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Cross-Border Shopping, E-Commerce, and Consumption Tax Revenues in Japan

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Abstract

This study estimates the impact of cross-border consumption and e-commerce on local consumption tax revenues for Japanese municipalities. Descriptive statistics reveal that, in 2019, expenditure through e-commerce accounts for 2.5% of household consumption expenditures, 9.1% in other municipalities in the same prefecture, and 6.1% in other prefectures, all of which are higher than the values five years ago. The main findings obtained from the panel data analysis are as follows: First, local consumption tax revenue per capita is significantly lower by approximately 0.3% in municipalities with 10% more consumption spending outside the municipalities. Second, the revision of rules for allocating consumption tax revenues in 2018 has the effect of favoring municipalities facing a consumption drain with a large population but low in-store sales.

Keywords: Cross-border shopping, E-commerce, Local consumption tax

JEL Classification Codes: H71, H26, D12

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1 Introduction

In the context of commodity tax competition, numerous studies have reported that cross-border shopping reduces consumption tax revenues for local governments. In addition to the direct loss of tax revenue for regions that drain consumption to other regions, the competition among governments to lower tax rates on mobile tax bases reduces overall tax revenues. Taking some examples of analyses targeting the cross-border consumption of specific goods, Asplund et al. (2007) find that the outflow of consumption from Sweden to Denmark as a result of the Danish spirits tax cut has resulted in a 2% decrease in Swedish tax revenues from spirits consumption. Manuszak and Moul (2009) show that the tax rate differential in Chicago's suburbs diverts approximately 40% of gasoline demand from central Chicago to the surrounding suburbs, which in turn reduces tax revenues in the center.[1] The loss of tax revenue due to cross-border consumption is not only a subject of study for tax researchers but also a concern for policy practitioners. For example, Washington State reports that it has lost $3 billion in taxable retail sales due to cross-border shopping to neighboring Oregon and Idaho, where sales tax rates are lower (Washington State Department of Revenue, 2014). In addition to cross-border shopping to neighboring regions, the expansion of purchases over the Internet in recent decades allows consumers to choose the region from which to purchase, not only from neighboring regions but also from more distant regions and, therefore, from a greater number of regions. This would accelerate the interregional commodity tax competition for cross-border consumption, and several empirical studies have shown the impact of the expansion of e-commerce on local tax revenues. Among the earliest studies, Bruce and Fox (2000) and Bruce et al. (2009) found that as of 1999, the United States had lost $7 billion in annual state and local tax revenue due to e-commerce, and it was estimated that by 2012, that amount would increase from approximately $11.4 billion to $12.7 billion.[2] In the two most recent estimates for regions other than the United States, Han (2020) estimated that e-commerce taxation in China missed out on tax revenue equivalent to 29.5% of the actual tax revenue earned, and Argiés-Bosch et al. (2020) estimated, based on financial data from retailers operating in 22 European regions, that e-commerce retailers avoided 5% more points in taxes than traditional retailers.[3]

Several measures have been proposed in theory to make cross-border consumption and e-commerce neutral with respect to local tax revenues. If cross-border consumption is caused by differences in tax rates between regions, one approach would be for regional governments to apply a common tax rate, which would reduce the transactions across borders driven by taxes (Mintz and Tulkens, 1986; Kanbur and Keen, 1993). Taxation based on the destination principle rather than the origin principle is another way of mitigating this problem (Lockwood et al., 1994, p.5; Agrawal and Fox, 2017, p.917). In the case of origin-based taxation, a region with a lower tax rate has an advantage in terms of the tax burden on mobile firms and consumers, leading to a race for lower taxes. However, in the case of destination-based taxation, even if tax rates differ among regions, their tax burden remains the same regardless of where the production and consumption activities transpire; thus, competition for lower taxes is avoided and efficiency is not impaired. This has led to an international trend toward the destination-based taxation of goods purchased online (Agrawal and Fox, 2017; 2021). The common tax rate and destination-based tax are expected to correct the distortion in local tax revenues associated with cross-border consumption. However, at this stage, merely a few empirical studies have tested this notion, and the extent whereto they contribute to avoiding a decline in local tax revenues is unclear.

This study focuses on Japan, which practices two policies, namely, a common local tax rate and a destination-based consumption tax, and is a suitable country to quantify their effects. The former has applied to all municipalities since 1997, when the local consumption tax was introduced, and the latter is practiced through the *clearing system* that allocates consumption tax revenues based on the location of residence and consumption. However, the *clearing system* has been revised several times because it is difficult to neutralize the impacts of cross-border consumption. Specifically, in response to the expansion of e-commerce transactions, a revision was made in 2017 to eliminate its impact on local tax revenues.

