labor markets.

2.2 Amazon Tax

The enactment of the Amazon Tax by state legislators mandates that out-of-state retailers are to collect state sales taxes for purchases realized in-state. This paper studies the impact of the Amazon Tax legislation on local labor markets.

To provide some context, consumers across the US are responsible for paying sales taxes for out-of-state purchases, also known as "use taxes". Use taxes are set to discourage circumventing sales taxes through out-of-state consumption. Consumers are required to remit use taxes on the income tax returns annually. However, Manzi (2010) finds that only 27 states that have sales and income taxes include a line on the income tax return to report use tax. Furthermore, he finds that more than 89% of the of income tax returns of those states do not report any use tax. Low compliance on use tax reporting could be explained due to use taxes not being collected at the time of the purchase and consumers relying on retailers to collect sales taxes.[8]

Moreover, in the 1992 case *Quill v. North Dakota*, the US Supreme Court ruled that out-of-state retailers cannot be required to collect state sales taxes due to lack of nexus (physical presence) in the state. The reason sustained by the Court was that otherwise collecting sales taxes would impermissibly burden interstate commerce due to many diverse taxing jurisdictions.[9] Hence, since 1992, the US Supreme Court ruling gave a price advantage to out-of-state online retailers over brick-and-mortar retailers. Furthermore, several researchers estimate and forecast revenue losses from uncollected state sales taxes due to e-commerce. Bruce and Fox (2001) estimates these losses were $7B in 2001 and forecasts those losses to be $29.17B in 2011 (2.83% of total sales tax collection). As estimates and forecasts have been updated the revenue losses have increased.[10]

As state government's concerns increased, in 2008, the state of New York enacted the first legis-

[8] Since the difference between sales taxes and use taxes relies on the location of the retailer, on the remaining of the paper, we will use sales taxes and use taxes interchangeably.

[9] Lunder and Pettit (2014)

[10] Bruce and Fox (2004) estimate the losses as $15.5B in 2003 and forecast them as $21.5B in 2008. Bruce et al. (2009) update the estimates to $23.39B in 2008 and the forecast to $30.67B in 2011 with an high growth sales scenario of $40.82B for the same year. Additionally, Omar et al. (2008) estimates that the revenue losses would rise to $62.1B by 2011.

lation that changed the definition of nexus to require sales tax collection from out-of-state retailers. The definition of nexus as physical presence was replaced by "having a constitutionally sufficient connection between the state and business". The new legislation considers retailers that have affiliates, associates or subsidiaries in-state to have a sufficient connection with the state, and hence being required to collect sales taxes.[11]

In the following years, 28 states have implemented sales taxes on out-of-state e-commerce sales by making the definition of nexus broader. These legislation changes, also known as the "Amazon Tax", have been associated to increases in sales tax collection and declines in consumption. Afonso (2019) finds that the Amazon Tax increases local sales tax revenue while comparing tax revenue collection in North Dakota counties with South Dakota counties after North Dakota enacted the Amazon Tax. Moreover, he finds that the policy change benefits urban jurisdictions more so than rural or tourism-rich jurisdictions due to the urban jurisdiction also collecting local sales taxes. Additionally, Baugh et al. (2018) estimates a reduction of Amazon purchases by 9.4% due to Amazon sales tax collection. These findings are supported by Kaçamak and Wilking (2020)'s work, finding that consumers face higher prices and in turn reduce their online expenditures.

Previous papers focus on the year in which Amazon.com, Inc. (Amazon) starts collecting sales taxes, which entails Amazon decision and may lead to endogeneity issues. The timing of Amazon's decision to start collecting sales taxes may be correlated with local economic conditions that also affect other retailers decisions. As previous papers are focusing on consumer behavior, relying on Amazon Tax collection does not bring the same endogeneity issues. Instead, we focus on the Amazon Tax enactment dates from state legislation. By focusing on the enactment of the legislation, we intend to avoid any type of anticipation that retailers and consumers may face.

The Amazon Tax definition of nexus only allowed state governments to collect sales taxes from out-of-state retailers that were selling their own goods. However, some online retailers, like Amazon, act both as retailers and a marketplace. In a further effort to reduce tax revenue losses, state governments enacted new legislation in the years 2017 and 2018, that broadened the definition of nexus to include marketplace collection. Hence, we restrict the analysis to the period 2005-2016.

Finally, in the 2018 case *South Dakota v. Wayfair, Inc*, the US Supreme Court overruled *Quill* stating not only that physical presence was no longer needed, but also highlights " the inherently unfair competitive advantage of online retailers over retailers with a physical presence in a state and the economic distortions caused by businesses who intentionally avoid any physical presence in a state." (Newmark et al., 2019). In other words, the *Wayfair* ruling supports the idea that before the enactment of the Amazon Tax, out-of-state retailers had a price advantage over brick-and-mortar retailers. Removing that price advantage through sales tax collection affected consumption patterns and helped the states recover tax revenue losses, however, it is unclear how it affected local business in particular and local labor markets in general.

[11] A previous attempt to increase and simplify sales tax collection, in 2005, 13 state governments signed the Streamline Sales and Use Tax Agreement (SSUTA), while 10 additional states were incorporated as full members at a later date. The agreement is meant to ease the registration process for businesses operating in multiple sales tax-levying states, as well as set common sales tax-related definitions and rules, simplifying rate structures. The agreement also provides exemptions for smaller remote sellers from tax collection responsibilities, even though they were already exempt from collecting due to *Quill*. Finally, the agreement proposes providing all participating remote sellers free tax software. Nevertheless, as the definition of nexus requires physical presence, in SSUTA states, out-of-state retailers collect tax voluntarily. Hence, the effect of SSUTA on tax revenue collection is not clear.

3 Removing E-commerce Price Advantage

Once the Amazon Tax is enacted, consumers face the same net prices on their purchases at brick-and-mortar retailers as well as online. Consistent with Baugh et al. (2018) findings, one could expect declines in online consumption. If online consumption falls, out-of-state e-commerce retailers would require less services from local last-mile transportation and warehousing, which in turn could lead to declines in employment in these sectors.

Moreover, the reduction in online consumption could be a response of consumers substituting online purchases with in-person purchases at local brick-and-mortar retailers, or due to consumers narrowing their overall consumption. On one hand, if consumers substitute among different retail channels, one would expect a recovery of the brick-and-mortar retail sector, leading to increases in local retail employment.

On the other hand, if consumers do not substitute back to in-person purchases, and lower their consumption overall, one could expect that local brick-and-mortar will attempt to recoup these sales by taking advantage of their proximity to consumers and moving to a hybrid model of production that offers both in-person and online sales. Hence, one would expect a change in the composition of employment in local retail brick-and-mortar, requiring more employees in office, service, professional and managerial positions and fewer employees in sales and related occupations. In the next sections, we test for these hypotheses empirically and evaluate the necessary and sufficient conditions that may lead to those results.

4 Data Sources and Empirical Strategy

4.1 Data and Sample

We use state-level and time variation from the Amazon Tax enactment to evaluate the effects of E-commerce on local labor markets. We combine information from a number of sources regarding employment, number of establishments, occupational shares and wages, for the years 2010-2016.

We define a local labor market as a commuting zone within a state as unit of observation. We identify local labor markets using commuting zones. According to Dorne (2009) focusing on commuting zones presents two advantages: commuting zones are already defined for the entire US, and that, instead of being based on state borders or population, commuting zones rely principally on economic geography. Moreover, by focusing on commuting zones we can observe effects separately for Urban commuting zones and for non-Urban commuting zones. The distinction between urban and non-urban areas is needed not only because in urban areas local governments often impose local sales taxes, but also due to urban areas having larger access to high speed internet. We classify as urban commuting zones those that are above the percentile 75 of the population distribution from year 2000 Census.

From the 722 commuting zones, however, 18% cross state borders, hindering the distinction between treated and control areas due to the Amazon Tax legislation being enacted by states. Therefore, we divide commuting zones that cross state borders to define the units of observation. One advantage of splitting commuting zones by states is that the partition of a commuting zone in an untreated state is a good comparison of the partition of the same commuting zone in a treated state. However, if the local markets are integrated, spillovers may occur, leading to the violation of stable

unit treatment value assumption (SUTVA). As a robustness check, we exclude commuting zones that cross state borders from the analysis.[12]

To evaluate the effects of e-commerce on establishments and employment over time, we use data from County Business Patterns (CBP). CBP data is elaborated by the U.S. Census Bureau from the Business Register (BR), which combines several data sources as the Economic Census, Annual Survey of Manufactures and Current Business Surveys, and IRS administrative records. CBP county annual data includes the number of establishments, employment during the week of March 12, first quarter payroll, and annual payroll of each 6-digit industry. To preserve the confidentiality of individual employers, the U.S. Census Bureau suppressed the number of employees for the majority of county-industry cells. Accordingly, a flag is provided indicating the bin in which the suppressed number belongs to. Bartik et al. (2018) and Eckert et al. (2021) both overcome this suppression by developing linear programming methods that impute the suppressed values. We use the Eckert et al. (2021) imputed version, since not only harmonize industry codes to NAICS 2012, but also bridge county codes making them consistent through the entire panel. Eckert et al. (2021) impute 1975-2016 CBP employment values with an algorithm that relies on linear programming. The algorithm minimizes the distance to the midpoint of the flagged bin, conditional on being inside the interval and all values adding to the parent category both by industry and geography. The algorithm also accounts for inconsistent bounds due to possible errors either in the employment of disclosed cells or in the employment bounds of the suppressed cells. In 2017, the U.S. Census Bureau changed the disclosure rule for cells with less than 3 establishments, removing flags—rendering all algorithms inadequate to impute 2017 and 2018 employment values. Therefore, we restrict the analysis of CBP to the period 2010-2016.

We combine the data on number of establishments and employment with population and working age population data from Census Intercensal Population Estimates for the periods 2000-2010 and 2010-2020. The Census Intercensal Population Estimates is a product from the U.S. Census Bureau, which reconcile the population and housing units post-censal estimates with the census counts at the county, state and national level. The annual population county estimates account for births, deaths and migration patterns and are constructed using the Das Gupta method, confirming that the sum of county estimates amounts to the national level. Finally, we collapse the data to commuting zone - state level using crosswalks from CBP county 2000 and CBP county 2010 definitions provided by Autor et al. (2013).

To evaluate changes in wages and occupational structures, we rely on data from the IPUMS-USA version of the American Community Survey (ACS). ACS data was collected yearly starting in 2005. The dataset consists of a yearly 1-in-100 nationally representative sample and contains questions regarding employment status, occupation and pre-tax wages and salaries received in the previous calendar year (annual income wages). We deflate wages and salaries to 2014 usd and measure changes in the occupational structure through changes in occupational shares. We harmonize occupational codes to the 2010 Standard Occupational Classification System (SOC). We focus on annual income wages of employees in retail (NAICS 44) and last-mile transportation and warehousing (NAICS 49) as well as occupational shares of sales and related occupations (SOC 41-) and transportation and material moving occupations (SOC 53-) employees. The smallest identifiable geographical unit in ACS data is the Public-Use Microdata Area (PUMA) defined by the Census Bureau every 10 years.

[12] Results are robust to excluding commuting zones that cross state borders from the sample

To evaluate the effects on local labor markets, we collapse the data at commuting zones - state, using crosswalks from PUMA 2000 and PUMA 2010 definitions to commuting zone definition from Autor and Dorn (2013) and Autor, Dorn and Hanson (2019).

Additionally, given that effects of the Amazon Tax in labor markets may be mediated by consumption, we control for predictors of changes in consumption and e-commerce consumption as a robustness check . To predict changes in consumption, we rely on the median household income estimates from the Small Area Income and Poverty Estimates (SAIPE) Program. The SAIPE Program is conducted by the US Census Bureau, which combines data from administrative records, survey data and population estimates to produce median household income estimates at the county level. To predict changes in e-commerce consumption patterns, we collect location records of Amazon.com, Inc fulfillment centers provided by MWPVL International.[13] The reasons behind using Amazon locations as a predictor of e-commerce consumption patterns are twofold: Amazon is one of the biggest e-commerce retailers in the period studied; and Amazon sets locations such that it minimizes shipping costs according to consumption patterns.[14] We complement data on the location of Amazon fulfillment centers from MWPVL International with information on fulfillment centers from newspaper articles.[15]

4.2 Empirical Strategy

In order to estimate the effect of e-commerce on local labor markets, we exploit the idea that the e-commerce growth was fueled, in part, by the price advantage that out-of-state e-commerce retailers had over in-state retailers. Hence, we define the treatment as the enactment of an the Amazon Tax by the state government. While previous literature evaluating the effects of the Amazon Tax define treatment when Amazon starts collecting sales taxes, by focusing on the enactment of legislation we avoid any possible anticipation from consumers and retailers regarding a decrease in local purchases due to the increase of the tax.

We consider commuting zones in states that enacted an the Amazon Tax in 2013 as treated observations, while commuting zones in states that did not enacted an the Amazon Tax before 2016 are in the control group (never treated). Additionally, we exclude from the sample those commuting zones in states that signed voluntary collection agreements(VCA) and where Amazon was not collecting sales taxes before 2008. The main reason for these exclusions is that while the enactment of new legislation can be considered exogenous, voluntary collection agreements and amazon deciding to collect sales taxes before any legislation changes involve negotiation between state officials and Amazon, Inc, leading to not only possible endogeneity but also anticipation from other actors. Figure 11 shows which states are in the treated and control groups.

In an ideal experiment, state government would randomly enact the Amazon Tax to reduce such price advantage, leading to local labor markets in treated states and in control states to be statistically identical in observable and unobservable characteristics. Not only that is not the case, but treated

[13] MWPVL International is a firm which provides services on supply chain and logistics network strategy. As part of their research analysis of the current Amazon.com logistics network they collected Amazon.com fulfillment center's locations.

[14] See Houde et al. (2017)

[15] Results are robust to the inclusion of time-varying controls, however, these specifications may incorporate additional bias as these controls may also be affected by the enactment of the Amazon Tax.

and control states exhibit differences in observable characteristics. Table 1 shows a comparison of some observable characteristics in treated and control states before the first year of treatment (2005-2007). States that enacted the Amazon Tax have higher sales tax rates, lower household income, and higher rate of older and more educated population. Moreover, states that enacted the Amazon Tax exhibit a different industry composition that states that did not enact the Amazon Tax.

In the absence of random assignment, the difference-in-difference (DID) approach estimates the policy effects in a quasi-experimental setting by comparing the outcome of a treated and control units before and after the enactment of the Amazon Tax. While DID approach does not require that treated and control units are similar in characteristics, it does rely on the assumption that the outcome of treated and control units present parallel trends. Hence, by assuming parallel trends, in the absence of the treatment, treated units would have exhibit same trends as control units. Then, the main identification assumption is that commuting zones in states where the legislation was enacted and commuting zones in states which did not enact the Amazon Tax exhibit parallel trends in employment, wages, number of establishments and occupational shares that would have continue in the absence of the treatment.

