**2023년도 최종보고서**

개인간 거래의 건전한 거래질서 확립을 위한
# 플랫폼 정책 연구 II

# E-Commerce and Local Labor Market

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## Abstract

The rapid growth of e-commerce is widely blamed for job losses in brick-and-mortar retail. Using geographic variations in online spending, constructed from over 30 billion credit card transactions in Korea, we examine the causal effect of e-commerce on local retail employment. We find that the rise in the share of online spending from 2010 to 2015 decreased county-level retail employment by about 4.9 percent. We also find that employment shifted from offline retail to other local businesses, such as restaurants and personal services. However, the shift in employment was confined to metropolitan areas, falling far short of offsetting employment losses in non-metropolitan areas. Our finding suggests that a Retail Job Apocalypse is likely in certain local labor markets (i.e., non-metropolitan areas).

Keywords: E-Commerce, Employment, Local Labor Market, Retail, Credit Card

## 1. Introduction

The rapid growth of e-commerce has dramatically changed the modern retail sector over the last few decades. The recent evolution of physical retail markets, driven by the shift in consumers' shopping behaviors toward online shopping, has caused an increasing number of traditional brick-and-mortar stores to shut down. Particularly, a series of bankruptcies among major retail chains in the US (e.g., Sears in 2018 and ToysRus in 2017) has raised concerns in the media about jobs being lost in the

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so-called "Retail Apocalypse" (Economist 2017, New York Times 2017). The extinction of physical retail stores, as some extreme views predict, may have a disruptive influence on local markets with a high retail job concentration by eliminating local jobs and shrinking local tax bases.

However, our understanding of the ongoing restructuring process in the retail industry and its effect on local labor markets is still limited. For example, along with the substantial job losses resulting from the destruction of brick-and-mortar stores, as reported in the major news media, some local businesses, on which the time and money saved via online shopping are now spent, can also fuel job creation. Despite the importance of the impact this process could have on local labor markets, academic efforts to quantify the effects of e-commerce have thus far remained scarce (Hortaçsu and Syverson 2015).

As an initial step in examining the effect of the diffusion of e-commerce on local labor markets, we attempt to answer the following three questions:

(i) Does online shopping expansion affect local offline retail employment negatively, and how large is this effect?

(ii) Is there any employment shift from offline retail to other local sectors (e.g., restaurants and personal services)?

(iii) In general, does e-commerce lead to a Retail Job Apocalypse? If not, does this occur in some local labor markets (i.e., metropolitan versus non-metropolitan)?

In this paper, we construct a unique measure of online retail spending share (hereafter "online share") at the county level based on more than 30 billion credit and debit card (hereafter "credit card") transactions in Korea. We match the county-level online share to the employment data constructed from the Census on Establishments (CE) and quantify the causal effect of e-commerce on retail employment.[2] Our findings are as follows.

First, we find that the increase in online shares decreased county-level

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[2] "Sigungu," in Korean, is a second-tier administrative division, and in the literature, this term conventionally translated into English as "county" (Cho et al. 2015). In Korea, counties are broadly consistent with local labor markets, and thus, they are chosen as a unit of observation in this study.

offline retail employment. The magnitude of this effect was not catastrophic but was substantial: a 1-percentage-point (pp) increase in online shares reduced employment by half a percent. Our estimate implies that the increase in online shares from 2010 to 2015 led to about 302 workers losing their jobs in a typical county, corresponding to an approximately 4.9% reduction in retail employment. To account for the endogeneity problem, we use instrumental variables and conduct falsification tests. The results are robust across model specifications, tests, and various alternative analyses. Moreover, we find that the negative effect of online shopping on employment at brick-and-mortar stores is widespread throughout all locations.

Second, we find some evidence that employment shifted from offline retail to other local businesses within a county, such as restaurants and personal services. This finding suggests that consumers who save time and money through online shopping may shift their resources toward other local businesses, such as coffee shops, restaurants, entertainment, beauty services, and gyms. We believe that the abovementioned changes in consumer behavior create new jobs in other local sectors, possibly offsetting job losses in the offline retail sector. However, such an employment shift is not uniformly observed across all locations; local service jobs are likely to be created in metropolitan areas but not necessarily in non-metropolitan ones.

