【Articles】

Segmentation of Regional Consumer Markets in Japan

日本国内における消費財・サービスの地域市場の分断

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(Abstract)

This study examines whether regional markets of consumer goods and services are integrated with each other or segmented in Japan. It uses a price differential that remains over the long term as an indicator of segmentation. Two metrics are used to measure the degree of segmentation: the sample-period average of inter-regional price differentials, and the constant term in an autoregressive linear adjustment of inter-regional price differentials. Retail prices of consumer goods and services in prefectural capitals are used as data. Forty-two items were selected, and divided into three groups: perishable goods, nonperishable goods, and services. The main results are as follows. Of the three groups, markets of nonperishable goods show the least regional segmentation. Markets of perishable goods are segmented between regions to a greater degree, and markets of services are the most segmented. Although both are classified as goods, perishable and nonperishable goods exhibit different degrees of segmentation. Segmentation of markets is affected by the distance and the wage differentials between regions. Segmentation of markets of nonperishable markets is connected more strongly with the distance than for perishable goods. Segmentation of markets of services is not affected by the distance. On the other hand, segmentation of services is more strongly connected with the wage differentials than segmentation of perishable and nonperishables goods.

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1. Introduction

Japan has a developed transportation system and a relatively homogeneous society, which suggest that Japanese regional economies should be well integrated with each other. Well-integrated regional economies imply integration of regional markets. This study examines whether regional consumer markets in Japan are integrated or segmented, applying ideas developed in Choi et al. (2017).

A traditional notion in economics is a dichotomy between goods and services in regard to the integration of markets, with integration of regional markets of goods but segmentation of markets of services. Goods are regarded as tradable between locations, so that markets of goods in different locations are integrated. In contrast, services are not regarded as tradable, so that their markets in different locations are not integrated, implying segmentation of their regional markets. Although there are some exceptions, services are generally supplied to customers who are physically close to their suppliers. This study examines the accuracy of this traditional idea.

Some studies have undermined this simple dichotomy. One common approach is to break down differences in relative price levels into a factor related to tradables and a factor related to nontradables. Here, tradables and nontradables can be interpreted as synonyms of goods and services. According to the dichotomy, differences in the relative price levels should be due entirely to nontradables. Engel (1999) claims that the dichotomy between tradables and nontradables does not hold internationally, based on empirical measurements of prices of nontradables in changes in US real exchange rates, and concluded that changes in the real exchange rates are dominated by changes in the prices of tradables.[1)] The present study takes an alternative approach, and examines the inter-regional relative prices themselves rather than their changes, and quantifies the degree of the segmentation of markets for each item. It does not employ price indexes for the analysis.

Gunessee and Zhang (2022) review the literature in the area of domestic market integration, and they classify studies into three groups basing on their approaches to the issue; the trade-related approach, the capital-related approach, and the arbitrage price-related approach. The present study belongs to the group of the arbitrage price-related approach. The issue is analyzed basing on differentials between local prices in the present study. A price differential is used between two regional markets that persists over the long run as an indicator of segmentation. If the markets are integrated, the price differential eventually disappears. Based

on the Law of One Price (LOP), if a price differential between two regions persists in the long run, this means that the two regional markets are segmented. Degrees of segmentation are examined, and factors affecting the segmentation are investigated. Retail prices of consumer goods and services in prefectural capitals in Japan are used as data. Forty-two items are chosen, and divided into three groups: perishable goods, nonperishable goods, and services, following Choi et al. (2017). Two indicators are used as metrics of segmentation: the sample-period average of inter-regional price differentials, and the constant term in an autoregressive linear adjustment of inter-regional price differentials. The constant term is interpreted as a differential that persists even after sufficient adjustment. Among the three groups, markets of the nonperishable goods are found to exhibit the least regional segmentation. Although both are classified as goods, markets of perishable and nonperishable goods have considerably distinct degrees of regional segmentation. As being generally expected, markets of services are highly segmented between regions. The distance between regions generally affects the degree of the segmentation, but the effect of the distance varies from item to item. The effects of the distance are found to be significant in the case of the goods, and more significant for nonperishable goods than perishable goods. The effects are mostly insignificant for services. The effects of differentials of wages between regions are also analyzed, and the effects are mostly significant for services. Those results indicate that a simple dichotomy between goods and services does not hold. There is a difference in segmentation of markets between perishable goods and nonperishable goods.