[1] These results in turn mean that regions that attract consumers with low tax rates can increase their tax revenues. As a study from the perspective of consumption inflows countries, for example, Banfi et al. (2005) show that 9% of gasoline sales in the areas of Switzerland bordering Germany, France, and Italy can be attributed to cross-border consumption, which generates a corresponding increase in tax revenue.

[2] The main reasons for lower tax revenues are that it is technically more difficult to collect taxes on e-commerce, and e-commerce firms are more likely to move the nexus on which tax payments are based to regions with lower tax burdens.

[3] See Agrawal et al. (2022, Sec. 3.4) for other studies on the relationship between e-commerce developments and local taxes.

In the following year, 2018, the national government made a second revision to mitigate the impact of cross-border consumption. Quantifying the impact of cross-border consumption and e-commerce on local tax revenues in conjunction with an evaluation of system revisions is an empirical challenge. However, there is currently no study on Japan that quantitatively demonstrates whether the *clearing system* with these two institutional revisions has been able to neutralize the effects of cross-border consumption and e-commerce.

In this study, we use city-level data for 2014 and 2019, reflecting the changes to the rules for allocating tax revenues among municipalities implemented during this period and answer the following three questions: (i) To what extent do purchases of goods through e-commerce and cross-border purchases occur? (ii) Are cross-border and online consumption neutral to local consumption tax revenues under a *clearing system* for common tax rates and destination-based taxation? (iii) Have the reforms in 2017 and 2018 meant to address the development of cross-border consumption and e-commerce been effective? Our findings on these three questions are as follows: First, the average household spends 15.2% of its total consumption in other municipalities in our dataset. Second, on average, consumption expenditure through e-commerce as a percentage of total household consumption expenditure is 2.5%, with the municipality having the highest figure being at 9.4%. Third, even after controlling for the role of the *clearing system*, which aims to internalize the impacts of cross-border consumption and e-commerce, cross-border consumption still significantly reduces municipal consumption tax revenues, albeit on a smaller scale, whereas e-commerce has no significant impact. More specifically, cities with 10% more consumption outside the city by residents compared to the average have a 0.3% lower per capita tax revenue allocation. Finally, the rule revision for 2017 that mitigated the effects of e-commerce did not show a significant effect, while the 2018 revision that mitigated the effects of cross-border consumption did have a significant effect. It had the effect of increasing tax revenues in cities where consumption was draining, that is, where in-store sales in the city were low for a large population.

The remainder of this paper is organized as follows: Section 2 provides an overview of the Japanese consumption tax system and the estimation model. Section 3 presents the estimation results, and Section 4 concludes the paper.

2 Background and model

2.1 Local consumption tax in Japan

The government structure in Japan comprises three tiers: the national government, prefectures, and municipalities; the latter two are called local governments. Presently, Japan has 47 prefectures and 1,718 municipalities, each of which belongs to 1 prefecture. Notably, 1,718 municipalities are classified into 792 cities, 743 towns, and 183 villages. There are differences in population requirements depending on when a municipality changes the category to which it belongs: cities must have a population of 30,000 to 50,000 or more, in addition to an urbanization ratio and commercial and industrial ratios above a certain level. Towns have a population requirement of 8,000 or more, as well as other requirements set by each prefectural ordinance. Villages are municipalities that do not meet the definitions of cities or towns.

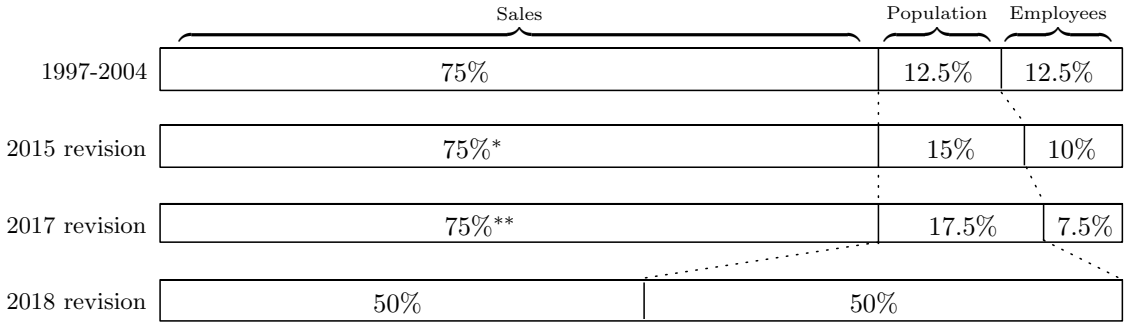
Introduced in 1989 as a national tax with a 3% rate, the consumption tax rate in Japan increased to 5% in 1997. At the time of this increase, a local consumption tax was introduced, and tax revenue equivalent to a 1% point of the 5% tax rate was to be allocated to local governments (the remaining 4% tax revenue would be national tax revenue). When the tax rate increased to 8% in 2014, the local consumption tax rate became 1.7% (the national tax rate was 6.3%). Furthermore, when the tax rate increased to 10% in 2019, the local consumption tax rate became 2.2% (the national tax rate was 7.8%). As the national and local governments tax the same tax base at different rates, national governments such as Canada, Germany, and Australia are responsible for collecting all consumption tax revenues and distributing them to local governments. The rules for allocating tax revenues differ from one country to another, and governments face the challenge of establishing how to achieve efficient and equitable tax revenue distribution. Japan is no exception. Consumption tax is collected by the national government and revenues are intended to be allocated to municipalities where consumption occurs based on certain rules, which were changed twice in 2017 and 2018 to reflect the development of cross-border consumption and e-commerce in the allocation of tax revenues. These changes were in response to complaints from cities adjacent to centers of sales, such as Tokyo and Osaka, where the clearing system did not adequately reflect consumption outflows and resulted in less tax revenue being allocated (Nakazato, 2018).