Lastly, our finding suggests that Retail Job Apocalypses are not likely to be broadly observed. We find that Retail Job Apocalypses are only likely to occur in some local labor markets. Both metropolitan and non-metropolitan labor markets have suffered decreases in offline retail employment. However, the benefits of new job creation in local services are unevenly distributed between metropolitan and non-metropolitan areas. Although metropolitan areas have seen job growth in restaurants and personal services, such gains were not observed in non-metropolitan areas. This finding implies that the restructuring process initiated by the diffusion of e-commerce may evolve differently across local labor markets. In particular, local labor markets in non-metropolitan areas are more likely to

suffer from severe job losses.

A growing number of economic studies have begun examining the impact of e-commerce on offline retail employment (Chava et al. 2018, Gebhardt 2018). Chava et al. (2018) attempted to estimate the effect of Amazon fulfillment centers on local employment, but their study was based on the strong assumption that demand for Amazon's services increases in counties that are near fulfillment centers. In addition, Gebhardt (2018) used the geographic distribution of high-speed broadband access to estimate the impact of online retailers on employment. However, the lack of a direct measure for e-commerce spending across geographic markets has made it difficult to quantify the effect of e-commerce on local labor markets. To overcome this difficulty, we construct a unique measure of online spending share using credit card transaction data, which enables us to identify geographic variations in e-commerce diffusion. We contribute to the literature by quantitatively evaluating the causal effects of the diffusion of e-commerce on local labor markets.

Our findings are broadly related to the literature on the effects of new technologies on the labor market. Analyzing variations in exposure to industrial robots in US local labor markets, Acemoglu and Restrepo (2020) found that robots are taking over tasks that were previously performed by human workers. However, as Acemoglu and Restrepo (2018) highlighted, new technologies not only replace human labor but also create new tasks. For retail services, in which jobs in offline retail and the service sector are local in nature, whether or not the creation and destruction of jobs occur in the same location has important policy implications. Our study shows that new jobs are not necessarily created in the locations where retail jobs were originally lost. Although the negative effects on jobs in physical stores have been widely observed, the creation of new jobs in local services, which may have benefited from e-commerce, may not be equally distributed. The local labor markets that shared the negative effects but not the benefits of shifts in consumption patterns do not have very bright futures. Thus, identifying those locations is important for labor-market policies.

Figure 1. Diffusion of E-Commerce in Korea between 2010 and 2015

A. 2010                                    B. 2015
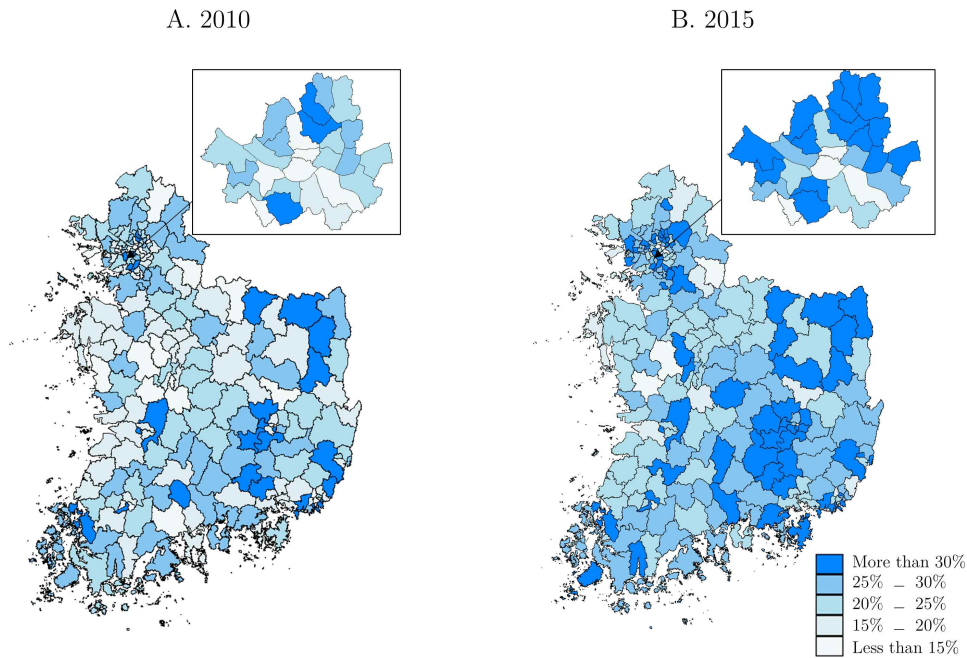


*Notes*: Maps A and B present the county-level online shares in 2010 and 2015, respectively. The online share of a county is computed as the sum of credit card spending at online retail stores by all credit cardholders of the Company who live in the county divided by the sum of the corresponding online and offline card spending in that county. The zoomed-in section is Seoul.