To evaluate the validity of the parallel trend assumption, first we visually compare outcomes' averages between treated and control commuting zones (CZ) in the pre-period. Figures 8, 9 and 10 show the comparisons for employment/working age population, wages and establishment/population by industry and retail occupational shares corresponding to CZ treated in 2013 and never treated CZ. With the exception of establishments per population in retail, the remaining outcomes do not exhibit parallel pre-trends.

A more formal traditional approach to evaluate the parallel trend assumption consists on testing the significance of the lead coefficients in an even study, which we evaluate together with the results in the next section.

Finally, for the baseline analysis, we assume that there are no spillover effects between commuting zones located at state borders. One possible threat to this assumption is that in those commuting zones, the enactment of the Amazon Tax in a particular state affects not only the employment of the commuting zones in that state, but also employment in neighbouring commuting zones out of that state. Additionally, commuting zones that are located in more than one state may face a threat to the assumption if the market is integrated leading to effects in the area located in the non treated state. In order to evaluate these threats to the stable unit treatment value assumption (SUTVA), we exclude from the specification all commuting zones in state borders as well as commuting zones that cross state borders as robustness check.[16]

4.3 Econometric Specification

In order to analyze the effects of removing a price advantage for out-of-state e-commerce retailers, we estimate an Event Study Difference-in-Differences model.

We estimate the following equations:

$$Y_{cy} = \alpha_c + \gamma_y + \sum_k \psi_k D^k_{sy} + \epsilon_{cy} \tag{1}$$

[16] All results are robust to the exclusion of commuting zones that cross state borders from the sample

$$Y_{cy} = \alpha_c + \gamma_y + \delta D_{sy} + \epsilon_{cy} \tag{2}$$

with $D^k_{sy} = I[y - e_y = k]$ being a dummy variable equal to one if the Amazon Tax is in place in state s during year y. With County Business Patterns (CBP) data, we focus on two main outcome variables, the ratio of employment over working age population in a commuting zone c at time y, $\frac{Emp_{cy}}{Pop_{cy}} \times 100000$, and the ratio of the number of establishments over total population, $\frac{Est_{cy}}{Pop_{cy}} \times 100000$ for both retail and transportation and warehousing sectors.

With American Community Survey (ACS) data, the outcome variables are logarithm of annual income wages of retail and transportation and warehousing employees, as well as the shares of employment on occupations i in commuting zone c at year y, $Y_{cyi} = \frac{Emp_cyi}{Emp_cy}$. We focus on sales occupations, office and service occupations, and transportation, construction and production occupations, and managerial and professional occupations, following the Standard Occupational Classification System. In both cases, we include commuting zone and year fixed effects and weight by population in 2005. Also, as the treatment takes place at the state level, we cluster standard errors at the state.

Since the removal of a price advantage changed consumption patterns affecting brick-and-mortar and e-commerce retailers, we focus on two industries: retail (NAICS 44) and it's main substitute related with e-commerce retail, last-mile transportation and warehousing (NAICS 49). Notice that this definition of transportation and warehousing (NAICS 49) does not include freight or transportation of passengers, only postal services and courier messengers which represents last-mile transportation. For the aforementioned industries, we evaluate the following labor market outcomes Y: employment per working age population, number of establishments per population and wages. Additionally, to evaluate changes in the local occupational structure, we focus on changes in the shares of retail employment for transportation and material moving occupations, production and construction occupations (SOC 53-, 51-, 45-, 47- and 29-), office and service occupations (SOC 43- , and 3X-), sales and related occupations (SOC 41-), and managerial and professional occupations (SOC 1X- and 2X-).

In the following sections we present the results evaluating the difference-in-differences of commuting zones in states that enacted the Amazon Tax in 2013. Moreover, as the pre-treatment period covers the period after the Great Recession, the comparison considers commuting zones that were already affected in the same way, without contamination from the Great Recession effects itself. Finally, since CBP data from years after 2017 cannot be imputed due to disclosure rules changes, and the Marketplace legislation was also enacted in 2017, looking at commuting zones treated in 2013 allows me to evaluate the ATT with a 3 year post-period window.

5 Results

5.1 Employment Effects

Among the concerns regarding the growth in e-commerce and the competition it presents for traditional brick-and-mortar retailers is that e-commerce retail requires fewer local retail employees. Moreover, as e-commerce retail depends on transportation and warehousing, the growth in e-commerce should be accompanied with an increase in employment in the transportation and warehousing sector. However, (Baugh et al., 2018) finds that once Amazon Tax is in place, online consumption decreases. As the enactment of the Amazon Tax may reduce the incentives for local e-commerce

retail growth while increasing the incentives for traditional retailers to switch to an hybrid model, as click-and-brick, we start the analysis by evaluating changes in employment in general as well as employment for both retail and last-mile transportation and warehousing sectors.

First, we evaluate the parallel trend assumption visually by observing the pre-period event study coefficients. Figure 12 presents the event study estimates corresponding to employment/working age population for main sectors: overall, transportation and warehousing, retail, warehouse clubs and supercenters, and general brick-and-mortar. We observe that in all cases there is no evidence of pre-trends, however, the pre-period estimates are noisy. Difference-in-differences estimates of the enactment of the Amazon Tax are presented in Table 2. Since urban areas have higher access to internet and also collect local sales taxes, we also separate effects for urban and non-urban commuting zones, following the methodology presented in section 4.1. Hence, table 2 panel A presents the estimates for the entire sample, while panel B and C presents the estimates for urban commuting zones and non-urban commuting zones respectively.

When comparing employment per 100,000 working population before and after the enactment of the Amazon Tax, there are 326.5 employees more among commuting zones in states that enacted the Amazon Tax than in those commuting zones in states without the enactment. However, the effect is not statistically different from zero. Moreover, we find a decline in employment of 34.82 employees in complementary sectors of e-commerce, as transportation and warehousing , per 100,000 working age population in commuting zones in states that enacted the Amazon Tax compared to commuting zones in states that did not enact the Amazon Tax. This effect represents a 9.57% decrease from the pre-period baseline mean and it is consistent with the 9% decline in online sales presented in Baugh et al. (2018).

Additionally, we find that in the retail sector, there is also a decrease in employment of 74.56 employees per 100,000 working age population after the enactment of the Amazon Tax in commuting zones in treated states versus commuting zones in states without the enactment of the Amazon Tax. The decline in retail employment represents 1.01% of its pre-period baseline mean. This decline contradicts the findings of Chun (2019) and Chava et al. (2018), which find that growth of e-commerce leads to declines in employment. Here, the shrinking of e-commerce sales is leading to declines in local retail employment.

As the previous result presents a puzzle, we differentiate between employment at warehouse clubs and supercenters and employment at other brick-and-mortar retailers. We find that the decrease in retail employment is driven by a decrease in employment at other brick-and-mortar retailers of 2.32% of its baseline mean, while employment in warehouse clubs and supercenters increases by 6.27% with respect of its baseline mean, after the enactment of the Amazon Tax. These results suggest that once the price advantage is removed, competition between local retailers increases: Big box retailers expand in size while other brick-and-mortar retailers reduce employment.

Finally, panels B and C show that the changes in retail employment in all sub-sectors are driven by changes in retail employment in urban commuting zones, while retail employment in non-urban areas exhibit no statistically and economically significative changes.

5.2 Wages Effects

The expansion of e-commerce may have additional consequences on retail and transportation and warehousing employees. Several claims have been made on how e-commerce can harm employees in

the retail sector. Chava et al. (2018) finds that after Amazon opens a fulfillment center, wages of brick-and-mortar employees decrease, mostly due to a reduction in working hours. Since the enactment of the Amazon Tax creates incentives not only for Amazon and other e-commerce retailers to set locations in the state, but also for brick-and-mortar retailers to convert to an hybrid system, the effects on wages may go in both directions. In this section, we explore what are the effects of the enactment of the Amazon Tax on income wages and hours worked.

First, we evaluate the parallel trend assumption visually by observing the pre-period event study coefficients. Figure 14 presents the event study estimates corresponding to the logarithm of annual income wages for main sectors: overall, transportation and warehousing and retail. We observe that in all cases there is no evidence of pre-trends, however, the pre-period estimates are noisy.

In a similar manner than with employment effects, Table 3 shows the difference-in-differences estimates of the enactment of the Amazon Tax. Panel A presents the estimates for the entire sample, while panel B and C presents the estimates for urban commuting zones and non-urban commuting zones respectively.

When comparing annual income wages of retail employees before and after the enactment of the Amazon Tax, there is a decline in wages of 1.19 percents among commuting zones in states that enacted the Amazon Tax compared to those commuting zones in states without the enactment, while the hourly wages of retail employees is 1.32 percent lower. Both declines in hourly and annual wages of retail employees are not statistically significant. However, we find that annual wages of employees in the transportation and warehousing sector decrease by 8.3 percent, while their hourly wages decrease by 7.7 percent in commuting zones in states that enacted the Amazon Tax compared to commuting zones in states that did not enact the Amazon Tax. These effects are both statistically significative at 1% and 5% respectively. Hence, employees at complementary sectors of e-commerce, like last-mile transportation and warehousing, are worse off after the enactment of Amazon Tax.

Panels B and C show that the changes in wages of transportation and warehousing employees are also driven by changes in wages for employees in urban commuting zones, while wages of transportation and warehousing employees in non-urban areas exhibit no statistically and economically significative changes.

5.3 Establishments Effects

One of the arguments to remove the price advantage that e-commerce retailers had over brick-and-mortar retailers is that brick-and-mortar establishments were closing at an alarming rate due to the disadvantage. Moreover, the media named this phenomenon "Retail Apocalypse", while politicians presented the Amazon Tax policies as a way to reduce brick-and-mortar establishments' closures. We evaluate the effect of the Amazon Tax enactment on the number of establishments in both retail and transportation and warehousing sectors.

By observing the pre-period event study coefficients in figure 13 corresponding to the number of establishments/population for main sectors: overall, transportation and warehousing, retail, warehouse clubs and supercenters, and general brick-and-mortar, we evaluate the parallel trend assumption visually. We observe that in all cases there is no evidence of pre-trends, however, the pre-period estimates are noisy.

Table 3 Panel A presents the difference-in-differences estimates of the enactment of the Amazon Tax for the entire sample, while panels B and C presents the estimates for urban commuting zones

and non-urban commuting zones respectively. First, we find that there is a decrease of 0.18 establishments in last-mile transportation and warehousing sectors per 100,000 people in commuting zones in states that enacted the Amazon Tax compared to commuting zones in states that did not enacted the Amazon Tax. This effect represents a 1.88% decrease from the pre-period baseline mean, however it is not statistically significative.

When comparing retail establishments per 100,000 people before and after the enactment of the Amazon Tax, there are 1.97 establishments fewer among commuting zones in states that enacted the Amazon Tax than in those commuting zones in states without the enactment. Nevertheless, the effect is not statistically different from zero. Additionally, when we differentiate between warehouse clubs and supercenters and other brick-and-mortar retailers, we find that the decrease in retail establishments is driven by a decrease in the number of establishments of other brick-and-mortar retailers of 0.53% of its baseline mean, while the number of establishments in warehouse clubs and supercenters increases by 3.14% with respect of its baseline mean, after the enactment of the Amazon Tax. Only the increase in the number of establishments in warehouse clubs and supercenters is statistically significant. Hence, the enactment of Amazon Tax did not slow down or stop the "Retail Apocalypse".

Panels B and C show that the changes in retail establishments in all sub-sectors are driven by changes in retail establishments in urban commuting zones, while retail establishments in non-urban areas exhibit no statistically and economically significative changes.

5.4 Occupational Structure Effects

Given that e-commerce retail and brick-and-mortar retail require employees on different occupations, with different skills, in this section we explore what are the effects of the Amazon Tax enactment on the retail occupational shares of four categories of main occupations of retail: transportation and material moving occupations, production and construction occupations (SOC 53-, 51-, 45-, 47- and 29-), office and service occupations (SOC 43-, and 3X-), sales and related occupations (SOC 41-), and managerial and professional occupations (SOC 1X- and 2X-).

Once more, we evaluate the parallel trend assumption visually by observing the pre-period event study coefficients. Figure 15 presents the event study estimates corresponding to retail occupational shares. We observe that in all cases there is no evidence of pre-trends, but, the pre-period estimates are noisy.

Difference-in-differences estimates of the effects of the enactment of the Amazon Tax on the retail occupational structure are shown in Table 5. Panel A presents the estimates for the entire sample, while panel B and C presents the estimates for urban commuting zones and non-urban commuting zones respectively.

We find that the difference in the retail share of sales occupations after the enactment of the Amazon Tax, when compared with prior to it was 0.397 percentage points lower among those commuting zones in states that enacted the Amazon Tax than those commuting zones in states without the Amazon Tax enactment. We also find that the retail share of managerial and professional occupations faces an increase of 0.29 percentage points in commuting zones in states that enacted the Amazon Tax compared to commuting zones in states that did not enacted the Amazon Tax. This effect represents a 3.23% increase from the pre-period baseline mean. Additionally, we find that in the retail sector, there is also a decrease the share of transportation, construction and production

occupations as well as an increase in the share of office and service related occupations after the enactment of the Amazon Tax in commuting zones in treated states versus commuting zones in states without the enactment of the Amazon Tax. The decline in the share of transportation, construction and production occupations represents 0.09% of its pre-period baseline mean, while the increase in the share of office and services related occupations represents 0.58% of its pre-period baseline mean. While these results suggest that the retail sector is substituting among employees in different occupations, the effects are not statistically different from zero.

However, Panels B and C show that the changes in retail transportation, construction and production share are driven by changes in urban commuting zones, while changes in the retail occupational shares of office and services and sales occupations are driven by non-urban areas. Moreover, these last changes represent an increase of 7.14 percent of the pre-period baseline mean of office and services occupational shares and a decrease of 4.79 percent of the pre-period baseline mean of sales occupational shares respectively in non-urban areas. Both these effects are statistically and economically significative, pointing to changes in the different occupational labor demands in local retail to incorporate that move in the direction of e-commerce occupational structure.

5.5 Robustness

In this section we present the results of a variety of tests performed to account for several concerns regarding the specification and sample construction.

First, the inclusion in the sample of commuting zones that cross state borders may lead to a violation of the stable unit treatment value assumption due to the possibility of spillovers. In Tables 6 we present the results of the difference-in-difference analysis while excluding such commuting zones from the sample. All results are robust to this specification.

Second, as the change in the sale tax affects labor market outcomes through changes in consumption, we want to compare commuting zones that present similar consumption patterns. To that effect, we control for consumption predictors in the difference-in-difference analysis. We include the following time-varying covariates: median household income, industry distribution at 1 digit, age distribution, and Amazon fulfillment center locations from MWPVL International and newspaper articles. Tables 7 present the results. Results are robust to the inclusion of time-varying controls, however, these specifications may incorporate additional bias as these controls may also be affected by the enactment of the Amazon Tax.