Tax revenues collected by the national government are distributed to local governments based on the ratio of the national to the local tax rate. They are first distributed to the prefectures according to interregional allocation rules called the *clearing rule*. Under this rule, prefectural governments receive 50% of the allocated tax revenues as theirs and distribute the remaining 50% to municipalities in the prefecture. When tax revenues are allocated from prefectures to municipalities, the amount that each municipality receives is determined by the municipal population share within the prefecture.[4]

Figure 1 shows the transition of clearing rules for allocating tax revenue from the national government to the prefectural governments. Rules are primarily structured using each prefecture's retail and service industry sales as well as the population (and number of employees before the 2018 revision of the criteria). In our paper, the *clearing rule* for 2018 and beyond is modeled as follows. The tax revenue allocated to prefecture i, R_i, is

$$R_i = \theta T \times \frac{\Pi_i}{\sum_{i=1}^{n} \Pi_i} + (1-\theta)T \times \frac{L_i}{\sum_{i=1}^{n} L_i}, \quad \text{where} \quad \Pi_i \equiv \Pi_{is} + \delta \Pi_{ie}. \tag{1}$$

θ and δ are policy variables, $n(=47)$ is the number of prefectures, T is the total tax revenue distributed from the national government to all prefectures, L_i is the population in prefecture i, and Π_i represents the sales in prefecture i, comprising in-store sales (Π_{is}) and sales from e-commerce (Π_{ie}). The clearing rule indicated in (1) refers to that of the total amount allocated from the national government (T), θ is allocated according to the local sales share, and the remaining $1-\theta$ is allocated according to the local population share. Until 2017, $\theta = 0.75$; since the 2018 revision, $\theta = 0.5$. Internet sales revenue is excluded from sales per the 2017 revision. This implies that what has been previously $\delta = 1$ is now $\delta = 0$ after 2018.



∗ Excluding information and communication sales and land sales, etc.
∗∗ Excluding Internet sales revenue

Figure 1. Clearing rules for allocating tax revenue from the national government to prefectures

Because half of the local tax revenues allocated to the prefectures is allocated according to the population ratio of the municipalities in the prefecture, given (1), the consumption tax revenue received by municipality j in prefecture i, r_{ij}, is given as follows:

$$r_{ij} = \frac{l_{ij}}{L_i} \times \frac{R_i}{2}, \quad \text{where} \quad L_i \equiv \sum_{j=1}^{m_i} l_{ij}. \tag{2}$$

m_i is the number of municipalities in prefecture i, and l_{ij} is the population of municipality j in prefecture i. Dividing both sides by l_{ij} yields the per capita local consumption tax revenue allocated to municipality j in prefecture i:

$$\frac{r_{ij}}{l_{ij}} = \frac{R_i}{2L_i}. \tag{3}$$

[4]The allocation of tax revenue from prefectures to municipalities is based solely on municipal population, so the municipal categories of city, town, and village can be ignored.

Substituting (1) into (3), and using $L_i \equiv \sum_{j=1}^{m_i} l_{ij}$ and $\Pi_i \equiv \Pi_{is} + \delta\Pi_{ie} = \sum_{j=1}^{m_i} \pi_{ijs} + \delta \sum_{j=1}^{m_i} \pi_{ije}$, where π_{ijs} and π_{ije} are store sales and e-commerce sales in municipality j of prefecture i, respectively, we have the basic equation for estimation:

$$\frac{r_{ij}}{l_{ij}} = \frac{T}{2} \cdot \left(\frac{\sum_{j=1}^{m_i} \pi_{ijs} + \delta \sum_{j=1}^{m_i} \pi_{ije}}{\sum_{j=1}^{m_i} l_{ij}} \cdot \frac{\theta}{\Pi} + \frac{1-\theta}{L} \right), \tag{4}$$

where $\Pi \equiv \sum_{i=1}^{n} \Pi_i$ and $L \equiv \sum_{i=1}^{n} L_i$ are constant values on an annual basis. From (4), it is expected that the larger the population of a municipality, the lower the tax revenue per resident.