## 2. E-Commerce and Local Labor Markets

E-commerce sales have grown rapidly worldwide. As of 2015, the online shares in the UK, China, the US, and Japan were 12.5%, 10.8%, 7.18%, and 4.75%, respectively.[3] The online share in Korea reached 11.7% in 2015, considerably higher than that in most countries. Fast Internet connections and relatively low shipping costs, thanks to the country's relatively small country size, explain the fast diffusion of e-commerce in Korea.

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3) Sources: UK: Office for National Statistics "Internet Sales as a Percentage of Total Retail Sales"; US: US Census Bureau "Estimated Quarterly US Retail Sales (Adjusted): Total and E-commerce"; China: National Bureau of Statistics of China, "China Statistical Yearbook 2016"; Japan: Ministry of Economy, Trade and Industry "Results Compiled of the E-Commerce Market Survey"; Korea: Statistics Korea, "Monthly Online Shopping Survey"

As Figure 1 shows, e-commerce, measured as online shares, dramatically increased in Korea between 2010 and 2015. However, although the increase in online shares was widely observed in most counties in Korea, the degree of increase was not uniform across these counties. Specifically, the increase in online shares in metropolitan areas was 6.5 pp higher, on average, than non-metropolitan areas during the same period. Notably, however, despite some differences across locations, online shopping has become a major shopping method nationwide.

Offline retail stores, along with restaurants and personal services, are key employers in local labor markets. Technological progress and structural changes in the retail sector have affected local labor markets worldwide. The effect of such changes on the labor market has received considerable attention from economists and policymakers. Since the 1990s, the expansion of large discount stores (e.g., Walmart) has significantly influenced local labor markets (Basker 2005, Neumark et al. 2008, Cho et al. 2015). They have replaced and complemented neighborhood stores by using information and communication technology to secure low prices and high productivity (Foster et al. 2006, Haltiwanger et al. 2010).

Although these changes occurred between "physical" stores in local markets, replacing jobs at traditional stores with those at the big-box or new chain stores, the impact of e-commerce on local labor markets has been fundamentally different. The penetration of e-commerce has not necessarily created physical establishments in specific locales. Therefore, if online sales further increase, the closings of numerous brick-and-mortar stores could lead to a Retail Apocalypse (Corkery 2017, Economist 2017). Nonetheless, academic studies on this issue have been limited due to the difficulty of measuring the impact of e-commerce on individual local markets (Chava et al. 2018, Gebhardt 2018).

The diffusion of e-commerce has also dramatically changed local labor markets in Korea. From 2010 to 2015, the average growth rate of retail trade employment was approximately 2.5%, lower than that of total employment in all industries. Slow employment growth in the offline retail sector was widely observed across counties.

## 3.  Summary Statistics

To measure annual online shares by county, we use the credit card transaction data provided by Shinhan Card Co. (hereafter, "the Company"). And, we use two employment measures in our analysis: the number of workers and that of full-time-equivalent (FTE) jobs. To determine local retail employment, we mainly exploit the Census on Establishments (CE) obtained from Statistics Korea.

### Table 1. Descriptive Statistics at the County Level

A.  Employment: Dependent variables

|  | Mean | Median | S.D. | P25 | P75 |
|---|---|---|---|---|---|
| Offline retail employment per 10K people | | | | | |
|  Workers | 273 | 257 | 128 | 224 | 295 |
|  FTE jobs | 255 | 240 | 120 | 209 | 275 |
| Population | 225,609 | 150,598 | 214,764 | 58,375 | 339,711 |
| Workers | 5,686 | 4,274 | 5,148 | 1,615 | 8,543 |
| FTE jobs | 5,294 | 3,948 | 4,785 | 1,513 | 7,967 |

B.  E-commerce: Main explanatory variables

|  | Mean | Median | S.D. | P25 | P75 |
|---|---|---|---|---|---|
| Online share (%) | | | | | |
|  All | 24.124 | 23.895 | 6.357 | 19.751 | 27.749 |
|  Metropolitan counties | 24.776 | 24.557 | 7.351 | 19.883 | 29.078 |
|  Non-metropolitan counties | 23.795 | 23.613 | 5.770 | 19.724 | 27.009 |

C.  Control variables

|  | Mean | Median | S.D. | P25 | P75 |
|---|---|---|---|---|---|
| Per capita property tax (1,000 KRW) | 925 | 877 | 255 | 745 | 1,085 |
| Population growth rate (%) | 0.248 | -0.213 | 2.068 | -0.810 | 0.777 |
| Car ownership per capita | 0.395 | 0.400 | 0.075 | 0.350 | 0.440 |
| Share of female population (%) | 49.945 | 49.985 | 1.056 | 49.326 | 50.622 |
| Average household size | 2.384 | 2.370 | 0.217 | 2.204 | 2.564 |

*Notes:* The sample consists of 197 counties from 2011 to 2015. Both the online shares and control variables in panels B and C are lagged by one year.