6 Discussion of Effects of E-commerce

In section 4, we show that reducing the price advantage of out-of-state e-commerce retailers not only reduces retail employment and the number of establishments, but also alters the retail employment distribution across subindustries. While employment in warehouse clubs and supercenters increases, employment in general brick-and-mortar retailers decreases. In this section, we present a four-sector general equilibrium model to rationalize the effects of taxing e-commerce on local labor markets.

6.1 The Basic Model

The economy has four sectors: general brick-and-mortar retail (B), warehouse clubs and supercenters (S), out-of-state e-commerce retail (E) and transportation and warehousing (T). The only production factor is labor (L). The production of the three types of retail (B, S, E) occurs in a constant returns to scale environment:

$$B = L_B, \qquad S = L_S, \qquad E = T = L_T \tag{I}$$

Additionally, out-of-state e-commerce retail is produced in-state with transportation and warehousing services (W), which in turn are produced with labor. To simplify notation we label it as $L_T = L_E$.

In this setup, labor has a fixed total supply, but workers can freely move between sectors (with no unemployment). Thus:

$$L_B + L_S + L_E = \bar{L} \tag{II}$$

In each sector, labor is paid the value of its marginal product in competitive markets (zero profit condition)[17]:

$$p_B B = w_B L_B, \qquad p_S S = w_S L_S, \qquad p_E E = w_E L_E \tag{III}$$

Workers' decision regarding how much labor they want to allocate in each sector is given by their corresponding wages, w_B, w_S, w_E and their indirect utility $V(w_B, w_S, w_E)$, which is reflected in the elasticities of substitution: η_1, workers' elasticity of substitution between warehouse clubs and supercenters (S) and general brick-and-mortar retail (B); η_2, workers' elasticity of substitution between transportation and warehousing (T) and general brick-and-mortar retail (B); and η_3, workers' elasticity of substitution between warehouse clubs and supercenters (S) and transportation and warehousing (T).

We assume that workers preferences for working in the different sectors are well-behaved (complete, transitive, monotonic and convex). We also assume that workers see the different sectors as substitutes ($\eta_1 > 0, \eta_2 > 0, \eta_3 > 0$), and that they see working at B and working at S as the most substitutable jobs, and that they see working at T and working at B as the least substitutable jobs, while the elasticity of substitution between working at T and working at S is between the others ($\eta_1 > \eta_3 > \eta_2$). This assumption comes from the fact that B and S have similar occupational structures, that is they require similar occupations and skills, while B and T have dissimilar occupational structures.

Finally, consumers maximize their utility $U(B, S, E)$. Consumer's preferences are characterized by the elasticity of substitution between demands of B, S and E: σ_1, elasticity of substitution between warehouse clubs and supercenters (S) and general brick-and-mortar retail (B); σ_2, workers' elasticity of substitution between out-of-state e-commerce retail (E) and general brick-and-mortar retail (B); and σ_3, workers' elasticity of substitution between warehouse clubs and supercenters (S) and out-of-state e-commerce retail (E).

[17] While these markets rarely behave as perfectly competitive markets, this simplifying assumption allows me to focus on the competition across channels instead of the competition within each channel

Consumer face price $p_i(1+\tau_i)$ and an *ad valorem* tax τ_i for $i = B, S, E$. We assume that consumers' preferences are well-behaved (complete, transitive, monotonic and convex), and they see retail from different sectors as substitutes ($\sigma_1 > 0, \sigma_2 > 0, \sigma_3 > 0$). We also assume that consumers see purchasing at B and purchasing at S as the most substitutable purchases, and that they see purchasing at E and purchasing at B as the least substitutable purchases, while the elasticity of substitution between purchasing from E and purchasing at S is between the others ($\sigma_1 > \sigma_3 > \sigma_2$). This assumption is consistent with the idea of all brick-and-mortar retailers (B and S) requiring trips to the shop, hence once consumers are already outside the house they will prefer purchasing at the cheapest places (prices matter more), while E and B being completely different purchasing experiences. [18]

In this economy, with pre-existing tax rates τ_B, τ_S and τ_E, we evaluate the effect of a small increase in the tax rate of out-of-state e-commerce retail (E).

6.2 Effects of the Amazon Tax

We solve for the effects of an increase in the *ad valorem* tax rate on sales of out-of-state e-commerce retail, sector E, while the remaining tax rates do not change, $\widehat{\tau_B} = 0$,$\widehat{\tau_S} = 0$. Since we focus on real behavior, we choose S as numeraire, hence $\widehat{p_S} = 0$. The general solutions are:[19]

$$\widehat{w_S} = \widehat{p_S} = 0 \tag{14a}$$

$$\widehat{w_E} = \widehat{p_E} = \widehat{w_T} = \widehat{p_T} = -A\widehat{\tau_E} \tag{14b}$$

$$\widehat{w_B} = \widehat{p_B} = -A\epsilon_L\widehat{\tau_E} \tag{14c}$$

$$\widehat{L_E} = \widehat{E} = \widehat{L_T} = \widehat{T} = \underbrace{[\lambda_S\sigma_1\epsilon_U A}_{\text{Indirect Effect}} + \underbrace{(\lambda_E - 1)\sigma_2(\epsilon_U - 1)A]}_{\text{Direct Effect}}\widehat{\tau_E} \tag{14d}$$

$$\widehat{L_B} = \widehat{L_B} = \left[\lambda_S\sigma_1\epsilon_U A + \lambda_E\sigma_2(\epsilon_U - 1)A\right]\widehat{\tau_E} \tag{14e}$$

$$\widehat{L_S} = \widehat{L_S} = \left[(\lambda_S - 1)\sigma_1\epsilon_U A + \lambda_E\sigma_2(\epsilon_U - 1)A\right]\widehat{\tau_E} \tag{14f}$$

where ϵ_U and ϵ_L are the relative differences in preferences for consumers and workers respectively: $\epsilon_U = \frac{\sigma_3 - \sigma_2}{\sigma_1 - \sigma_2}$ and $\epsilon_L = \frac{\eta_3 - \eta_2}{\eta_1 - \eta_2}$, $A \equiv \frac{1}{1 - \frac{\epsilon_L}{\epsilon_U}}$, and $\lambda_i = \frac{L_i}{L}$.

From (14a), wages in sector S do not change. The change of wages and price in sector E is proportional with respect to A, which measures the relation between relative differences in preferences for consumption and labor, from (14b).

The effects of increasing the tax rate on sales of E on the production of both B, S and E and their respective labor requirements can be split in two effects, Direct effects, and Indirect effects. The Direct effect reflects the trade-off that the consumer faces when substituting between general brick-and-mortar retail (B) and out-of-state e-commerce retail(E). The Direct Effect from both (14d),

[18] The consumer budget constraint here is implied by the assumption that the tax revenues are rebated lump sum to consumers and equations in (III).

[19] See Appendix 8.1 for derivations

(14e) and (14f) consists of an effect given by the elasticity of substitution σ_2 between consumption of B and E, which is in turn weighted by a function of share of labor used in the production of E and the ratio of elasticity differences for consumption, ϵ_U, and the relation between relative differences in preferences for consumption and labor, A.

The Indirect effect reflects the trade-off that the consumer faces when substituting across brick-and-mortar retailers, that is between general brick-and-mortar retail (B) and warehouse clubs and supercenters (S). The Indirect Effect from both (14d), (14e) and (14f) consists of an effect given by the elasticity of substitution σ_1 between consumption of B and S, which is in turn weighted by a function of share of labor used in the production of S and the ratio of elasticity differences for consumption (ϵ_U) and A, the relation between relative differences in preferences for consumption and labor.

Both the direct effect and the indirect effect are a result of changes in relative prices of e-commerce p_E, since they both include the change in prices and wages in sector E from equation (14b)

The following proposition shows in which cases a rise on the tax rate on out-of-state e-commerce sales, $\widehat{\tau_E} > 0$, leads to the observed effects present in the empirical results: declines in employment and wages in last-mile transportation and warehousing, declines in employment in general brick-and-mortar retail, and increases in employment in warehouse clubs and supercenters.

Proposition 1 *Let ϵ_U and ϵ_L be the relative differences in preferences for consumers and workers respectively: $\epsilon_U = \frac{\sigma_3 - \sigma_2}{\sigma_1 - \sigma_2}$ and $\epsilon_L = \frac{\eta_3 - \eta_2}{\eta_1 - \eta_2}$. Let Ψ_B be the relative subsitutability of brick-and-mortar retail in the economy: $\Psi_B = \frac{\lambda_S \sigma_1}{\lambda_E \sigma_2}$. Both wages and employment in transportation and warehousing and general brick-and-mortar retail will fall $\widehat{w_T} = \widehat{w_E} < 0, \widehat{w_B} < 0$, $\widehat{L_T} = \widehat{L_E} < 0, \widehat{L_B} < 0$, while employment in warehouse clubs and supercenters will rise, $\widehat{L_S} > 0$, if an only if:*
$\frac{1}{1+\Psi_B} > \epsilon_U > \epsilon_L > 0$, *and* $\frac{1-\lambda_E}{\lambda_E} > \Psi_B > \frac{\lambda_S}{1-\lambda_S}$

In the Appendix, we present Propositions 2-6 which build up to Proposition 1. Under Proposition 1, Propositions 2-6 hold simultaneously. Proposition 1 consists of two main blocks. The first block refers to the relationship between the relative differences in preferences for consumers and workers, ϵ_U and ϵ_L respectively. Due to workers seeing the different sectors as substitutes, with B and S the most subsitutable and B and T the least substitutable ($\eta_1 > \eta_3 > \eta_2 > 0$), the relative difference in workers preferences is larger than 0. This assumption is derived from the differences in occupational structures, with B and S having a similar occupational structure and B and T a dissimilar occupational structure.

As consumers also see purchasing at retail sectors as substitutes, with purchases at B and S being the most substitutable and purchases at B and E being the least substitutable ($\sigma_1 > \sigma_3 > \sigma_2 > 0$), the relative difference in consumers preferences is also larger than 0. But for the first block of Proposition 1 to hold, the relative difference in consumers preferences has to be larger than the relative difference in workers preferences. By definition of relative differences in preferences, this condition is equivalent to consumers being more sensitive to changes in prices than workers to changes in wages.[20] Additionally, the relative difference in consumers preferences has to be bounded by the

[20] Relative differences in preferences can be expressed not only as differences in elasticities of substitution but also as differences in price elasticities. For example $\epsilon_U = \frac{\sigma_3 - \sigma_2}{\sigma_1 - \sigma_2} = \frac{\gamma_S - \gamma_E}{\gamma_B - \gamma_E}$ with γ_i the price elasticity of sector $i = B, S, E$. See Gørtz (1977) for further details.

inverse of the relative substitutability of brick-and-mortar retail in the economy Psi_B, which refers to the ratio of elasticities of substitution of brick-and-mortar retail by the other sectors, σ, each weighted by the size of their respective sector in the economy, measured by the share of labor in their sector, λ.

Finally, for Proposition 1 to hold, the relative substitutability of brick-and-mortar retail in the economy Ψ_B has to be bounded by the relative size of e-commerce retail and the relative size of warehouse clubs and supercenters retail. If the e-commerce sector is too small ($\lambda_E \to 0$), then Ψ_B has to be at most 1, and the relative difference in consumers preferences has to be at most 0.5.

6.3 Substitution in the Retail Market

In this section, we explore the determinants of the elasticities of substitution. As mentioned before, a consumer can either buy from a brick-and-mortar retailer, either a general brick-and-mortar or a big box retailer, or buy online from an out-of-state e-commerce retailer. We assume consumers buy multiple goods, and for each good acquisition they decide from the three purchasing options.

Each purchasing option involves a cost $C_{ij} = h(\cdot)$ associated with the type of retailer j and how the consumer i perceives the purchase. The first difference in purchasing costs between buying from a brick-and-mortar retailer and buying from an e-commerce retailer comes from the searching time that consumers spend on selecting the product. Searching times, $t_j = g(\theta_j, \psi_j)$ are affected by how well the retailer shows the product characteristics, θ_j, and how much variety,ψ_j, they offer. For example, through e-commerce, consumers face lower costs associated to accessing detailed information of the characteristics of the products, comparing across products, comparing prices across different sites and buying with a click in their computer or mobile device. On one hand, brick-and-mortar store offers limited product variety, however, by searching online the vast product variety can obfuscate the consumer.

Moreover, brick-and-mortar retailers' proximity to each other creates an environment where consumers can visit many stores and purchase all the goods in the same visit, similar to searching online and comparing many websites. Hence, distance to the store, d_j, is a key cost associated to purchases from brick-and-mortar retailers. Hence, the lack of proximity to consumers of some brick-and-mortar stores, like outlet malls, creates a challenge for consumers without transportation means. Distance costs associated to purchasing experiences, therefore, are different for the two types of brick-and-mortar retailers. Big box retailers allow consumers for the possibility of trip bundling, effectively reducing the purchasing associated costs due to distance. However, the options for general brick-and-mortar retailers locations are limited. While they could be placing themselves close to one another in an attempt to reduce traveling costs for consumers, they have less control on how consumers preferences are regarding their neighbour stores and which complementarities or substitutabilities are between the goods they sell and other goods offered nearby.

Another difference between buying online and in-store is that while delivery is not needed in brick-and-mortar stores, it is required for online purchases, adding waiting time, m_j, and shipping costs, s_j, to the associated purchasing costs. Although consumers could reduce both waiting time and shipping purchasing related costs by subscribing to some e-commerce retailers' member programs, like Amazon Prime, those associated costs do not completely disappear, which does happen when buying at local retail stores. Additionally, pre-purchase interactions at brick-and-mortar stores reduce consumption costs related to measurements, touch, smell, try, and feel, which is not possible

online. We consider this cost as experience related costs X, where $X = 0$ at the store and $X = 1$ online.

Finally, there are some learning costs, L_{ij} associated with purchasing in general. For instance, when buying in the store the consumer learns where the products are located, if those products are moved to different shelves the consumer will have to re-learn the products location. Furthermore, buying online requires developing certain skills such as internet browsing skills and how to recognize safe sites and platforms from scams.

Consumers then maximize utility given by:

$$U_{ij} = v_i - p_j - C_{ij}$$

depending on how much their value the good v_i, the price they face at each purchasing option p_j, and the associated cost from the purchase, $C_{ij} = h(t_j, s_j, m_j, d_j, X_j, L_{ij})$.