$$\frac{\partial (r_{ij}/l_{ij})}{\partial l_{ij}} = -\frac{\theta T}{\Pi} \frac{\Pi_i}{L_i^2} < 0. \tag{5}$$

As noted above, the tax revisions that occur in 2017 and 2018 are captured by the declines in δ and θ in (4), and that the former revision is expected to disadvantage municipalities with large e-commerce sales and the latter municipalities with large sales and smaller populations.

2.2 Estimation model

Given (4), the basic estimation model is

$$\begin{aligned} tax\ revenue_{jt} = {} & \alpha_0 + \alpha_1 \cdot crossborder_{jt} + \alpha_2 \cdot Ecommerce_{jt} + \beta_1 \cdot storesales_{jt} + \beta_2 \cdot Ecomsales_{jt} \\ & + \beta_3 \cdot pop_{jt} + \gamma_1 \cdot year \times storesales_{jt} + \gamma_2 \cdot year \times Ecomsales_{jt} \\ & + \gamma_3 \cdot year \times pop_{jt} + \tau \cdot Z_{jt} + f_j + \epsilon_{jt}, \end{aligned} \tag{6}$$

where the variables are logarithmic; thus, the coefficients are indicated by elasticities. $tax\ revenue_{jt}$ on the left-hand side represents the consumption tax revenue per resident allocated to municipality j in year t, which corresponds to r_{ij}/l_{ij} in (4). On the right-hand side, $crossborder_{jt}$ and $Ecommerce_{jt}$ are, respectively, the expenditures that flow out to other prefectures from municipality j and the expenditures on mail order and Internet shopping in municipality j. Sales in municipality j are divided into in-store ($storesales_{jt}$) and online sales through e-commerce ($Ecomsales_{jt}$), corresponding to π_{ijs} and π_{ije} in (4), respectively. pop_{jt} represents the population of municipality j, corresponding to l_{ij} in (4). The number of employees in a municipality is also a component of the pre-2018 clearing rules. However, because the population and number of employees are strongly correlated, only the former is used in (6) to avoid multicollinearity. *year* is a dummy variable for rule changes in 2017 and 2018, which takes the value of 0 for 2014 and 1 for 2019. The year dummy captures the effect of the change in δ from 1 to 0 and the change in θ from 0.75 to 0.5 in (4). Z_{jt} is the control variable, and f_i is the municipality fixed effect. Time fixed effect is not included in (6) because there are only two periods of analysis. ϵ_{jt} is the error term, and to account for heterogeneity of variance, we use robust standard errors.

Based on the *clearing rules* presented in (1) and (2), β_1 and β_2 are expected to be positive. The theoretical prediction in (5) implies that β_3 is expected to be negative. γ_1 and γ_3 capture the effect of θ decreasing from 0.75 to 0.5, and γ_2 captures the effect of δ decreasing from 1 to 0. If these policy changes were effective, γ_1 and γ_2 would be expected to be negative, and γ_3 would be positive. We are most interested in α_1 and α_2, which capture the effects of consumption outflows on neighboring municipalities and e-commerce, respectively. As explained in the previous section, the Japanese clearing system and its two revisions are designed to neutralize the impact of cross-border consumption and e-commerce on local tax revenues as much as possible. After controlling for the effects of the clearing system through β_1 to β_3 and γ_1 to γ_3, we identify whether cross-border consumption and consumption through e-commerce still affect the local consumption tax revenue.

3 Results

3.1 Data

This study mainly focuses on cross-border and online purchases, for which the following two sets of data are essential. First, data showing the relationship between place of residence and place of purchase

	2014				2019			
	avg	s.d.	min	max	avg	s.d.	min	max
E-commerce (%)	2.27	0.79	0.58	5.74	2.51	1.19	0.39	9.40
cross-border within prefecture (%)	8.61	5.54	1.43	28.05	9.05	5.45	0.64	31.36
cross-border outside the prefecture (%)	5.19	3.00	0.53	19.38	6.09	3.98	0.52	21.21

Table 1: Descriptive statistics on e-commerce and cross-border consumption

Note. The sample size is 158 for 2014 and 159 for 2019. *E-commerce* is the share of e-commerce in consumption expenditures. *Cross-border within prefecture* is the share of consumption expenditures spent in other municipalities in the same prefecture. *Cross-border outside the prefecture* is the share of consumption expenditures spent in other prefectures.