Choi et al. (2017) investigated the segmentation of US regional consumer markets. They used retail prices of consumer products including goods and services, and analyzed market segmentation using price differentials between city pairs. They find that the extent of market segmentation depends on the products and that it is not necessarily larger for nontradable services than tradable goods. The distance between cities is an important factor affecting the segmentation.

The present study uses a monthly series of retail prices for 42 items in all 47 prefectural capitals, i.e., 47 cities, in Japan. A few series have missing data, but most series cover all 47 cities, and price differentials are studied for each binary pair of cities. The items studied are classified into perishable goods, nonperishable goods, and services. This classification is intended to shed light on the relation between segmentation and tradability. When goods are classified into perishable and nonperishable goods, nonperishable goods are generally more tradable. Perishable goods are less easy to transport than nonperishable goods. From the point of view of tradability, perishable goods are intermediate between nonperishable goods and services. The extent of segmentation is investigated for each item, and the results are summarized on the basis of the three groups. The relation between the degree of the segmentation and the distance is analyzed for each item. The relation between the degree of the segmentation and the wage differentials is also analyzed for each item.

This paper is organized as follows. The second section details the data used in this study. The third section explains the metrics used to measure the degree of the segmentation. The

fourth section sets out two preliminary tests; examining unit-roots in the price differentials and investigating the relation between the metrics. The fifth section investigates segmentation for each item, using the two metrics. The sixth section investigates effects of the distance and the wage differentials between cities on segmentation. Finally, concluding remarks are given.

2. Data

This study uses monthly series of retail prices over the period 2000-2022. A total of 42 items of goods and services are selected from among those covered by the consumer price index (CPI), which is compiled from more than 500 items in Japan. The items investigated here are selected as follows:

(1) The items should be purchased frequently by households.

(2) The items should have a nonnegligible share in the composition of the CPI.

(3) The list of items should cover a large range of items. All items covered by the CPI are broken down into fifteen groups, including "food products", "textiles", "petroleum products", "meals outside the home", and others. The list should cover as many groups as possible. It should cover perishable goods, nonperishable goods, and services. In this study, perishable goods are items which are classified as "fresh foods" in "List of information for items of the 2020-Base CPI." The classification of goods and services is based on the same list.

(4) The items should not contain many missing observations.

The Bureau of Statistics provides detailed information on items from which the CPI is compiled.[2)] The following information is included: the share of individual items in the CPI; typical frequencies of purchases of individual items; and the definition of perishable foods. Prices of some items in the CPI list are the same nationwide or across several prefectures, such as postal fees and telephone fees. These are not chosen below. Prices of items traded on the internet are also excluded. The prices of some items are regulated by the government, such as medical fees. These are not chosen. If three consecutive observations are missing for any item, that series is not chosen. If only one or two observations are missing, they are complemented by a linear interpolation. Fortunately, the interpolation was rarely needed. The start and end of the sample period are adjusted in some cases because of missing observations.

The items eventually selected for statistical works in this study are shown in the list in the Appendix, with the sample period and the number of covered cities. A series typically covers 47 cities, so that price differentials between 1081 (=47x46/2) pairs of cities are investigated for each item.

The data are seasonally adjusted using the X11 seasonal adjustment method by the author for this study after being taken from the home page of the Statistics Bureau of Japan.[3)]

3. Metrics of segmentation

The LOP asserts that no price differential should exist in an integrated market. Accordingly, this study considers that two regional markets are segmented when the price differential remains between the two regional markets over a long run. The differential over a long run is

used as the metric of segmentation. Two metrics are used to measure the segmentation of local markets. One is the sample-period average of price differentials (SAPD), and the other is the constant term in an autoregressive linear adjustment of price differentials (AR-LAPD). Both are used in Choi et al. (2017).

The price difference of the item k between two cities i and j at period t is defined as

$$d_{ij,t}^{k} \equiv \left| p_{i,t}^{k} - p_{j,t}^{k} \right|$$

where $p_{i,t}^{k}$ is the logarithm of the price of item k in city i. The SAPD, d_{ij}^{k}, is defined as the average $d_{ij,t}^{k}$ over the sample period.