As out-of-state e-commerce retailers do not collect sales taxes, consumers buying from them pay a price p, while consumers buying from general brick-and-mortar retailers pay the price $p(1 + \tau)$, with τ being the *ad valorem* sales tax. As warehouse clubs and supercenters usually offer discounts due to buying in bulk, consumers buying from them pay the price $p'(1 + \tau)$. For simplicity, we assume $p < p'(1+\tau) < p(1+\tau)$ and that the associated purchasing cost at both brick-and-mortar retail options are the same (C_{is}).

Even though some e-commerce retailers and some warehouse clubs offer memberships, the decision of acquiring the membership and paying the fixed fee occurs only once a year.

Hence, in this setting, the elasticities of substitution between purchasing channels are functions of both the price advantage and consumers' purchasing associated costs. In that sense, as urban and rural areas have observable characteristics that lead to differences in both the type of price advantage and the determinants of purchasing associated costs, we expect differences in consumers' substitution patterns. For example, urban areas not only have state sales taxes, they also have local sales taxes. Hence, in urban areas the price advantage is not removed when the Amazon Tax is enacted, only reduced, which may lead to a smaller substitution between e-commerce purchases and brick-and-mortar purchases by consumers. On the other hand, consumers in non-urban areas may face lower product variety, higher distance to the stores, waiting times, shipping costs, and learning costs due to lack of access to internet. While the first two imply higher associated costs for purchases from brick-and-mortar retailers, the last three imply higher associated costs for purchases from e-commerce retailers. Therefore, we may expect larger or smaller substitution from consumers depending which mechanisms prime.

Additionally, once the price advantage is removed, general brick-and-mortar retailers may have incentives to enter to the e-commerce retail market, given that now they compete with e-commerce retailers at the same prices, while e-commerce retailers may have incentives to locate closer to consumers, given that now they have to collect taxes everywhere.

6.4 Retail Production and Substitution in the Labor Market

In the previous section, we assume that retailers in each sector produce retail with only labor. However, from the empirical analysis, the retail production functions require different combinations of tasks performed by employees from a variety of occupations (skills) according to the type of retail.

Let's consider the main four occupational groups present in retail: sales employees L_{si}, professional and managerial employees L_{pi}, transportation, production and construction employees L_{ti}, office and service employees L_{oi} and let θ_{hi} be the share of each occupation h required for the production in sector $i = B, S, T$, and L_i be the vector of retail employment required to produce in such sector.

Notice that while out-of-state e-commerce retail requires only last-mile transportation and warehousing services in the local labor market, when located in-state e-commerce retail also requires employees from the main four occupations. For the following analysis, we focus on in-state e-commerce requirements since general brick-and-mortar retailers may have incentives to enter into e-commerce retail market and out-of-state e-commerce retailers may have incentives to locate closer to consumers. To make the distinction clear, we label in-state e-commerce retail sector as O.

In line with the observations from the data, we assume that e-commerce retailers require fewer employees than general brick-and-mortar retailers and warehouse clubs and supercenters.[21] we also assume that general brick-and-mortar retailers require larger shares of sales and related occupations and smaller shares of the remaining occupations than e-commerce retailers, and that warehouse clubs and supercenters require a larger share of service and office occupations than general brick-and-mortar retailers, but smaller than e-commerce retailers. Finally, we assume that warehouse clubs and supercenters require smaller shares of transportation, production and construction occupations and professional and managerial occupations than both general brick-and-mortar and e-commerce retailers.[22]

Here, in-state e-commerce retail requirements for transportation and related occupations are considering both in-house and out-sourced. Previously, we've chosen to consider that out-of-state e-commerce retailers outsource last-mile transportation and warehousing instead of conducting these processes in-house as that was how major e-commerce retailers conducted the last-mile transportation and warehousing during the period studied.

For the following analysis let's consider a labor market problem as a simplification of Bartik (2018). In this framework, in-state occupational wages are determined by the inverse labor-demand elasticity σ_h and a labor productivity shifter α_h such that the inverse-labor demand for a given occupation is $w_h = \alpha_h LD_h^{-\sigma_h}$, where the in-state labor demand LD_h for each occupation h be $LD_h = \sum_j l_{hj}$, with $j = B, S, O$ representing the in-state retail sectors, general brick-and-mortar retail, warehouse clubs and supercenters and e-commerce retail.

In the baseline model, workers chose how much of their work was allocated to each sector. However, as sectors have different requirements for occupations, it is reasonable to assume that workers are in fact choosing between different occupations. Hence, in this framework, each worker k has a bundle of skills, Θ_k, to perform several tasks. We assume all bundles can be placed on a line such that different intervals belong to different occupations. For example, transportation and material moving occupations require less complex skills than sales and related occupations or professional occupations. While employees that require less complex skills can acquire additional skills and access to other occupations, skill acquisition is costly, since it requires human capital accumulation. Also, workers with more complex skills can perform occupations that require less complex skills, however as they are not the best match to those occupations, they face costs related to adaptation

[21] This means that $L_S > L_B > L_O$

[22] This is equivalent to assume
$\theta_{sS} > \theta_{sB} > \theta_{sO}, \theta_{pO} > \theta_{pB} > \theta_{pS}, \theta_{oO} > \theta_{oS} > \theta_{oB}$ and $\theta_{tO} > \theta_{tB} > \theta_{tS}$.

and lower wages.

In that sense, for a given set of distributions of wages, skill bundles, initial occupation h_0 and vacancies, workers place themselves into occupations such that they maximize their indirect utility over occupation h:

$$v_{kh} = \ln(w_h) - s^H c_k^H \times 1(h \neq h_0)$$

Where w_h is the occupational wage, c_k^H is an idiosyncratic moving cost which is a function of the bundle of skills that the worker has $c_k^H(\Theta_k)$, and s^H is a measure of the importance of this cost. This setup is a particular case of Bartik (2018) in which workers do not move across locations (location moving cost is set to infinity).

The labor supply for each occupation will depend on the vector of wages w, the initial number of workers in each occupation N_{h_0}, and a function $G(\cdot)$ that assigns probabilities of choosing each occupation based on w and the distribution function of moving costs $F(c_i^H)$:

$$LS_h(w) = \sum_{h_0} N_{h_0} G(F(c_i^H), w)$$

The equilibrium in the labor market is characterized by the aggregate labor demand being equal to the aggregate labor supply for each occupation:

$$LD_h(w) = LS_h(w)$$

As the labor demand for each occupation is the sum of all retailers labor demands for such occupation, the labor demand in a given occupation will be affected by both the importance of each retailer in the total labor demand, previously defined as λ_j, as well as the shares that the occupation represents in each retailer labor demand, θ_{hj}.

As an increase in the sales tax rate for out-of-state e-commerce retailers reduces their demand of last-mile transportation and warehousing services, this reduction will lead to a decline of the labor demand and wages of transportation employees in that sector.

Moreover, if in response to the removal of the price advantage there is an increase in employment in warehouse clubs and supercenters and a decrease in employment of general brick-and-mortar retail, we may expect a decline in the labor demand of transportation and professional occupations, and an increase in the labor demand of sales and office occupations. Finally, as general brick-and-mortar retailers now have incentives to start selling online, and out-of-state e-commerce retailers now have incentives to locate themselves in the local economy, we may expect a decrease in the labor demand of sales occupations, and an increase in the labor demand of professional, office and transportation occupations. Hence, given the observed wages and occupational moving costs, transportation employees may be underqualified to work in sales or office occupations, while professional employees may be underqualified to work in sales or office occupations, leading to mismatches in the retail local labor market. Similarly, sales employees may be overqualified to work in transportation occupations, or underqualified to work in professional or office occupations, leading to additional mismatches in the retail local labor market.

7 Conclusion

In this paper, we present evidence of a non-neutral role for e-commerce on local labor markets. I find that the enactment of legislation requiring out-of-state e-commerce retailers to collect sales taxes, known as the Amazon Tax, leads to decreases in retail employment and retail establishments, as well as in last-mile warehousing and transportation employment and wages, consistent with the findings of Chun (2019) and Chava et al. (2018). Moreover, we discover that these effects are more pronounced in urban commuting zones, and that they are explained by a decrease in employment of brick-and-mortar retailers while the employment at warehouse clubs and supercenters increases.

Additionally, in non-urban commuting zones, we observe a change in the retail occupational structure consisting of an increase in the share of office and service related occupations and a decrease in the share of sales and related occupations, which leads to a similar occupational structure of e-commerce retail.

Finally, we show that the effects of e-commerce differ by sector and spatial dimension. Through a general equilibrium model, we connect the differential effects with different elasticities of substitution, which is consistent with Bar-isaac et al. (2012) and Vitt (2020).

These results suggest that even though e-commerce retail is only a small portion of the retail sector, it plays an important role in the local economy, in contrast with the conclusions of Hortaçsu and Syverson (2015). The differential effects in employment in warehouse clubs and supercenters and general brick-and-mortar retail may indicate that once the e-commerce retail price advantage is removed, the competition between the first two retail sectors could intensifies, forcing general brick-and-mortar retailers to either downsize or go out of business. In non-urban areas, the compositional changes in employment imply that retailers turn towards a hybrid model that anticipates internet usage growth.

Furthermore, the results may indicate the ineffectiveness of an increase in sales taxes, such as the enactment of the Amazon Tax, in terms of slowing down or stopping the "Retail apocalypse". The inefficacy of this policy may be caused by erroneous perceptions of elasticities of substitution sizes. Additional research is needed regarding both consumers' and workers' preferences to better identify policies that protect retail employees from the changes caused by e-commerce growth.

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8 Appendix

8.1 Solving for Equilibrium Effects

In this section, I present the equations of change of the model following the log-linearization method of Jones (1965), and solve for the effects of a small increase in the tax rate of out-of-state e-commerce retail. Totally differentiating the production functions from equations in (I):

$$\widehat{B} = \widehat{L_B} \tag{3}$$

$$\widehat{S} = \widehat{L_S} \tag{4}$$

$$\widehat{E} = \widehat{L_E} \tag{5}$$

Where $\widehat{i}$ is the proportional change of $i = B, S, E$, $\widehat{i} \equiv di/i$, and $\widehat{L_i}$ is the proportional change of labor in sector $i = B, S, E$, $\widehat{L_i} \equiv dL_i/L_i$

From differentiating the resource constraint:

$$\lambda_X \widehat{L_X} + \lambda_Y \widehat{L_Y} + \lambda_Z \widehat{L_Z} = 0 \tag{6}$$

Here, the fraction of labor supplied used in the production of retail is given by λ_i for $i = B, S, E$, with $\lambda_i = \frac{L_i}{\hat{L}}$. As before, $\widehat{L_i} \equiv \frac{dL_i}{L_i}$ is the proportional change in L_i.

I totally differentiate the equations in (III)to obtain:

$$\widehat{p_B} + \widehat{B} = \widehat{w_B} + \widehat{L_B} \tag{7}$$

$$\widehat{p_S} + \widehat{S} = \widehat{w_S} + \widehat{L_S} \tag{8}$$

$$\widehat{p_E} + \widehat{E} = \widehat{w_E} + \widehat{L_E} \tag{9}$$

From the definition of workers' elasticity of substitution between sectors:

$$\widehat{L_B} - \widehat{L_S} = \eta_1 \left(\widehat{w_S} - \widehat{w_B}\right) \tag{10}$$

$$\widehat{L_B} - \widehat{L_E} = \eta_2 \left(\widehat{w_E} - \widehat{w_B}\right) \tag{11}$$

$$\widehat{L_E} - \widehat{L_S} = \eta_3 \left(\widehat{w_S} - \widehat{w_E}\right) \tag{12}$$

Finally, from the definition of consumer' elasticity of substitution for types of retail(B, S, E):

$$\widehat{B} - \widehat{S} = \sigma_1 \left(\widehat{p_S} + \widehat{\tau_S} - \widehat{p_B} - \widehat{\tau_B}\right) \tag{13}$$

$$\widehat{B} - \widehat{E} = \sigma_2 \left(\widehat{p_E} + \widehat{\tau_E} - \widehat{p_B} - \widehat{\tau_B}\right) \tag{14}$$

$$\widehat{E} - \widehat{S} = \sigma_3 \left(\widehat{p_S} + \widehat{\tau_S} - \widehat{p_E} - \widehat{\tau_E}\right) \tag{15}$$

With $\widehat{\tau_i} = \frac{d\tau_i}{1+\tau_i}$

This model is characterized by the assumptions of perfect competition, perfect mobility, perfect information and perfect certainty, and defined by equations (3)-(18).

I solve for the effects of an increase in the ad valorem tax rate on sales of out-of-state e-commerce retail, sector E, while the remaining tax rates do not change, $\widehat{\tau_B} = 0$,$\widehat{\tau_S} = 0$. Since I focus on real behavior, I choose S as numeraire, hence $\widehat{p_S} = 0$. Combining equations I, II, III and 3, 4, 5, I find:

$$\hat{p_B} = \hat{w_B}, \hat{p_S} = \hat{w_S}, \hat{p_E} = \hat{w_E} \tag{15}$$

As $\hat{p_S} = 0$ due to S being the numeraire, hence:

$$\widehat{w_S} = \widehat{p_S} = 0 \tag{14a}$$

Combining equations 8,9 and 10, I obtain the expression:

$$\hat{p_B} = \frac{\sigma_3 - \sigma_2}{\sigma_1 - \sigma_2}(\hat{p_E} + \hat{\tau_E}) = \epsilon_U(\hat{p_E} + \hat{\tau_E}) \tag{16}$$

Combining equations 5,6 and 7, I obtain the expression:

$$\hat{p_B} = \frac{\eta_3 - \eta_2}{\eta_1 - \eta_2}\hat{p_E} = \epsilon_L\hat{p_E} \tag{17}$$

Combining expressions 15, 16 and 17, I find 14b and 14c

$$\widehat{w_E} = \widehat{p_E} = \widehat{w_T} = \widehat{p_T} = -A\widehat{\tau_E} \tag{14b}$$

$$\widehat{w_B} = \widehat{p_B} = -A\epsilon_L\widehat{\tau_E} \tag{14c}$$

Combining equation 8 with 14b and 14c, I obtain:

$$\hat{S} = \hat{B} + \frac{\sigma_1\epsilon_L\epsilon_U}{\epsilon_L - \epsilon_U}\hat{\tau_E} \tag{18}$$

Combining equation 9 with 14b and 14c, I obtain:

$$\hat{E} = \hat{B} + \frac{\sigma_2\epsilon_L(\epsilon_U - 1)}{\epsilon_L - \epsilon_U}\hat{\tau_E} \tag{19}$$

Combining expressions 18 and 19 with equation 3 and I, I find:

$$\widehat{L_B} = \widehat{L_B} = [\lambda_S\sigma_1\epsilon_U A + \lambda_E\sigma_2(\epsilon_U - 1)A]\,\widehat{\tau_E} \tag{14e}$$

Combining equation II, 14e and expression 18, I obtain

$$\widehat{L_S} = \widehat{L_S} = [(\lambda_S - 1)\sigma_1\epsilon_U A + \lambda_E\sigma_2(\epsilon_U - 1)A]\,\widehat{\tau_E} \tag{14f}$$

Finally, combining equations III, 14e and expression 19 I find

$$\widehat{L_E} = \widehat{E} = \widehat{L_T} = \widehat{T} = [\lambda_S\sigma_1\epsilon_U A + (\lambda_E - 1)\sigma_2(\epsilon_U - 1)A]\widehat{\tau_E} \tag{14d}$$

8.2 Derivations of Proposition 1

To derive Proposition 1, I evaluate each of the effects separately. I present the conditions that lead to Proposition 1 through Propositions 2-6.