of goods. Second, data showing the mode of purchase of the goods, that is, whether the goods were purchased through online and mail orders or in brick-and-mortar stores, and from which location they were purchased. Accordingly, we use a dataset from the National Survey of Family Income and Expenditure, which aggregates consumption-side information at the municipal level. This is a national survey conducted every five years by the Ministry of Internal Affairs and Communications, as obtained through a survey that comprehensively examines household income and expenditure. For the cross-border shopping indices, we use data that break down household purchases into (i) out-of-prefecture purchases, (ii) purchases in other municipalities in the prefecture, and (iii) purchases within the municipality in which they reside. For the method of purchase, we use data broken down into purchases made online and those made in brick-and-mortar stores.[5] In our analysis, we only use data from two years, 2014 and 2019, for the following reasons. First, we could only use data from 2014 onward because no surveys on online or mail order purchases were conducted prior to 2014. Second, the 2024 survey has not yet been conducted, and the 2019 survey results are the most recently available. Despite the limitations of panel data at only two time points, this study can at least capture the short-term effects of the revision of clearing rules between 2014 and 2019.

Table 1 presents the descriptive statistics on the consumption side with information on e-commerce and cross-border consumption. *E-commerce* is the share of e-commerce in household consumption expenditures. *Cross-border within prefecture* is the share of household consumption expenditures spent in other municipalities in the same prefecture. *Cross-border outside the prefecture* is the share of household consumption expenditures spent in other prefectures. The table shows that e-commerce expenditures as a percentage of total consumption expenditures is 2.27% in 2014 and 2.51% in 2019. The percentages consumed in other municipalities in the same prefecture were 8.61% and 9.05% for 2014 and 2019, respectively. The percentages consumed in other prefectures were 5.19% and 6.09% for 2014 and 2019. These figures indicate that cross-border consumption accounts for 13.80% of consumption expenditures in 2014 and 15.14% in 2019, which show that both e-commerce and cross-border consumption have expanded in the five years since 2014. Under the clearing rule, only out-of-prefecture cross-border consumption expenditures affect municipal consumption tax revenues, so it is *cross-border outside the prefecture* that is used as *crossborder* in the estimation in (6).

The descriptive statistics for the variables comprising the clearing rule and other control variables for the two years are summarized in Table 2. *Tax revenue* represents the local consumption tax revenue per resident and is used as a dependent variable in (6). *Ecomsales* and *storesales* are the annual e-commerce and retail store sales, respectively, in the municipality. The latter is defined as total retail sales minus *Ecomsales*. They are both taken from the Economic Census Activity Survey compiled by the Ministry of Economy, Trade, and Industry, which provides sales-side information. This dataset, surveyed every four years, includes retail store sales and ecommerce sales within the municipality, and we use it for two years, corresponding to the consumption side of the dataset. *Ecomsales share* is the share of

[5]The "brick-and-mortar stores" here refers to general retail stores, supermarkets, convenience stores, department stores, co-ops, discount stores, and mass retailers.

		avg	s.d.	min	max
tax revenue	¥1000 per population	14.7	12.8	1.3	56.5
Ecomsales	¥million	21464	49488	285	520144
storesales	¥million	366146	458810	26035	3546499
Ecomsales share	%	4.04	4.44	0.22	45.15
population share	%	13.76	12.82	1.31	56.47
monthly consumption	¥1000	237.0	299.5	160.9	334.5
Internet access	%	87.5	6.0	66.4	95.4
vacancy rate	%	14.9	3.1	11.6	25.9
industrial employment	%	23.0	6.7	9.7	45.2
current account	%	92.5	5.0	67.1	102.4
debt service ratio	%	6.3	4.0	0.0	19.5
population outflow	%	4.9	5.0	0.1	14.9
Internet trouble	%	50.5	5.1	34.1	59.7

Table 2: Descriptive statistics on control variables

Note. The number of observations is 305 for *Ecomsales*, *storesales*, and *Ecomsales share* and 306 for the other variables. *Tax revenue* is the local consumption tax revenue per resident. *Ecomsales* is annual e-commerce sales within the municipality. *Storesales* is the annual retail store sales in the municipality and is defined as total retail sales minus *Ecomsales*. *Ecomsales share* is the share of *Ecomsales* to total annual retail sales in the municipality. *Population share* is the percentage of municipal population to the population of the prefecture to which it belongs. *Monthly consumption* is the monthly household consumption expenditure. *Internet access* is the percentage of population with Internet access. *Vacancy rate* is the percentage of vacant stores to all stores. *Industrial employment* is the ratio of employees in the secondary industry. *Current account* is the current account ratio, defined by the ratio of current expenses to current revenue, and *debt service ratio* is the ratio of debt redemption costs and interest payments to general revenues. The smaller these two fiscal values are, the more fiscal leeway there is. *Population outflow* is the percentage of population commuting to work or school outside their municipality of residence. *Internet trouble* is the percentage of the population experiencing spam mails and fictitious billing on the Internet.