The other metric is based on the following standard linear autoregression model:

$$\Delta q_{ij,t}^{k} = \kappa_{ij}^{k}\left(1-\rho_{ij}^{k}\right) - \left(1-\rho_{ij}^{k}\right) q_{ij,t-1}^{k} + \sum\nolimits_{h=1}^{m} \delta_{h,ij}^{k} \Delta q_{ij,t-h}^{k} + \varepsilon_{ij,t}^{k}, \tag{1}$$

where $q_{ij,t}^{k} \equiv p_{i,t}^{k} - p_{j,t}^{k}$, and $\varepsilon_{ij,t}^{k}$ is an error term. The AR-LAPD is defined as the absolute value of κ_{ij}^{k}, i.e, $|\kappa_{ij}^{k}|$. The constant term represents the time-invariant effect. Goldberg and Verboven (2005) interpreted the constant term $\kappa_{ij}^{k}(1-\rho_{ij}^{k})$ as a measure of the segmentation. As $q_{ij,t}^{k}$ is equal to κ_{ij}^{k} when $\Delta q_{ij,t}^{k}$ and $\varepsilon_{ij,t}^{k}$ remains zero over time, $|\kappa_{ij}^{k}|$ should be a better metric than $\kappa_{ij}^{k}(1-\rho_{ij}^{k})$.

4. Preliminary tests: unit-root tests and correlation between the two metrics

This section executes two preliminary tests on the inter-regional price differentials. First, the mean-reversion of the inter-regional price differentials is examined by a unit-root test. After that, correlation between the two metrics is examined.

Whether the price differentials are mean-reverting or not has implications for the interpretation of the results. There are already studies on mean-reversion on inter-regional price differentials in many countries, including Japan.[4)] These studies are classified into two groups: one uses price indexes, and the other uses prices of individual items. This paper examines the mean-reversion of the inter-regional price differentials of individual goods and services, because the aim of this study is to explore integration and segmentation of markets for individual items. Accordingly, unit-root tests are performed on $q_{ij,t}^{k}$ using the augmented Dickey-Fuller (ADF) test. These ADF tests are executed on Equation (1) with the lag length set to five, i.e., $m = 5$, over the periods shown in the list in the Appendix, adjusting the start to allow the lag length. Table 1 shows the proportions of rejection of the null of unit root at the 5% and 10% levels in all binary pairs of cities investigated for each item. Of the three groups, the perishable and nonperishable goods have higher proportions of the rejection of unit-root than do services. This implies that the prices of tradable goods are more likely to be mean-reverting than the prices of nontradable services. Some service items show minimal support for mean-reversion, including “ramen”, “rent”, and “veterinary fees”. On the other hand, the results do not support the hypothesis that the prices of all goods are converging. The proportion of rejection takes various values among both perishable and nonperishable goods. Values typically higher for perishable goods than nonperishable goods.

Table 1. ADF unit-root tests : proportion of rejection of the null hypothesis

	item	ADF 5%	ADF 10%
Perishable goods			
1	tuna	0.261	0.368
2	salmon	0.296	0.453
3	pork	0.131	0.219
4	chicken	0.171	0.278
5	eggs	0.291	0.440
6	cabbages	0.755	0.861
7	onions	0.535	0.667
8	tomatoes	0.566	0.693
9	bananas	0.237	0.349
average		0.360	0.481
Nonperishable goods			
1	rice	0.364	0.520
2	white bread	0.067	0.130
3	cup noodle	0.414	0.539
4	fish cake	0.140	0.250
5	sausage	0.152	0.254
6	milk	0.085	0.151
7	yogurt	0.284	0.403
8	tofu	0.092	0.163
9	cooking oil	0.202	0.335
10	chocolate	0.697	0.814
11	ice cream	0.119	0.198
12	tea beverages	0.213	0.316
13	beer	0.183	0.304

	item	ADF 5%	ADF 10%
Nonperishable goods			
14	kerosene	0.511	0.655
15	bathroom paper	0.190	0.315
16	laundry detergent	0.284	0.426
17	men's shirts	0.182	0.286
18	ladies' underwear	0.150	0.231
19	ladies' shoes	0.084	0.142
20	gasoline	0.530	0.667
21	notebook	0.053	0.110
average		0.238	0.343
Services			
1	ramen	0.044	0.098
2	sushi	0.063	0.126
3	Japanese barbeque	0.082	0.143
4	rent	0.008	0.050
5	laundering of men's shirts	0.069	0.122
6	car maintenance fee	0.059	0.101
7	garage fee	0.194	0.235
8	tutoring school fee	0.060	0.109
9	gym fee	0.143	0.183
10	veterinary fee	0.051	0.092
11	hair dressing fee	0.079	0.118
12	ladies' hair cut	0.109	0.173
average		0.080	0.129