Proposition 2 *The wage, and price, of E will fall if an only if:*

$$\epsilon_L = \frac{\eta_3 - \eta_2}{\eta_1 - \eta_2} < \frac{\sigma_3 - \sigma_2}{\sigma_1 - \sigma_2} = \epsilon_U$$

That is, wages in transportation and warehousing will fall if and only if the relative differences in preferences for consumers, ϵ_U , is larger than the relative differences in preferences for workers, ϵ_L.

An example where this proposition holds is a case where consumers' elasticity of substitution between e-commerce retail and warehouse clubs and supercenter retail, σ_3, is larger than consumers' elasticities of substitution for both types of retail with respect of general brick-and-mortar retail, σ_2 and σ_1, while the workers' elasticities of substitutions are similar across the three sectors.

Proposition 3 *The wage, and price, of B will fall if an only if:*

$$\frac{1}{\epsilon_U} = \frac{\sigma_1 - \sigma_2}{\sigma_3 - \sigma_2} < \frac{\eta_1 - \eta_2}{\eta_3 - \eta_2} = \frac{1}{\epsilon_L}$$

Hence, wages in general brick-and-mortar retail will fall if and only if the inverse of relative differences in preferences for consumers, ϵ_U , is larger than the inverse of relative differences in preferences for workers, ϵ_L. Proposition 2 also holds with the previous example.

The following propositions show under which conditions a rise on the tax rate on out-of-state e-commerce sales, $\widehat{\tau_E} > 0$, leads to a rise or fall of the labor requirements of the three sectors.

Proposition 4 *Let ϵ_U and ϵ_L are the relative differences in preferences for consumers and workers respectively: $\epsilon_U = \frac{\sigma_3 - \sigma_2}{\sigma_1 - \sigma_2}$ and $\epsilon_L = \frac{\eta_3 - \eta_2}{\eta_1 - \eta_2}$, and $C = \frac{\lambda_S \sigma_1}{(\lambda_E - 1)\sigma_2}$. E-commerce consumption,E, as well as labor requirements in transportation and warehousing,L_W, will fall if an only if either one of these cases holds:*

Case I: $0 < \epsilon_L < \epsilon_U$ *and* $\epsilon_U < \frac{1}{1+C}$
Case II: $\epsilon_L < \epsilon_U$, $\epsilon_L < 0$ *and* $\epsilon_U > \frac{1}{1+C}$
Case III: $\epsilon_L > \epsilon_U$, $\epsilon_L > 0$ *and* $\epsilon_U > \frac{1}{1+C}$
Case IV: $0 > \epsilon_L > \epsilon_U$ *and* $\epsilon_U < \frac{1}{1+C}$

Under cases I and II, Propositions 2 and 3 also hold. The additional requirement for Proposition 4 to hold is given by the consumers' relative elasticity of substitution of general brick-and-mortar retail with respect to other retail sectors, σ_1/σ_2, weighted by the ratio of labor shares in warehouse clubs and supercenters and e-commerce retail, $\lambda_S/(\lambda_E - 1)$. Notice that as $\lambda_E - 1 < 0$, C is also negative. Hence, for case I to hold, it must be the case that $0 \leq |C| < 1$ and larger enough such that $\epsilon_U < \frac{1}{1+C}$.The underlying condition such that the absolute value of C is smaller than 1 is given by $\lambda_S/(1 - \lambda_E) < \sigma_1/\sigma_2$, where $\lambda_S/(1 - \lambda_E) = \lambda_S/(\lambda_S + \lambda_B) < 1$. An example in which case I may be true is if consumers' elasticity of substitution between general brick-and-mortar and warehouse clubs and supercenters is smaller than their elasticity of substitution between general

brick-and-mortar and e-commerce retail. For case II to hold, it must be true that either $\leq |C| > 1$ or $\epsilon_U > \frac{1}{1+C}$; then a sufficient condition is that $\lambda_S/(1-\lambda_E) > \sigma_1/\sigma_2$ which holds with σ_1 sufficiently small.

Under cases III and IV, Propositions 2 and 3 don't hold, which implies that wages in transportation and warehousing and general brick-and-mortar retail increase when the tax on e-commerce increase. Moreover, case III and IV only require $\epsilon_U > \frac{1}{1+C}$ and $\epsilon_U < \frac{1}{1+C}$ respectively, without any boundary restriction for C.

Proposition 5 *Let ϵ_U and ϵ_L are the relative differences in preferences for consumers and workers respectively: $\epsilon_U = \frac{\sigma_3-\sigma_2}{\sigma_1-\sigma_2}$ and $\epsilon_L = \frac{\eta_3-\eta_2}{\eta_1-\eta_2}$, and $D = \frac{(\lambda_S-1)\sigma_1}{\lambda_E\sigma_2}$. Retail warehouse clubs and supercenters consumption, S, as well as its labor requirements will rise if an only if either one of these cases holds:*

Case V: $0 < \epsilon_L < \epsilon_U$ *and* $\epsilon_U > \frac{1}{1+D}$
Case VI: $\epsilon_L < \epsilon_U$, $\epsilon_L < 0$ *and* $\epsilon_U < \frac{1}{1+D}$
Case VII: $\epsilon_L > \epsilon_U$, $\epsilon_L > 0$ *and* $\epsilon_U < \frac{1}{1+D}$
Case VIII: $0 > \epsilon_L > \epsilon_U$ *and* $\epsilon_U > \frac{1}{1+D}$

Under cases V and VI, Propositions 2 and 3 also hold. The additional requirement for Proposition 5 to hold is given by the consumers' relative elasticity of substitution of general brick-and-mortar retail with respect to other retail sectors, σ_1/σ_2, weighted by the ratio of labor shares in warehouse clubs and supercenters and e-commerce retail, $(\lambda_S - 1)/\lambda_E$. Notice that as $\lambda_S - 1 < 0$, D is also negative. Hence, for case V to hold, it can be true that either $\leq |D| > 1$ or $\epsilon_U > \frac{1}{1+D}$; then a sufficient condition is that $(1 - \lambda_S)/\lambda_E = (\lambda_B + \lambda_E)/\lambda_E > \sigma_1/\sigma_2$ which holds with σ_1 sufficiently small, since $(1 - \lambda_S)/\lambda_E > 1$. For case VI to hold, it must be the case that $0 \leq |D| < 1$ and larger enough such that $\epsilon_U < \frac{1}{1+D}$.The underlying condition such that the absolute value of D is smaller than 1 is given by $(1 - \lambda_S)/\lambda_E < \sigma_1/\sigma_2$, where $(1 - \lambda_S)/\lambda_E = \lambda_E + \lambda_B/\lambda_E > 1$. An example in which case VI may be true is if consumers' elasticity of substitution between general brick-and-mortar and warehouse clubs and supercenters is smaller than their elasticity of substitution between general brick-and-mortar and e-commerce retail.

Under cases VII and VIII, Propositions 2 and 3 don't hold, which implies that wages in transportation and warehousing and general brick-and-mortar retail increase when the tax on e-commerce increase. Moreover, case VII and VIII only require $\epsilon_U < \frac{1}{1+D}$ and $\epsilon_U > \frac{1}{1+D}$ respectively, without any boundary restriction for D.

Proposition 6 *Let ϵ_U and ϵ_L are the relative differences in preferences for consumers and workers respectively: $\epsilon_U = \frac{\sigma_3-\sigma_2}{\sigma_1-\sigma_2}$ and $\epsilon_L = \frac{\eta_3-\eta_2}{\eta_1-\eta_2}$, and $F = \frac{\lambda_S\sigma_1}{\lambda_E\sigma_2}$. Retail consumption from general brick-and-mortar retailers, B, as well as their labor requirements will fall if an only if either one of these cases holds:*

Case IX: $\frac{1}{1+F} > \epsilon_U > \epsilon_L > 0$
Case X: $\epsilon_U > \frac{1}{1+F} > 0 > \epsilon_L$
Case XI: $\epsilon_L > \epsilon_U > \frac{1}{1+F} > 0$
Case XII: $0 > \epsilon_L > \epsilon_U$ *and* $\epsilon_U < \frac{1}{1+F}$

Under cases IX and X, Propositions 2 and 3 also hold. The additional requirement for Proposition 6 to hold is given by the consumers' relative elasticity of substitution of general brick-and-mortar

retail with respect to other retail sectors, σ_1/σ_2, weighted by the ratio of labor shares in warehouse clubs and supercenters and e-commerce retail, λ_S/λ_E. Notice that as both λ_S and λ_E are shares of labor employed in each sector, $\lambda_S/\lambda_E > 0$, then F is also positive and $1/(1+F) < 1$. For case IX to hold, it must be true that $\epsilon_U < 1$; then a necessary condition is that either $\sigma_3 < \sigma_1$ with σ_2 sufficiently small or $\sigma_3 > \sigma_1$ with σ_2 sufficiently large. The opposite is true for cases X and XI.

Under cases XI and XII, Propositions 2 and 3 don't hold, which implies that wages in transportation and warehousing and general brick-and-mortar retail increase when the tax on e-commerce increase. Moreover, case XI and XII only require $\epsilon_U < \frac{1}{1+F}$ and $\epsilon_U > \frac{1}{1+F}$ respectively. Case XII requires then that $\epsilon_U < 1$, or equivalently either $\sigma_3 < \sigma_1$ with σ_2 sufficiently small or $\sigma_3 > \sigma_1$ with σ_2 sufficiently large, while case XI does not impose any additional boundary restriction for F.

9 Tables

Table 1: Balance Table - State characteristics before the Amazon Tax enactment

	Without Amazon Tax	With Amazon Tax	Difference
Number of Amazon FC	0.02	0.00	0.02
Median HHD income	47596	43898	3698***
Employment share ind. 1	0.01	0.00	0.00***
Employment share ind. 2	0.08	0.07	0.01**
Employment share ind. 3	0.12	0.15	-0.03***
Employment share ind. 4	0.25	0.24	0.01**
Employment share ind. 5	0.15	0.14	0.01**
Employment share ind. 6	0.20	0.24	-0.03***
Employment share ind. 7	0.14	0.11	0.03***
Employment share ind. 8	0.04	0.05	-0.00*
State sales tax rate	3.90	5.58	-1.68***
Population 0 to 14	0.20	0.18	0.01***
Population 15 to 24	0.13	0.13	-0.00
Population 25 to 44	0.23	0.23	0.00
Population 45 to 64	0.28	0.28	-0.00
Population 65 to 84	0.14	0.15	-0.01***
Working age population	93995	120859	-26865
Total Population	141580	181500	-39920
College rate	0.20	0.18	0.02***
High school degree rate	0.52	0.56	-0.05***
Rate of white	0.84	0.94	-0.10***
Rate of black	0.05	0.03	0.03**
Rate of Hispanic	0.09	0.03	0.06***
Rate of female	0.50	0.50	-0.01***

The table presents a comparison of selected characteristics between states that enacted Amazon Tax in 2013 and states that did not enact Amazon Tax or signed Voluntary Collection Agreements before 2017. Employment shares by industries grouped at 1 digit code: Agriculture, forestry, fishing and hunting (ind 1), Mining, Utilities and Construction (ind 2), Manufacturing (ind 3), Wholesale trade, Retail, Transportation and Warehousing (ind 4), FIRE and Professional and Business Services (ind 5), Education, Health Care, and Social Assistance (ind 6), Arts, Entertainment, Recreation, Accommodation, and Food Services (ind 7) and Other services (ind 8). Sources: American Community Survey (ACS) years 2010-2016, Census Intercensal Population Estimates 2010-2020, Small Area Income and Poverty Estimates Program, MWPVL International and TaxFoundation.org

Table 2: Employment

Panel A: Sample all commuting zones

	Overall	Transportation & Warehousing	Retail	Warehouse Clubs & Supercenters	General Brick-and-Mortar Retail
Enactment of Amazon Tax	326.5	-34.82**	-74.56**	66.84*	-143.3***
	(485.6)	(13.55)	(31.41)	(31.85)	(40.53)
Baseline mean	46848.09	364.31	7349.84	1062.36	6183.85
Observations	2,051	2,051	2,051	2,051	2,051
Year and CZ FE	YES	YES	YES	YES	YES

Panel B: Sample urban commuting zones

	Overall	Transportation & Warehousing	Retail	Warehouse Clubs & Supercenters	General Brick-and-Mortar Retail
Enactment of Amazon Tax	532.4	-33.20*	-96.48**	86.22**	-181.6***
	(533.5)	(18.08)	(38.84)	(38.83)	(43.44)
Baseline mean	54564.11	496.60	7866.42	1112.24	6589.61
Observations	518	518	518	518	518
Year and CZ FE	YES	YES	YES	YES	YES

Panel C: Sample non-urban commuting zones

	Overall	Transportation & Warehousing	Retail	Warehouse Clubs & Supercenters	General Brick-and-Mortar Retail
Enactment of Amazon Tax	-532.9	-39.13	-1.150	-10.00	0.0713
	(328.4)	(25.56)	(61.91)	(30.77)	(71.85)
Baseline mean	44240.85	319.61	7175.28	1045.51	6046.74
Observations	1,533	1,533	1,533	1,533	1,533
Year and CZ FE	YES	YES	YES	YES	YES

This table presents the estimates of the difference-in-differences model, where Enactment of Amazon Tax refers to the estimation coefficient (δ) from $Y_{cy} = \alpha_c + \gamma_y + \delta D_{sy} + \epsilon_{cy}$, where outcome variable is $\frac{Emp_{cy}}{Pop_{cy}} \times 100000$ for both each corresponding sector (columns). All specifications include year and commuting zone fixed effects and standard errors cluster at the state level.