Ecomsales to total annual retail sales in the municipality. Looking specifically at the municipalities with the highest percentage of *Ecomsales* in the annual municipal sales, *Sasebo* and *Okawa* have the values of 45.2 and 37.6 percent, respectively. The former, with a population of approximately 240,000, is home to Japan's largest Internet mail-order company, while the latter, with a population of approximately 30,000, is the municipality with the largest furniture production in Japan. *Population share* is the ratio of the municipal population to the population of the prefecture to which it belongs. These variables constitute the clearing rule, and we also use the following six control variables to reflect the industry, purchasing power, and financial situation of each municipality. *Monthly consumption* denotes the monthly household consumption expenditure. *Internet access* is the percentage of population with Internet access. *Vacancy rate* is the percentage of vacant stores to all stores. *Industrial employment* is the proportion of employees in the secondary industry. *Current account* is the current account ratio, defined as the ratio of current expenses to current revenue, and *debt service ratio* is the ratio of debt redemption costs and interest payments to general revenues. The smaller these two fiscal values are, the more fiscal leeway there is. The last two variables in Table 2 are those used in the instrumental variable (IV) method that will be explained later. *Population outflow* is the percentage of the population commuting to work or school outside their municipality of residence. *Internet trouble* is the percentage of the population that experiences spam mails and fictitious billing on the Internet.

We aggregate data from various datasets. For example, *Internet trouble* and *Internet access* are based on data from the Household Survey of Communications Usage Trends conducted by the Ministry of Internal Affairs and Communications. The vacancy rate is based on the Survey of Shopping District by Small and Medium Enterprise Agency. Unfortunately, however, data intersecting all sets of information are only available for prefectures or cities with populations over 150,000. As there are only 47 prefectures, the sample is too small for a two-period panel data analysis. Hence, this study uses data from 151 of the 1,718 municipalities with populations of 150,000 or more for which a larger sample is available as balanced panel data.

3.2 Estimation results

The estimated results are given in Table 3. Our focus is on the coefficients for *cross-border* and *E-commerce*, that is, α_1 and α_2 in (6), in the first block, which indicate the impact of cross-border and online purchases on the local tax revenues that would still be generated under the current clearing system.

Column (a) of Table 3 shows the most basic ordinary least squares (OLS) estimation model that considers local consumption tax revenue per resident as the dependent variable, assuming that *cross-border* and *Ecommerce* are exogenous variables. According to the estimation results, the coefficient of *cross-border* is positive, but not significant, while the coefficient of *Ecommerce* is 0.008 and significant at the 1% level. The clearing rule and its revisions are intended to eliminate the impact of cross-border consumption (*cross-border*) and e-commerce (*Ecommerce*) on local consumption tax revenues. Column (b) shows the results of the OLS estimation, which checks whether the impact of *cross-border* and *Ecommerce* on the allocation of local consumption tax remains even after taking them into account along with various control variables. Here, the coefficient of *Ecommerce* is still positive and significant at the 1% level, but the coefficient of *cross-border* is negative. In column (b), we devise a way to avoid missing variable bias by adding *Internet access* and *vacancy rate* to the control variables, but it is still possible that the endogeneity problem associated with *cross-border* and *Ecommerce* remains unresolved due to simultaneity bias.

Therefore, we address the endogeneity issue using IV estimation and use the outflow population ratio (*population outflow*) and trouble experience rate on the Internet (*Internet trouble*) as IVs.[6] Columns (c) and (d) of Table 3 are the results of the IV estimation.[7]

Impact of cross-border consumption and ecommerce. The first block in Table 3 shows the impact of cross-border consumption and ecommerce on local tax revenues. The coefficient of *cross-border* is negative and significant in Columns (c) and (d). Conversely, the coefficients of *Ecommerce* are neither clear nor significant. This result means that cities with more residents spending across borders to other prefectures tend to have less local consumption tax revenue, even after accounting for the effects of the clearing system and the two revisions of the rules in 2017 and 2018. Specifically, cities that spend 10% more than the average on other municipalities receive approximately 0.3% less consumption tax revenue. However, the coefficient on *Ecommerce* is not significant. This finding indicates that differences among cities in online purchase rates do not have a significant impact on the allocation of consumption tax revenue.