The use of the two metrics of segmentation assists in indicating the robustness of the results. However, if the two metrics should suggest very different degrees of segmentation for the same pair of cities, it would be troublesome in regard to interpretation of the results. It is desirable that the two metrics exhibit the same tendency. Correlation between the two metrics is calculated for each item. Correlation between d_{ij}^{k} and $|\kappa_{ij}^{k}|$ is calculated over all pairs of cities for each item. Table 2 shows the correlations and their t-values for each item with degrees of freedom. The perishable and nonperishable goods show a strong correlation between the two metrics. Many service items do not show a strong correlation, however. For some items, such as “car maintenance fees”, “garage fees”, and “hair dressing fees”, the correlation is virtually nil.

The results from the two preliminary tests are summarized as follows. Many items of perishable and nonperishable goods show a high proportion of rejection of unit-root and a strong correlation between the two metrics. Many service items fail to reject the unit-root and also do not show correlation between the two metrics. As mentioned above, the metric

Table 2. Correlation between SAPDs and AR-LAPDs

	item	correlation	df	t-value
Perishable goods				
1	tuna	0.706	1079	32.79
2	salmon	0.604	664	19.50
3	pork	0.261	1079	8.89
4	chicken	0.423	1079	15.36
5	eggs	0.710	1079	33.11
6	cabbages	0.859	1079	55.10
7	onions	0.849	1079	52.80
8	tomatoes	0.673	1079	29.86
9	bananas	0.131	1079	4.34
Nonperishable goods				
1	rice	0.727	1079	34.74
2	white bread	0.796	1079	43.23
3	cup noodle	0.558	1079	22.08
4	fish cake	0.269	901	8.39
5	sausage	0.270	1079	9.20
6	milk	0.146	1079	4.86
7	yogurt	0.705	1079	32.64
8	tofu	0.420	1079	15.19
9	cooking oil	0.630	1079	26.67
10	chocolate	0.423	1079	15.36
11	ice cream	0.732	1079	35.31
12	tea beverages	0.398	1079	14.26
13	beer	0.583	1079	23.57

	item	correlation	df	t-value
Nonperishable goods				
14	kerosene	0.890	1079	63.96
15	bathroom paper	0.586	1079	23.77
16	laundry detergent	0.632	1079	26.81
17	men's shirts	0.684	1079	30.76
18	ladies' underwear	0.414	1033	14.60
19	ladies' shoes	0.057	1079	1.86
20	gasoline	0.892	1079	64.86
21	notebook	0.276	1033	9.23
Services				
1	ramen	0.087	1079	2.87
2	sushi	0.031	1036	1.00
3	Japanese barbeque	0.240	1033	7.93
4	rent	0.138	1079	4.59
5	laundering of men's shirts	0.168	1079	5.59
6	car maintenance fee	0.009	1079	0.31
7	garage fee	0.006	1079	0.21
8	tutoring school fee	0.040	1033	1.27
9	gym fee	0.671	1033	29.08
10	veterinary fee	0.178	1079	5.93
11	hair dressing fee	0.019	1079	0.62
12	ladies' hair cut	0.203	1079	6.80

AR-LAPD, $|\kappa_{ij}^{k}|$, is based on the AR linear equation, i.e., Equation (1). If the series $q_{ij,t}^{k}$ contains a unit-root, which implies that $(1-\rho_{ij}^{k})$ is equal to zero, then κ_{ij}^{k} is not estimable, and the estimated value of the metric AR-LAPD, $|\kappa_{ij}^{k}|$, is not sensible. This argument applies to some items of services. Results from the two preliminary tests suggest caution when we interpret results involving the metric AR-LAPD, $|\kappa_{ij}^{k}|$.

5. Segmentation of markets

Tables 3 and 4 show the average and median of the SAPDs and the AR-LAPDs for individual items. They also show the averages for each group of the average and median; perishable goods, nonperishable goods, and services.