Table 3: Establishments

Panel A: Sample all commuting zones

	Transportation & Warehousing	Retail	Warehouse Clubs & Supercenters	General Brick-and-Mortar Retail
Enactment of Amazon Tax	-0.175	-1.970	0.638*	-2.195
	(0.187)	(2.107)	(0.312)	(1.954)
Baseline mean	9.33	441.13	20.33	414.69
Observations	2,051	2,051	2,051	2,051
Year and CZ FE	YES	YES	YES	YES

Panel B: Sample urban commuting zones

	Transportation & Warehousing	Retail	Warehouse Clubs & Supercenters	General Brick-and-Mortar Retail
Enactment of Amazon Tax	-0.304	-3.712*	0.685**	-3.969**
	(0.183)	(1.869)	(0.307)	(1.656)
Baseline mean	9.79	379.34	14.07	357.23
Observations	518	518	518	518
Year and CZ FE	YES	YES	YES	YES

Panel C: Sample non-urban commuting zones

	Transportation & Warehousing	Retail	Warehouse Clubs & Supercenters	General Brick-and-Mortar Retail
Enactment of Amazon Tax	0.275	4.006	0.523	3.951
	(0.338)	(3.484)	(0.468)	(3.543)
Baseline mean	9.18	462.01	22.44	434.11
Observations	1,533	1,533	1,533	1,533
Year and CZ FE	YES	YES	YES	YES

This table presents the estimates of the difference-in-differences model, where Enactment of Amazon Tax refers to the estimation coefficient (δ) from $Y_{cy} = \alpha_c + \gamma_y + \delta D_{sy} + \epsilon_{cy}$, where outcome variable is $\frac{Emp_{cy}}{Pop_{cy}} \times 100000$ for both each corresponding sector (columns). All specifications include year and commuting zone fixed effects and standard errors cluster at the state level.

Table 4: Annual wages and hourly wages

Panel A: Sample all commuting zones

	ln(annual income wages)			ln(hourly wages)		
	Overall	Transportation &Retail Warehousing		Overall	Transportation & Warehousing	Retail
Enactment of Amazon Tax	0.00283	-0.0830***	-0.0119	-0.0107	-0.0770**	-0.0132
	(0.00985)	(0.0228)	(0.0199)	(0.00739)	(0.0310)	(0.0204)
Baseline mean	25170.64	36413.11	21520.36	17.84	22.80	14.30
Observations	2,051	2,051	2,051	2,051	2,051	2,051
Year and CZ FE	YES	YES	YES	YES	YES	YES

Panel B: Sample urban commuting zones

	ln(annual income wages)			ln(hourly wages)		
	Overall	Transportation &Retail Warehousing		Overall	Transportation & Warehousing	Retail
Enactment of Amazon Tax	0.00498	-0.0740**	-0.00458	-0.0100	-0.0815*	-0.0109
	(0.0101)	(0.0350)	(0.0191)	(0.00794)	(0.0387)	(0.0270)
Baseline mean	27283.75	38113.17	22127.82	19.41	23.84	15.35
Observations	518	518	518	518	518	518
Year and CZ FE	YES	YES	YES	YES	YES	YES

Panel C: Sample non-urban commuting zones

	ln(annual income wages)			ln(hourly wages)		
	Overall	Transportation &Retail Warehousing		Overall	Transportation & Warehousing	Retail
Enactment of Amazon Tax	-0.00428	-0.114	-0.0403	-0.0106	-0.0572	-0.0212
	(0.0193)	(0.0966)	(0.0326)	(0.0109)	(0.0806)	(0.0177)
Baseline mean	24456.62	35838.67	21315.10	17.31	22.45	13.94
Observations	1,533	1,533	1,533	1,533	1,533	1,533
Year and CZ FE	YES	YES	YES	YES	YES	YES

This table presents the estimates of the difference-in-differences model, where Enactment of Amazon Tax refers to the estimation coefficient (δ) from $Y_{cy} = \alpha_c + \gamma_y + \delta D_{sy} + \epsilon_{cy}$, where outcome variable is annual wages and hourly wages for each corresponding sector (columns). All specifications include year and commuting zone fixed effects and standard errors cluster at the state level.

Table 5: Retail occupational shares

Panel A: Sample all commuting zones

	Occupational Share			
	Transportation, Construction & Production	Office & Sales Services		Managerial & Professional
Enactment of Amazon Tax	-0.0160	0.123	-0.397	0.290
	(0.553)	(0.377)	(0.503)	(0.448)
Baseline mean	17.32	21.15	52.67	8.86
Observations	2,051	2,051	2,051	2,051
Year and CZ FE	YES	YES	YES	YES

Panel B: Sample urban commuting zones

	Occupational Share			
	Transportation, Construction & Production	Office & Sales Services		Managerial & Professional
Enactment of Amazon Tax	-0.274	-0.240	0.200	0.314
	(0.610)	(0.425)	(0.468)	(0.440)
Baseline mean	15.65	21.10	53.26	9.99
Observations	518	518	518	518
Year and CZ FE	YES	YES	YES	YES

Panel C: Sample non-urban commuting zones

	Occupational Share			
	Transportation, Construction & Production	Office & Sales Services		Managerial & Professional
Enactment of Amazon Tax	0.847	1.512***	-2.515**	0.156
	(0.773)	(0.507)	(0.940)	(0.823)
Baseline mean	17.88	21.17	52.47	8.47
Observations	1,533	1,533	1,533	1,533
Year and CZ FE	YES	YES	YES	YES

This table presents the estimates of the difference-in-differences model, where Enactment of Amazon Tax refers to the estimation coefficient (δ) from $Y_{cy} = \alpha_c + \gamma_y + \delta D_{sy} + \epsilon_{cy}$, where outcome variable is $Y_{cyi} = \frac{Emp_{cyi}}{Emp_{cy}}$ for each occupational group: transportation and material moving occupations, production and construction occupations (SOC 53-, 51-, 45-, 47- and 29-), office and service occupations (SOC 43-, and 3X-), sales and related occupations (SOC 41-), and managerial and professional occupations (SOC 1X- and 2X-). All specifications include year and commuting zone fixed effects and standard errors cluster at the state level.

Table 6: Restricted Sample: Employment

Panel A: Sample all commuting zones

	Employment/Population				
	Overall	Transportation & Warehousing	Retail	Warehouse Clubs & Supercenters	General Brick-and-Mortar Retail
Enactment of Amazon Tax	-82.04	-33.38*	-71.33*	35.62	-92.30***
	(371.8)	(16.62)	(38.73)	(22.88)	(30.34)
Observations	1,827	1,827	1,827	1,827	1,827
Year and CZ FE	YES	YES	YES	YES	YES

Panel B: Sample urban commuting zones that does not cross state borders

	Employment/Population				
	Overall	Transportation & Warehousing	Retail	Warehouse Clubs & Supercenters	General Brick-and-Mortar Retail
Enactment of Amazon Tax	82.67	-24.50	-97.33*	49.97*	-126.6***
	(381.3)	(26.13)	(47.43)	(27.34)	(38.97)
Observations	462	462	462	462	462
Year and CZ FE	YES	YES	YES	YES	YES

Panel C: Sample non-urban commuting zones that does not cross state borders

	Employment/Population				
	Overall	Transportation & Warehousing	Retail	Warehouse Clubs & Supercenters	General Brick-and-Mortar Retail
Enactment of Amazon Tax	-438.1	-58.92**	18.87	-2.963	12.75
	(359.3)	(26.21)	(65.15)	(35.16)	(81.42)
Observations	1,365	1,365	1,365	1,365	1,365
Year and CZ FE	YES	YES	YES	YES	YES

Table 7: Covariates: Employment

Panel A: Sample all commuting zones

	Overall	Transportation & Warehousing	Retail	Warehouse Clubs & Supercenters	General Brick-and-Mortar Retail
Enactment of Amazon Tax	-82.04	-33.38*	-71.33*	35.62	-92.30***
	(371.8)	(16.62)	(38.73)	(22.88)	(30.34)
Observations	1,827	1,827	1,827	1,827	1,827
Year and CZ FE	YES	YES	YES	YES	YES
Covariates	YES	YES	YES	YES	YES

Panel B: Sample urban commuting zones

	Overall	Transportation & Warehousing	Retail	Warehouse Clubs & Supercenters	General Brick-and-Mortar Retail
Enactment of Amazon Tax	392.1	-38.69	-79.97**	75.07**	-158.8***
	(290.8)	(26.80)	(35.11)	(30.56)	(41.99)
Observations	518	518	518	518	518
Year and CZ FE	YES	YES	YES	YES	YES
Covariates	YES	YES	YES	YES	YES

Panel C: Sample non-urban commuting zones

	Overall	Transportation & Warehousing	Retail	Warehouse Clubs & Supercenters	General Brick-and-Mortar Retail
Enactment of Amazon Tax	-485.7**	-23.24	-8.995	1.333	-15.75
	(206.6)	(17.15)	(68.93)	(27.40)	(76.00)
Observations	1,533	1,533	1,533	1,533	1,533
Year and CZ FE	YES	YES	YES	YES	YES
Covariates	YES	YES	YES	YES	YES

10 Figures

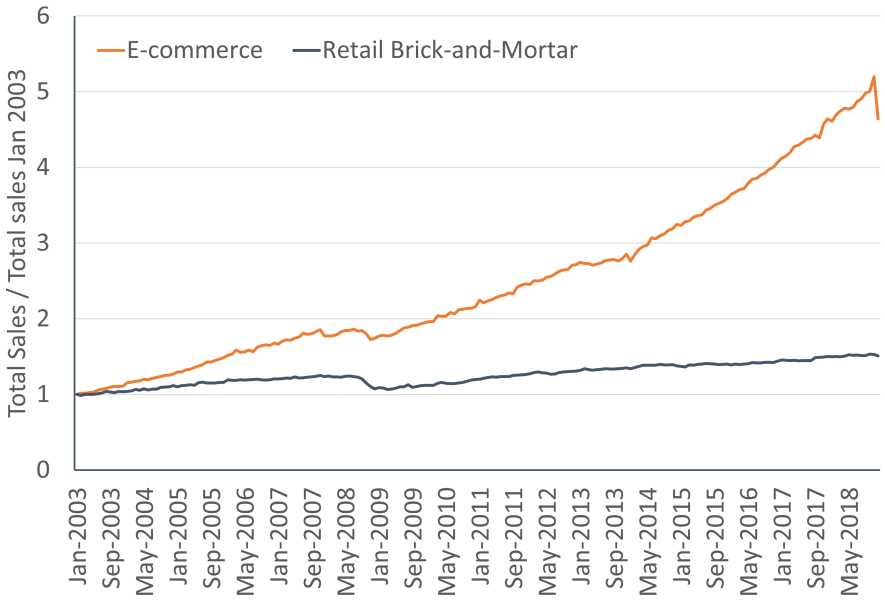
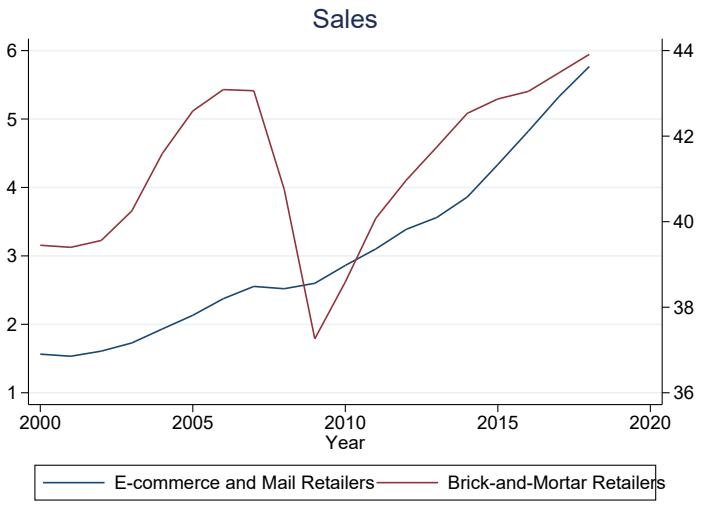
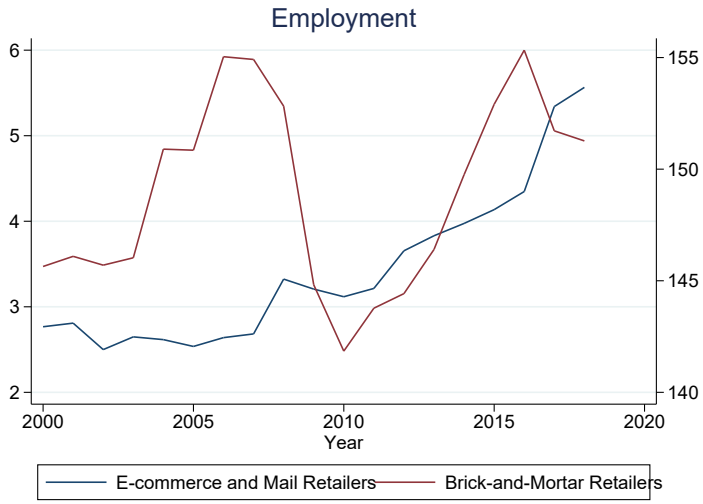


Figure 1: Sales growth e-commerce vs brick-and-mortar retailers

This figure presents e-commerce share and brick-and-mortar share from total sales computed from Annual Retail Trade Survey years 2003-2017. E-commerce retail here refers to electronic commerce and mail order houses industry (NAICS 4541), brick-and-mortar retailers are the remaining retailers.



(a) Sales



(b) Employment

Figure 2: Sales vs Employment in retail

These figures show total sales in millions computed from Annual Retail Trade Survey years 2005-2017. Employment in millions computed from County Business Patters data. Brick-and-mortar retailers are retailers that are not in the electronic commerce and mail order houses industry (NAICS 4541).