Impact of the revision of the clearing system. Next, let us examine the effect on the allocation of consumption tax revenues of revisions of the clearing system, as shown in the second block. First, the coefficients on *storesales* are positive, and the coefficient on the cross term between *storesales* and *year* is negative and significant. This indicates that although cities with larger store sales generate more tax revenue, and the 2018 revision of the clearing criteria that reduced the weight of retail sales in the allocation of tax revenue improved the situation in which cities with fewer store sales were disadvantaged in the allocation of tax revenue. Second, the coefficients on *Ecomsales* and the coefficient on the cross term between *Ecomsales* and *year* take the expected signs but are not significant. This implies that the 2017 revision of the clearing rule, which excluded online sales from the formula for allocating tax revenue, does not have a significant impact on the distribution of local tax revenues. Third, the coefficient on *population* is negative, and the coefficient of the cross term with the year dummy is positive and significant. The former indicates that the more populous cities receive less tax revenue per resident, which is consistent with (5). The latter indicates that the revision of the rule in 2018, which lowered the weight of retail sales and increased the population weight when allocating consumption tax revenue, has the effect of allocating more to cities with larger populations. These results indicate that the 2018 revisions work in the direction of increasing tax revenues for cities with large populations but low store sales, that is, cities suffering from an outflow of consumption outside their cities.

Background of results. Our dataset allows us to classify consumption expenditures into 10 categories: food, housing, utilities and water, furniture and household goods, clothing, health and medical care, transportation and communication, education, culture and entertainment, and others. Based on these categories, we discuss the possible background of the impact of e-commerce and cross-border consumption

[6] The results of the first stage estimation using IV are shown in Table 4 in Appendix.

[7] The endogenous test for both *cross-border* and *Ecommerce* shows that the hypothesis that they are exogenous is rejected and the estimation results using two IVs are adopted. Note also that they can be validated as IVs using the Sanderson–Windmeijer multivariate F-test.

	(a) OLS		(b) OLS		(c) IV		(d) IV	
cross-boder	0.002		-0.003		-0.032	**	-0.033	***
	(0.004)		(0.003)		(0.015)		(0.009)	
E-commerce	0.008	***	0.009	***	-0.007		0.013	
	(0.002)		(0.001)		(0.010)		(0.008)	
storesales			3,260.323	***			2,146.027	**
			(766.153)				(1035.668)	
storesales*year			-2,435.906	**			-3,131.174	***
			(1206.841)				(1104.176)	
Ecomsales			-830.314				692.486	
			(1647.529)				(1628.413)	
Ecomsales*year			-3,496.545				-1,009.060	
			(3175.114)				(3580.817)	
pop			-294.114	***			-221.051	**
			(75.273)				(92.945)	
pop*year			297.937	***			308.334	***
			(87.075)				(85.369)	
monthly consumption			-0.000	***			-0.000	
			(0.000)				(0.000)	
Internet access			0.026	***			0.028	***
			(0.002)				(0.003)	
vacancy rate			0.006	**			-0.005	
			(0.003)				(0.004)	
industrial employment			-0.003	**			-0.005	***
			(0.001)				(0.002)	
current account			-0.003	*			-0.001	
			(0.002)				(0.003)	
debt service ratio			0.002				-0.000	
			(0.003)				(0.004)	
const	-4.616	***	-6.367	***	-3.759	***	-6.868	***
	(0.101)		(0.261)		(0.531)		(0.488)	
F test of outflow					67.26	***	28.39	***
F test of ecom					42.43	***	10.19	***
Endogenous test					12.08	***	33.24	***
SW test of outflow					16.06	***	13.25	***
SW test of ecom					13.13	***	10.46	***

Table 3: Estimation results

Note. Number of samples is 302. The explained variable is local consumption tax revenue per resident. Numbers in parentheses represent robust standard errors. ***, **, and * denote 1%, 5%, and 10% levels of significance, respectively. SW test denotes the Sanderson–Windmeijer multivariate F-test.

on local tax revenues. First, a large share of purchases made through e-commerce are for furniture and houseware (8.2%), clothing (6.8%), and culture and entertainment (5.3%). However, these do not represent a large share of total consumption, with the exception of culture and entertainment expenses; the expenditure on furniture and houseware as a percentage of total consumption expenditures is 3.6%, and clothing expenditures account for 4.7% of total consumption. In addition to the exclusion of e-commerce sales from the clearing rules through the 2017 revision of the clearing rule, the fact that consumption items such as furniture and clothing purchased through e-commerce are currently a small share of total consumption may explain why consumption through e-commerce does not have a significant impact on local tax revenues.

Next, we examine cross-border consumption. The items with the highest cross-border consumption in other prefectures are culture and entertainment (12.7%), clothing (10.0%), and food (7.5%). By far, the largest portion of total consumption is food, which accounts for 27.0%, followed by transportation and communication (14.3%), and culture and entertainment (10.3%). The consumption of food, culture, and entertainment, which accounts for a high share of cross-border consumption and a large share of consumer expenditure, appears to be responsible for the significant relationship between cross-border consumption and the distribution of local tax revenues. Given that the cross-border consumption to other prefectures affects local tax revenues, how the treatment of spending on these items is designed in the clearing rules would be the most notable factor for the functioning of the destination principle tax in Japan.