Table 3 shows the results of the SAPDs. The average of individual items' averages and

Table 3. SAPDs : average and median of each item

	item	average	median
Perishable goods			
1	tuna	0.231	0.207
2	salmon	0.215	0.204
3	pork	0.096	0.089
4	chicken	0.120	0.110
5	eggs	0.079	0.076
6	cabbages	0.169	0.160
7	onions	0.147	0.133
8	tomatoes	0.127	0.121
9	bananas	0.145	0.134
average		0.147	0.137
Nonperishable goods			
1	rice	0.063	0.060
2	white bread	0.137	0.112
3	cup noodle	0.068	0.065
4	fish cake	0.203	0.190
5	sausage	0.104	0.098
6	milk	0.096	0.084
7	yogurt	0.076	0.072
8	tofu	0.254	0.228
9	cooking oil	0.117	0.112
10	chocolate	0.055	0.051
11	ice cream	0.069	0.061
12	tea beverages	0.059	0.055
13	beer	0.041	0.039

	item	average	median
Nonperishable goods			
14	kerosene	0.073	0.065
15	bathroom paper	0.127	0.122
16	laundry detergent	0.098	0.093
17	men's shirts	0.119	0.111
18	ladies' underwear	0.211	0.192
19	ladies' shoes	0.269	0.242
20	gasoline	0.031	0.028
21	notebook	0.126	0.110
average		0.114	0.104
Services			
1	ramen	0.114	0.098
2	sushi	0.192	0.173
3	Japanese barbeque	0.252	0.214
4	rent	0.200	0.139
5	laundering of men's shirts	0.188	0.162
6	car maintenance fee	0.212	0.179
7	garage fee	0.487	0.425
8	tutoring school fee	0.208	0.192
9	gym fee	0.183	0.156
10	veterinary fee	0.195	0.171
11	hair dressing fee	0.116	0.092
12	ladies' hair cut	0.158	0.130
average		0.209	0.178

medians is larger in the group of services than for the perishable and nonperishable goods groups. The averages for perishable goods are larger than for nonperishable goods. Regarding individual items, eleven out of the twenty-one nonperishable items and two of the nine perishable items have an average smaller than 0.1. None of the services has an average smaller than 0.1.[5)] These results indicate that markets for services are generally more segmented than markets of perishable and nonperishable goods, and markets of perishable goods are more segmented than those of nonperishable goods.

Even within a single group, the averages take various values. Among nonperishable goods, the following have an average smaller than 0.1; “rice”, “cup noodles”, “chocolate”, “ice cream”, “tea beverages”, “beer”, “laundry detergent”, “kerosene”, and “gasoline”. These are mass production items with easy distribution. On the other hand, “tofu” has an average larger than any perishable goods. These results imply that segmentation varies widely even among nonperishable items.

Table 4 shows the results for the AR-LAPDs. As with the SAPDs, the average of the

Table 4. AR-LAPDs : average and median of each item

	item	average	median
Perishable goods			
1	tuna	0.186	0.149
2	salmon	0.131	0.099
3	pork	0.079	0.058
4	chicken	0.098	0.080
5	eggs	0.051	0.041
6	cabbages	0.108	0.091
7	onions	0.089	0.072
8	tomatoes	0.079	0.064
9	bananas	0.126	0.073
average		0.105	0.081
Nonperishable goods			
1	rice	0.038	0.032
2	white bread	0.130	0.101
3	cup noodle	0.032	0.027
4	fish cake	0.146	0.110
5	sausage	0.063	0.047
6	milk	0.111	0.078
7	yogurt	0.041	0.035
8	tofu	0.280	0.206
9	cooking oil	0.063	0.053
10	chocolate	0.023	0.018
11	ice cream	0.065	0.051
12	tea beverages	0.045	0.031
13	beer	0.022	0.019

	item	average	median
Nonperishable goods			
14	kerosene	0.052	0.044
15	bathroom paper	0.060	0.051
16	laundry detergent	0.054	0.039
17	men's shirts	0.102	0.079
18	ladies' underwear	0.183	0.146
19	ladies' shoes	0.449	0.218
20	gasoline	0.022	0.018
21	notebook	0.169	0.078
average		0.103	0.071
Services			
1	ramen	0.246	0.101
2	sushi	0.307	0.147
3	Japanese barbeque	0.296	0.192
4	rent	0.221	0.123
5	laundering of men's shirts	0.290	0.136
6	car maintenance fee	0.729	0.157
7	garage fee	1.020	0.408
8	tutoring school fee	0.566	0.143
9	gym fee	0.193	0.160
10	veterinary fee	0.250	0.152
11	hair dressing fee	0.589	0.102
12	ladies' hair cut	0.193	0.127
average		0.408	0.162