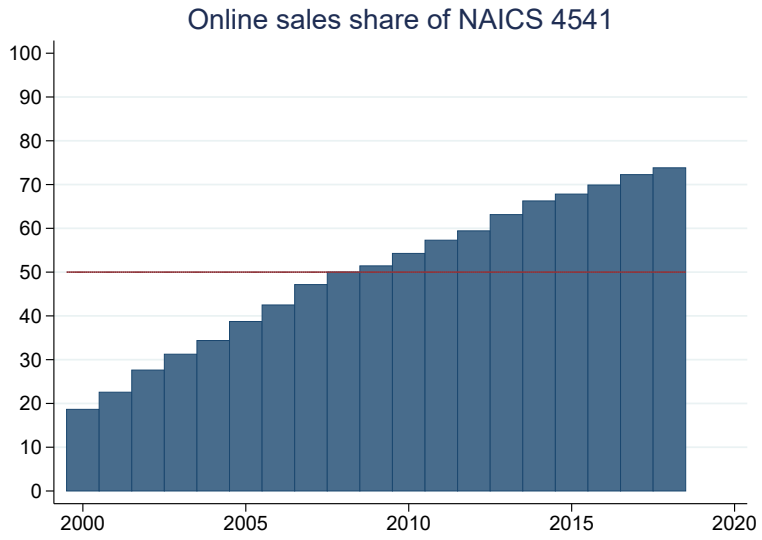


Figure 3: Online sales share from e-commerce retail sales

This figure shows online sales share from e-commerce total sales computed from Annual Retail Trade Survey years 2005-2017. E-commerce retailers here is short for electronic commerce and mail order houses industry (NAICS 4541)

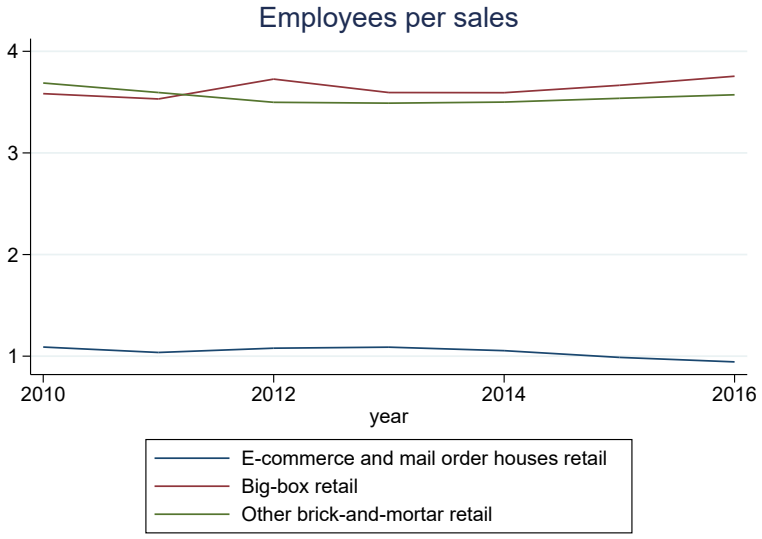
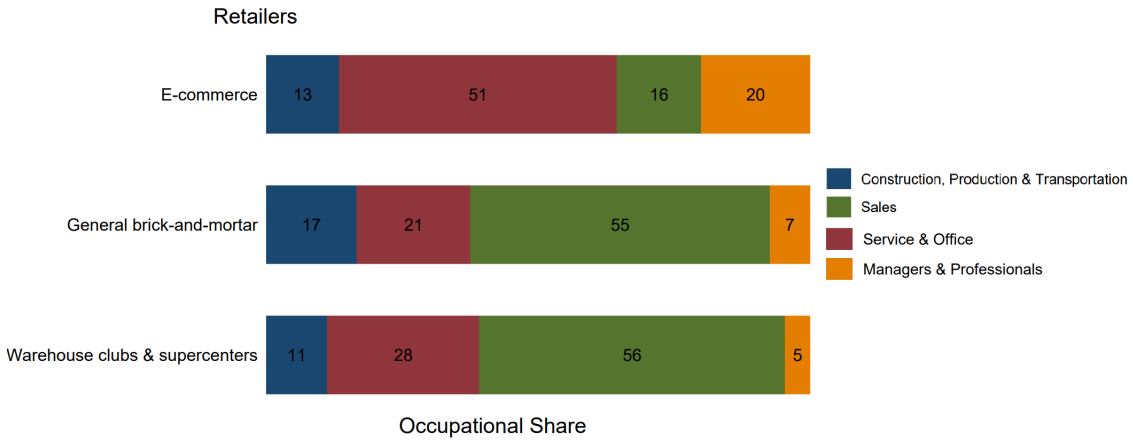


Figure 4: Employment per 100,000 M retail sales

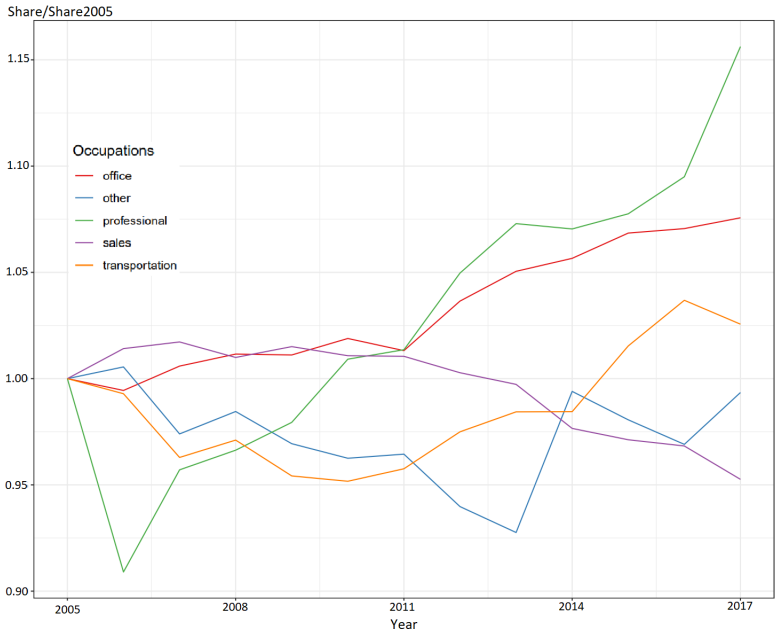
This figure shows total employment from County Business Patterns data. Total sales from Monthly Retail Trade and Food Services Survey years 2010-2017 deflated to 2014 usd.

Figure 5: Online retail sales growth vs warehousing and transportation employment growth

This figure shows warehousing and transportation employment growth rate computed from County Business Patterns data. Online retail sales growth rate computed from Annual Retail Trade Survey years 2005-2017.



(a) Retail Occupational Structure 2007



(b) Changes in the occupational structure of retail

Figure 6: Occupational Structure in Retail

This figure shows: Panel A: Share of occupations by sub-industry from Occupational Employment and Wage Statistics (OEWS) May 2007. Industries: E-commerce (NAICS 4541), Warehouse Clubs and Supercenters (NAICS 4529), General Brick-and-mortar (NAICS 441, 442, 443, 444, 445, 446, 447, 448, 451, 4521, 453, 4542 and 4543). Panel B: Share of occupations from the American Community Survey years 2005-2017. The occupational share represents Emp_{iR}/Emp_R where Emp is employment, i is the occupational group and R is retail. Changes are measured with respect to 2005, as $share_{iR,t}/share_{iR,2005}$. Panel A and B occupational shares for major retail occupations: transportation and material moving occupations, production and construction occupations (SOC 53-, 51-, 45-, 47- and 29-), office and service occupations (SOC 43-, and 3X-), sales and related occupations (SOC 41-), and managerial and professional occupations (SOC 1X- and 2X-)

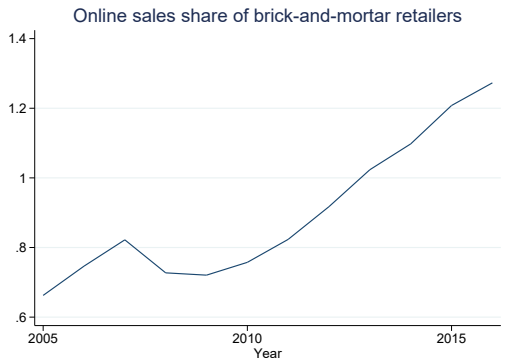


Figure 7: Online sales share from brick-and-mortar retail sales

This figure shows the share of online sales from brick-and-mortar total sales computed from Annual Retail Trade Survey years 2005-2017. Brick-and-mortar retailers are retailers that are not in the electronic commerce and mail order houses industry (NAICS 4541)

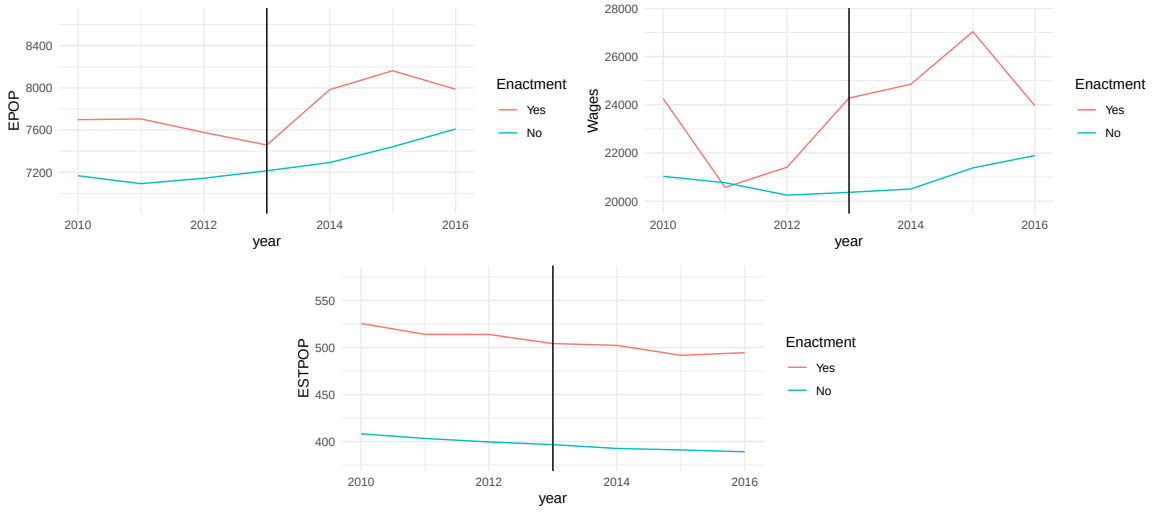


Figure 8: Retail - Enactment of the Amazon Tax in 2013
This figure presents: Panel (a) Average Retail Employment/working age population*100,000 for time-group treated commuting zones in 2013 vs Never Treated commuting zones. Working age population is population between ages 15 and 64 from Census Intercensal Population Estimates. Employment counts at the commuting zone level from County Business Patters. Panel (b) Average Retail Annual wages for time-group treated commuting zones in 2013 vs Never Treated commuting zones. Average annual income wages of employees in Retail at the commuting zone level from yearly American Community Survey. Panel (c) Average Retail Establishments/Population*100,000 for time-group treated commuting zones in 2013 vs Never Treated commuting zones. Population counts from Census Intercensal Population Estimates. Number of establishments at the commuting zone level from County Business Patters. Never Treated commuting zones exclude commuting zones of states that signed voluntary collection agreements or where Amazon.com, Inc was collecting sales tax due to physical presence.

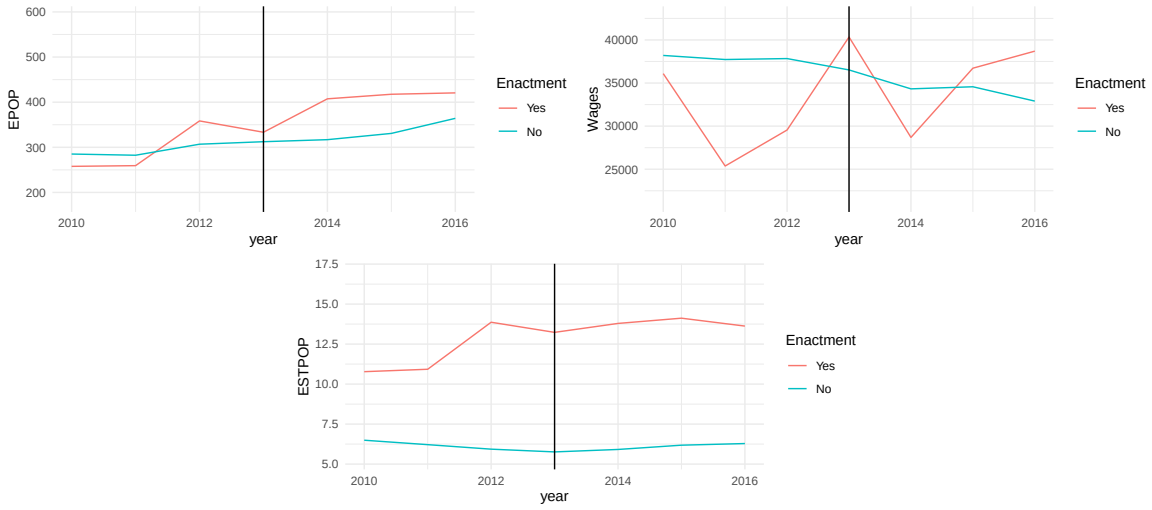


Figure 9: Last-mile transportation and warehousing - Enactment of the Amazon Tax in 2013
This figure presents: Panel (a) Average Transportation and Warehousing Employment/working age population*100,000 for time-group treated commuting zones in 2013 vs Never Treated commuting zones. Working age population is population between ages 15 and 64 from Census Intercensal Population Estimates. Employment counts at the commuting zone level from County Business Patters. Panel (b) Average Transportation and Warehousing Annual wages for time-group treated commuting zones in 2013 vs Never Treated commuting zones. Average annual income wages of employees in Transportation and Warehousing at the commuting zone level from yearly American Community Survey. Panel (c) Average Transportation and Warehousing Establishments/Population*100,000 for time-group treated commuting zones in 2013 vs Never Treated commuting zones. Population counts from Census Intercensal Population Estimates. Number of establishments at the commuting zone level from County Business Patters. Never Treated commuting zones exclude commuting zones of states that signed voluntary collection agreements or where Amazon.com, Inc was collecting sales tax due to physical presence.

Figure 10: Employment Shares for commuting zones that enacted Amazon Tax in 2013
This figure presents: Panel (a) Average retail employment share of transportation, construction and production occupations for time-group treated commuting zones in 2013 vs Never Treated commuting zones. Panel (b) Average retail employment share of office and service occupations for time-group treated commuting zones in 2013 vs Never Treated commuting zones. Panel (c) Average retail employment share of sales and related occupations for time-group treated commuting zones in 2013 vs Never Treated commuting zones. Panel (a) Average retail employment share of managerial and professional occupations for time-group treated commuting zones in 2013 vs Never Treated commuting zones. Employment counts by occupation and total employment at the commuting zone level from yearly American Community Survey. Never Treated commuting zones exclude commuting zones of states that signed voluntary collection agreements or where Amazon.com, Inc was collecting sales tax due to physical presence.