4 Conclusion

In Japan, the clearing system has taken steps to correct distortions in the distribution of consumption tax revenues among municipalities owing to cross-border consumption and e-commerce. After controlling for the impact of such a system on tax revenue allocation among municipalities, this study examines whether cross-border consumption and e-commerce still affect the tax revenues allocated to municipalities.

The results obtained from the descriptive statistics and two-year panel data analysis are as follows: First, the average household in 2019 spends 9.1% of its total consumption in other municipalities belonging to the same prefecture as the municipality in which it resides. It also spends 6.1% of the total consumption in a different prefecture than the one in which they reside. These figures indicate that 15.2% of the average household's consumption is classified as cross-border consumption. In the municipality with the highest percentage of cross-border consumption, 31.4% of the consumption expenditures were spent in other municipalities in the same prefecture and 21.2% in other prefectures. Second, 2.5% of the average household's total consumption is purchased through the Internet, and in the municipality with the most Internet purchases, the value is 9.4%. In addition to these descriptive results, third, we find that cross-border consumption still significantly reduces municipal consumption tax revenues, albeit on a smaller scale, given that the impact of cross-border consumption and e-commerce is controlled by the clearing system. More specifically, tax revenues allocated to cities with 10% more consumption outflow than other cities are approximately 0.3% lower. However, spending on e-commerce is neutral to local tax revenues. Third, while the 2017 institutional revision to mitigate the impact of e-commerce on consumption tax revenues did not show significant effects, the 2018 revision to neutralize the impact of cross-border consumption showed some effects. The 2018 revision shows the effect of increasing tax revenues in cities exposed to consumption outflows, that is, those with low store sales for a large population.

To summarize the above-stated results, in Japan's local consumption tax system, which is based on a common tax rate and a destination principle tax, e-commerce is not confirmed to have a significant effect on local consumption tax revenues, but cross-border consumption still has a significant effect. However, the impact of such cross-border consumption is not that large quantitatively, as the decrease in tax revenue in a municipality with 10% more cross-border consumption than the average is only approximately 0.3%. These results suggest that Japan's attempt through the clearing system to neutralize the impact of cross-border consumption and e-commerce on local sales tax revenues is working.

Appendix

Column (a) of Table 4 shows the estimation results when *cross-border* is taken as the dependent variable. The outflow population ratio (*population outflow*) is significantly and positively related to *cross-border*.

	(a) cross-border		(b) E-commerce	
population outflow	0.383	***	-0.319	***
	(0.051)		(0.109)	
Internet trouble	-0.014		-0.228	***
	(0.030)		(0.078)	
storesales	-4,409.176		67,540.710	**
	(9773.050)		(26316.400)	
storesales*year	-11,244.560		49,034.820	
	(14661.640)		(46796.080)	
Ecomsales	8,414.717		-59,358.480	
	(27938.140)		(92937.970)	
Ecomsales*year	24,772.480		-298,227.300	*
	(47187.240)		(157045.100)	
population	137.979		-4,613.192	***
	(717.917)		(1690.953)	
population*year	612.363		-126.703	
	(989.199)		(2696.213)	
monthly consumption	0.000	**	0.000	
	(0.000)		(0.000)	
Internet access	0.061	**	-0.147	**
	(0.030)		(0.071)	
vacancy rate	-0.022		0.112	
	(0.055)		(0.134)	
industrial employment	-0.037		0.062	
	(0.026)		(0.062)	
current account	0.016		0.075	
	(0.039)		(0.078)	
debt service ratio	-0.001		0.320	***
	(0.045)		(0.092)	
const	-4.588		58.259	***
	(4.604)		(9.882)	

Table 4: IV estimation of the first stage

Note. Number of samples is 302. Numbers in parentheses represent robust standard errors. ***, **, and * denote 1%, 5%, and 10% levels of significance, respectively.

The more the population moves to other municipalities for commuting to work or school during daytime hours, the less time they spend on consumption activities in their residential areas and, conversely, the more they spend outside their residential areas, indicating that the *population outflow* is positively related to the outflow. Column (b) of Table 4 shows the estimation results when *Ecommerce* is taken as the dependent variable. A city with a large outflow population ratio (*population outflow*) has a large population that spends less time at home during daytime hours, moving to other municipalities to commute to work or school. In such cities, it is natural for the online consumption rate, that is, *Ecommerce*, to be lower. In addition, we would expect the online consumption rate to be lower in cities with more people who have experienced troubles on the Internet. The estimated results are consistent with these findings. From the results of the first stage of estimation using IV, we discuss the results of the second stage of estimation using *population outflow* and *Internet trouble* as IVs in Section 3.

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