Table 1 presents the county-level descriptive statistics for the 197-county sample between 2011 and 2015. Panel A provides the information on

employment (i.e., dependent variable); panel B reports that on e-commerce (i.e., the main explanatory variable); and panel C shows that on control variables. All explanatory variables in panels B and C are lagged by one year. As seen in panel A, the mean of offline retail employment per 10,000 people is 273, whereas those of population and offline workers are 225,609 and 5,686, respectively. The mean number of full-time-equivalent (FTE) jobs (5,294) differs little from the number of workers because self-employment accounts for almost 40% of total employment in the Korean retail sector. As presented in panel B, the mean online share is approximately 24%, increasing from 23% in 2010 to 28% in 2015. For the control variables, we use the log of per capita property tax, population growth rate, per capita car ownership, the female share of the population, and average household size.

## 4. Impact of E-commerce Expansion on Employment

We examine the extent to which e-commerce affects local retail employment by estimating the following equation.

$$\frac{Emp_{jt}}{Pop_{jt}} = \beta_0 + \beta_1 OS_{j,t-1} + X'_{j,t-1}\gamma + \mu_j + \delta_t + \epsilon_{jt}, \tag{1}$$

where $\dfrac{Emp_{jt}}{Pop_{jt}}$ is the offline retail employment per 10,000 people. For offline retail employment $Emp_{jt}$, both the number of workers and that of FTE jobs are used. The main explanatory variable $OS_{j,t-1}$ is the online share in county $j$ in year $t-1$ constructed from the credit and debit transactions of the Company.[4] Vector $X_{j,t-1}$ consists of the lagged county-level control variables (e.g., the log of per capita property tax, population growth rate, car ownership per capita, share of female population, and average household size). $\mu_j$ is the county-fixed effect that

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4) We use a one-year lag of online share to deal with simultaneity (i.e., to consider the possibility that an increase in the online share has a lagged effect on the change in employment. Following the advice of an anonymous referee, we examined growth rate models based on a 1-year difference. The results were qualitatively the same as those from the 1-year-lagged model.

captures the time-invariant heterogeneity, $\delta_t$ is the year-fixed effect, and $\epsilon_{jt}$ is the county-clustered standard error.

To eliminate the potential endogenous bias in our estimation, we use a shift-share instrument that predicts online shares exogenously by interacting the initial value of the local consumption share of a good with the online share for that good at the national level.[5] This inner product removes county-specific components of the change in online share that may be correlated with unobservable shocks to local employment (refer to Chun et al. (2023) for details).

Table 2 reports the average effects of online shopping expansion on local offline retail employment, estimated using equation (1). Panels A and B present the results for workers and FTE jobs, respectively. And, the OLS estimates are provided in columns (1) and (2), juxtaposed with the IV ones in columns (3) and (4).

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5) To measure the variation in product-specific online shares caused by improvements in e-commerce technologies, we use US data rather than Korean data.

Table 2. E-Commerce's Effect on Offline Retail Employment

| | Dependent Variable: Offline Retail Employment | | | |
| --- | --- | --- | --- | --- |
| | OLS | | IV | |
| | (1) | (2) | (3) | (4) |
| **Panel A. Employment** | | | | |
| Online share (%) | -1.473*** | -1.553*** | -2.542** | -2.735** |
| | (0.470) | (0.502) | (1.164) | (1.065) |
| Effect of a 1-pp increase in online share on | | | | |
| % of offline retail employment | -0.54 | -0.57 | -0.93 | -1.00 |
| Adj. $R^2$ | 0.249 | 0.257 | 0.043 | 0.051 |
| **Panel B. Full-Time Equivalent Jobs** | | | | |
| Online share (%) | -1.363*** | -1.410*** | -2.012** | -2.303** |
| | (0.439) | (0.467) | (1.003) | (0.912) |
| Effect of a 1-pp increase in online share on | | | | |
| % of offline retail FTE jobs | -0.54 | -0.55 | -0.79 | -0.91 |
| Adj. $R^2$ | 0.155 | 0.164 | -0.066 | -0.063 |
| Control variables | No | Yes | No | Yes |
| $F$-statistic in the first stage | - | - | 65.36 | 62.83 |
| Obs. | 985 | 985 | 985 | 985 |