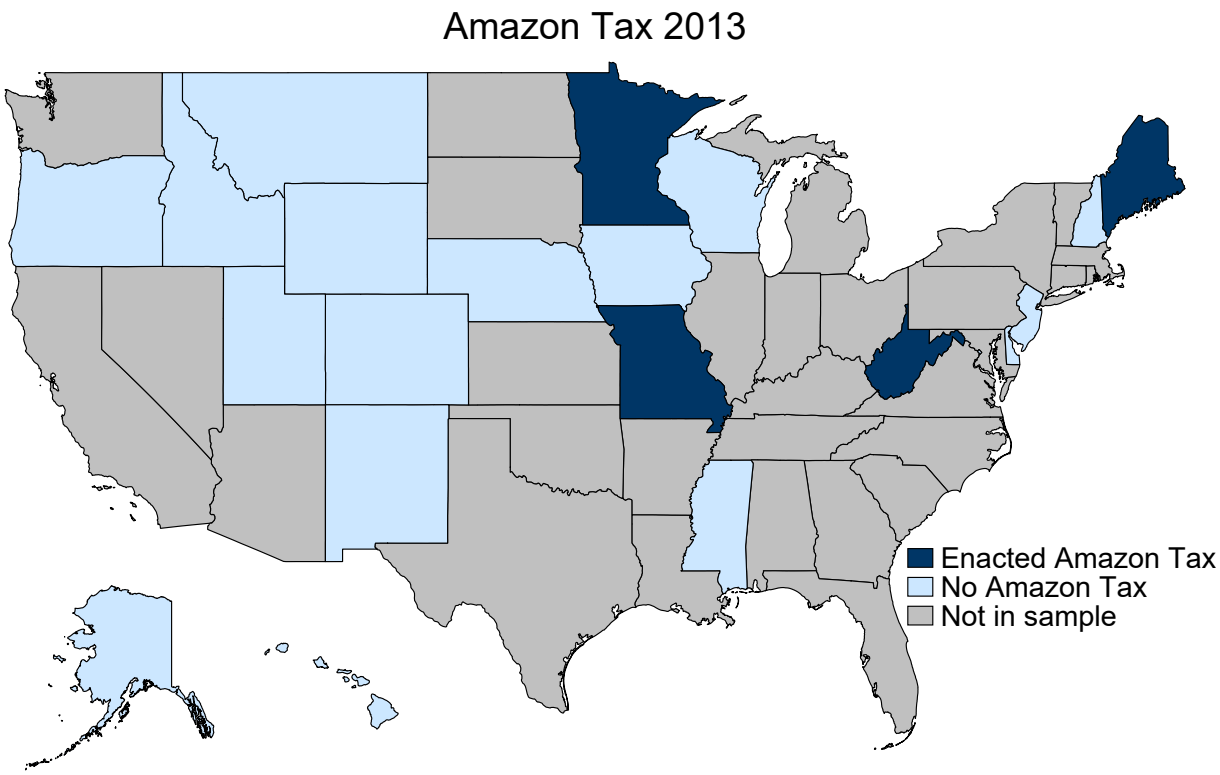
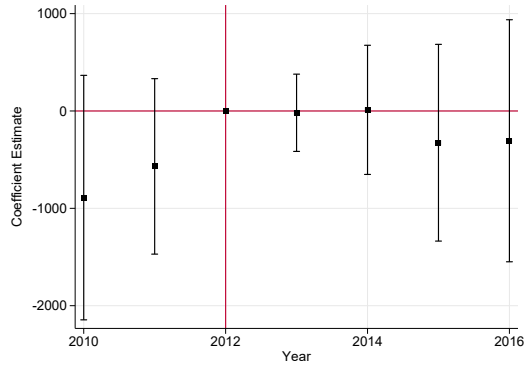
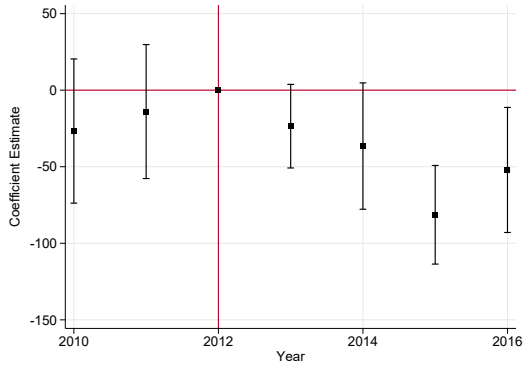


Figure 11: States in sample

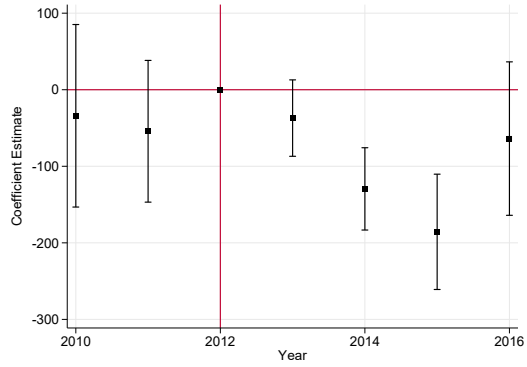
This figure presents in dark blue states that enacted the Amazon Tax in 2013, in light blue states that never enacted the Amazon Tax, in gray states excluded from sample because: enacted the Amazon Tax in other years,signed voluntary collection agreements with Amazon,Amazon was already collecting sales taxes due to physical presence.



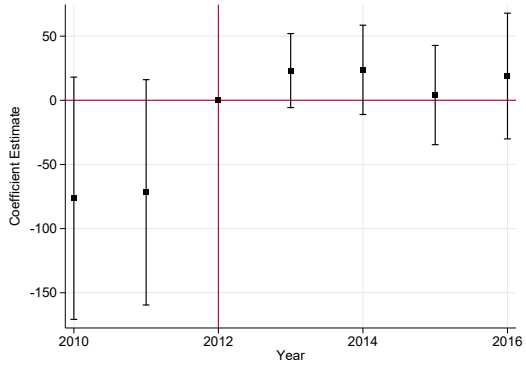
(a) Overall



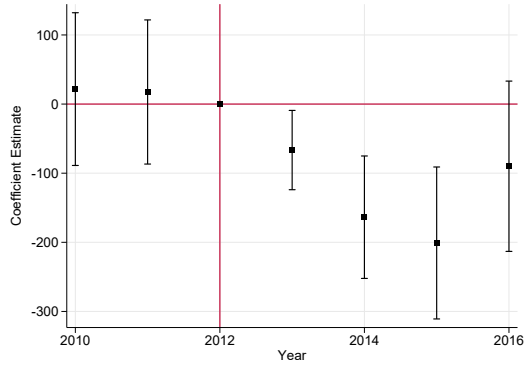
(b) Transportation & warehousing



(c) Retail



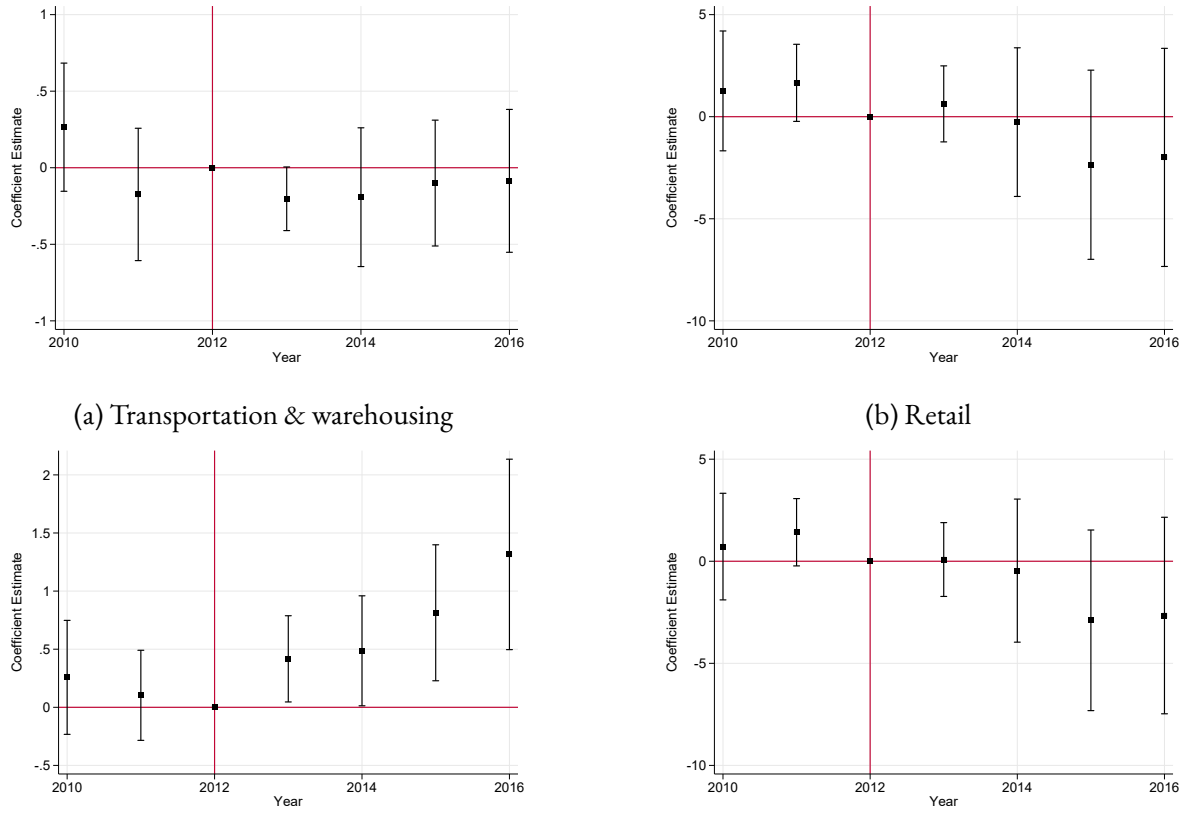
(d) Warehouse clubs & supercenters



(e) General brick-and-mortar retail

Figure 12: Employment/working age population by sector

This figure shows on each panel the coefficients and 95% confidence interval for separate event study regressions of the ratio between each sector employment and working age population. Regression coefficients are weighted by 2005 population and the standard errors are clustered at the state level.



(a) Transportation & warehousing

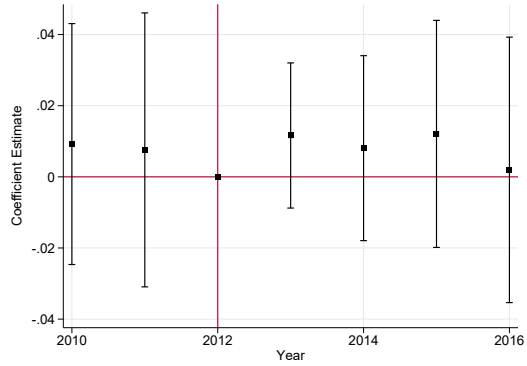
(b) Retail

(c) Warehouse clubs & supercenters

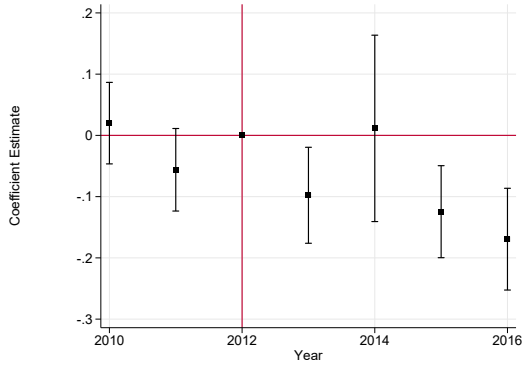
(d) General brick-and-mortar retail

Figure 13: Number of establishments/population by sector

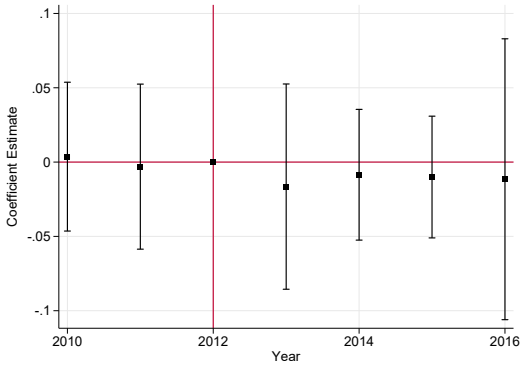
This figure shows on each panel the coefficients and 95% confidence interval for separate event study regressions of the ratio between each sector number of establishment and total population. Regression coefficients are weighted by 2005 population and the standard errors are clustered at the state level.



(a) Overall



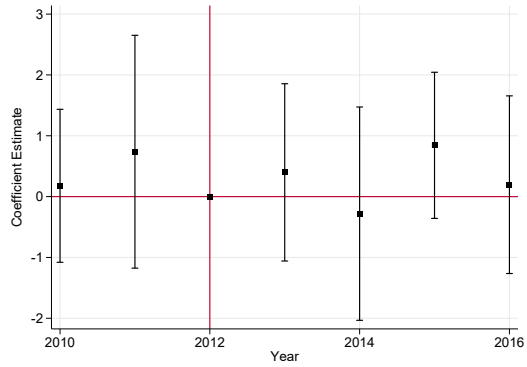
(b) Transportation & warehousing



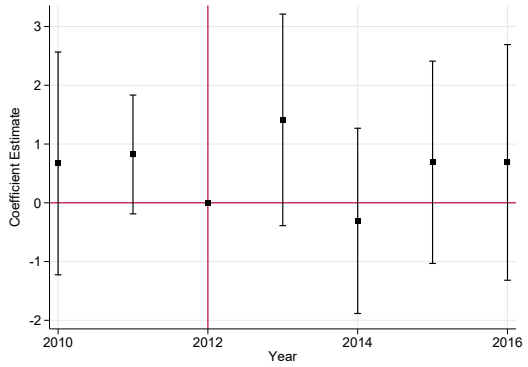
(c) Retail

Figure 14: log(annual income wages) by sector

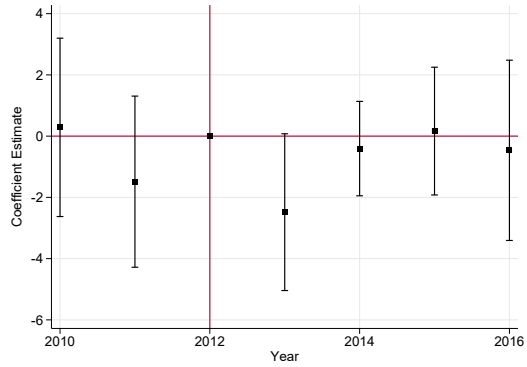
Each panel of this figure shows the coefficients and 95% confidence interval for separate event study regressions of the logarithm of each sector annual wages. Regression coefficients are weighted by 2005 population and the standard errors are clustered at the state level.



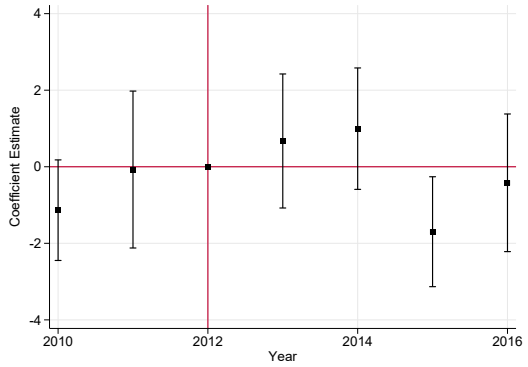
(a) Transportation, production & construction



(b) Office & services



(c) Sales



(d) Managerial & professional

Figure 15: retail occupational shares by occupation groups

Each panel on this figure shows the coefficients and 95% confidence interval for separate event study regressions of the retail occupational shares. Regression coefficients are weighted by 2005 population and the standard errors are clustered at the state level. Occupational shares classified as: transportation and material moving occupations, production and construction occupations (SOC 53-, 51-, 45-, 47- and 29-), office and service occupations (SOC 43-, and 3X-), sales and related occupations (SOC 41-), and managerial and professional occupations (SOC 1X- and 2X-)