*Notes:* The sample consists of 197 counties from 2011 to 2015. The dependent variable is county-level offline retail employment per 10,000 people. Employment is defined as the number of workers in panel A and the number of FTE jobs in panel B. The main explanatory variable, online share (%), is computed as the sum of credit card spending at online retail stores by all credit cardholders of the Company who live in the county divided by the sum of the corresponding online and offline card spending in that county. The instrument is used for IV estimation in columns (3) and (4), which exogenously predicts online shares by interacting the predetermined local product consumption shares in the initial period with national-level online shares by product. The control variables include the log of per capita property tax, population growth rate, per capita car ownership, female share of the population, and average household size. All explanatory variables are lagged by one year. All regressions include both the county- and year-fixed effects. County-clustered standard errors are presented in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

In column (1) of panel A, the OLS coefficient of online share is −1.473, which is negative and statistically significant at the 1% level. This means

that a 1-pp increase in online share led to a 1.473 decrease in offline retail workers per 10,000 people. To convert this into the change in the number of workers in a county, we multiply the estimated coefficient by the average county population in 10,000 people (i.e., 22.56 given in Table 1). The result implies that a 1-pp increase in online share eliminates 33.23 offline retail workers on average, equivalent to a 0.54% change in the total number of offline retail workers in a county. Under the model with control variables shown in column (2), the estimated impact is slightly greater than that shown in column (1), suggesting that a 1-pp increase in online share eliminates 35.03 workers (= 1.553 22.56) or 0.57% change at the county level.

As seen in columns (3) and (4), the IV results are not qualitatively the same, but their negative effects are slightly stronger. That is, the OLS specification is likely to underestimate these impacts, as the positive correlation between local employment and online share dominates the negative bias. The result in column (4) means the reduction of 61.70 workers (= 2.735 22.56) or 1.00% change at the county level due to a 1-pp increase in online share. Thus, our estimates suggest that the increase in the online share of 4.9 pp between 2010 and 2015 caused approximately 302 offline retail workers to lose jobs in each county, corresponding to approximately 4.9% of the total offline retail employment.

As Hortaçsu and Syverson (2015) highlighted, the diffusion of e-commerce has shown no sign of a slowdown, but it may reach saturation within a few decades. Based on the supposition that the online share will increase by 15 pp in the next decade, our estimates predict an almost 15% reduction in offline retail employment. In this respect, the negative effect our analysis reveals will have economic significance in the medium to long run.

Then, we examine whether the employment effect of e-commerce differs between metropolitan and non-metropolitan areas. In general, metropolitan areas are more densely populated than non-metropolitan ones, and because offline retail jobs are local in nature, e-commerce's impacts on them may vary. In our sample, metropolitan areas account for 34% of all

counties (66 of 197 counties) but 48% of the total population. For this analysis, we use the following equation:

$$\frac{Emp_{jt}}{Pop_{jt}} = \beta_M OS_{j,t-1} \times Metro_j + \beta_N OS_{j,t-1} \times NonMetro_j + X'_{j,t-1}\gamma + \mu_j + \delta_t + \epsilon_{jt}, \quad (2)$$

where $Metro_j$ is a dummy variable for whether county $j$ is located in metropolitan areas and $NonMetro_j$ is a dummy variable for whether county $j$ is located in non-metropolitan areas. The other variables and coefficients are the same as those in equation (1).

In fact, the time and money saved from online shopping may increase consumer demand for other local services, thereby potentially increasing employment in these service sectors. However, this positive effect of e-commerce is unlikely to be uniform across local markets. Understanding the effect of e-commerce on local labor markets requires careful examination of the extent to which such effects vary across locations. We consider two local service industries to which individuals who work in offline retail may transition relatively easily — restaurants and personal services. Here, we define personal services as services in personal care (e.g., hair shop), sports (e.g., gym), and entertainment (e.g., theater).

Figure 2 presents the estimated job losses and/or gains in (A) the offline retail sector, (B) the restaurant and personal-service sectors, and (C) the total (i.e., A and B combined) in metropolitan and non-metropolitan areas, during the sample period. In total, approximately 4,600 local jobs disappeared in metropolitan areas, whereas approximately 49,100 local jobs were lost in non-metropolitan areas. Previously, we found that retail job losses were common in all areas (approximately 4.9% on average). Although this is a substantial impact, we do not expect a serious problem in metropolitan areas where about eight-ninths of retail job losses were offset by job gains in other local sectors. However, in non-metropolitan areas, other local jobs were further destroyed (approximately 0.8% of restaurant and personal-service jobs combined). Our results provide possible evidence for a Retail Job Apocalypse in non-metropolitan areas, highlighting spatial disparities in the effects of e-commerce on labor markets.

Figure 2. Descriptive Statistics at the County Level
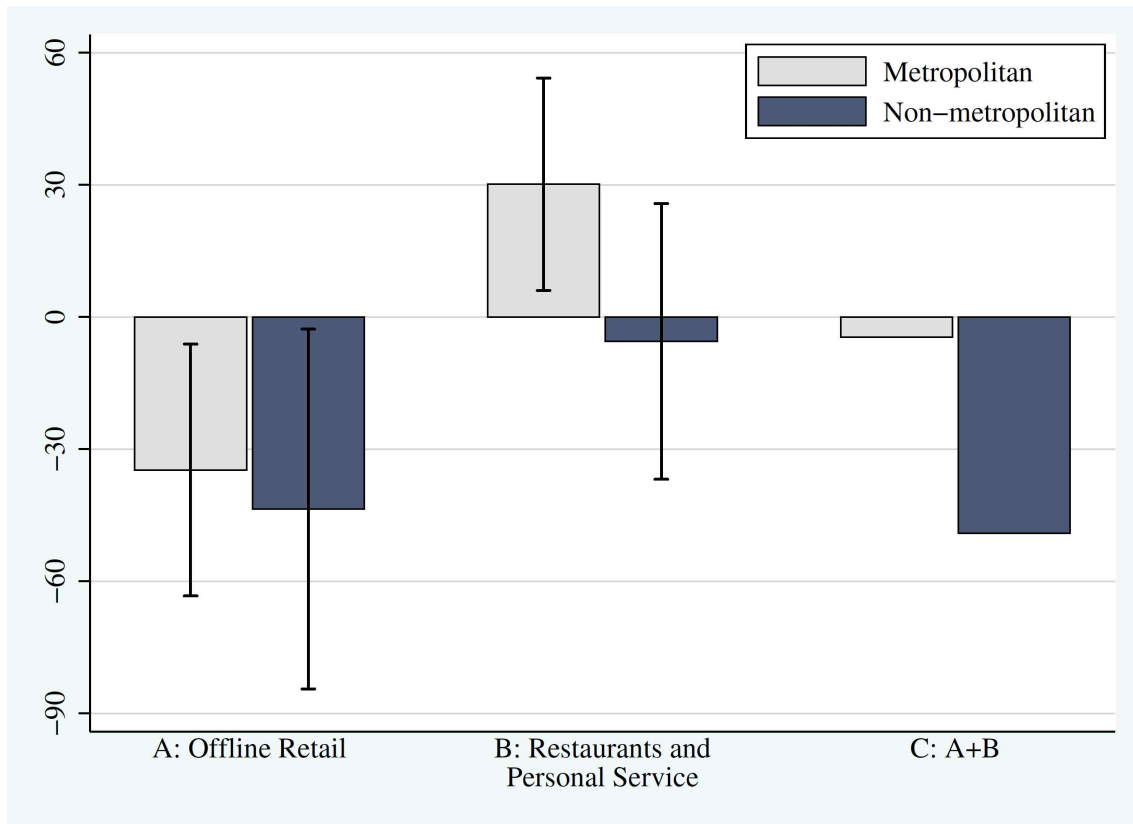


*Notes:* Panel A presents the e-commerce effect on local employment changes in the offline retail sector from 2010 to 2015; panel B describes that on the corresponding ones in the restaurants and personal service sectors (including hair shops, gyms, and theaters but excluding wedding, laundry, and funeral services) during the same period; and panel C depicts the combined effect of panels A and B. The gray bars denote the employment changes in the metropolitan counties, and the blue bars indicate those in the non-metropolitan ones. For example, as in Table 5, the metropolitan employment changes in the offline retail sector (e.g., the blue bar in panel A) is calculated as the coefficient estimate of metropolitan online share (−2.308) multiplied by the change in online share from 2010 to 2015 (6.532 pp) multiplied by the metropolitan population in 2010 (2,304 in 10,000). The unit of employment change is 1,000 workers. The other effects are calculated similarly. The black lines represent the 95% confidence intervals.

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