individual items' averages and medians is larger for services than for perishable and nonperishable goods. The average is virtually equal for perishable and nonperishable goods. This is different from the case of the SAPDs. Among nonperishable goods, thirteen items have an average less than 0.1, and most also have an average below 0.1. The averages and medians greatly differ between many service items, which implies that the distributions of the AR-LAPDs are highly skewed for service items.[6)]

The two metrics clearly support the idea that markets of services are more segmented than markets of perishable and nonperishable goods. Both metrics indicate that some perishable goods characterized by mass production and ready distribution show only a small degree of segmentation. SAPDs indicate that markets of perishable goods are more segmented than markets of nonperishable goods, although AR-LAPDs do not show a difference between their degrees of segmentation.

6. Effects of distance and wage

Various factors affect the segmentation of markets. A key factor which promotes segmentation is transportation cost between markets. In many previous studies the geographical distance between two regions is used to represent the transportation cost. In fact the transportation cost and the distance do not correspond exactly, but many studies show that the distance is nevertheless a useful proxy for the transportation cost.[7] This section examines the effect of the distance between two cities on segmentation. It also examines the effects of the wage differentials between markets. Labor is not generally tradable between regions, although migration is observed to a certain extent in the long run. Segmentation of labor markets causes wage differentials between regions. It does not immediately imply differentials in prices of goods and services. Effects of wage differentials on the price differentials are affected by tradability of goods and services.

The transportation cost between two locations hampers integration of the two regional markets, and the transportation cost varies with tradability of items. Individual items are therefore subject to different effects of the distance even among goods. Similarly, variety of tradability makes individual items subject to different effects of the wage differentials.

OLS regressions are performed on the following equations over all possible pairs of cities for each item. For the SAPDs,

$$d_{ij}^k = \alpha_{10}^k + \alpha_{11}^k \log\left(DIST_{ij}\right) + \varepsilon_{ij}^k,$$

$$d_{ij}^k = \alpha_{20}^k + \alpha_{21}^k \log\left(WAGE_{ij}\right) + \varepsilon_{ij}^k$$

and for the AR-LAPDs,

$$\left|\kappa_{ij}^k\right| = \beta_{10}^k + \beta_{11}^k \log\left(DIST_{ij}\right) + \varepsilon_{ij}^k,$$

$$\left|\kappa_{ij}^k\right| = \beta_{20}^k + \beta_{21}^k \log\left(WAGE_{ij}\right) + \varepsilon_{ij}^k.$$

where $DIST_{ij}$ is the distance between cities i and j in kilometers.[8] $WAGE_{ij}$ represents the differential of the legal minimum wage between prefectures in which cities i and j are located. It is the logarithm of the average over the period 2002 to 2022.[9] The parameters α_{11}^k, α_{21}^k, β_{11}^k and β_{21}^k are expected to be positive. A long distance leads to a large transportation cost which should hamper arbitrage and promote segmentation. A large wage differential leads a large price differential if products are not tradable..

Table 5 summarizes results of the regression analysis of the distance for the SAPDs. The estimate of the distance has the expected sign for all nonperishable goods items and most perishable goods items. On the other hand, almost a third of all service items do not have the expected sign. About four fifths of perishable goods items have a positive and significant estimate. Two thirds of nonperishable goods items and half of service items have a similar estimate. These results indicate that the effect of distance on segmentation is most significant for nonperishable goods, and it is least significant for services. The effect is intermediate for

perishable goods between the two cases.

Table 6 summarizes results of the regression analysis of the distance for the AR-LAPDs. The proportions having a significant estimate are generally lower than their counterpart for SAPDs. The proportion with a positive and significant estimate is largest for nonperishable goods and smallest for services. The case of perishable goods is intermediate between the two, again. The same effects of distance therefore appear as in the case of SAPDs.

Table 7 summarizes results of the regression analysis of the wage differential for the SAPDs. The estimate of the wage differential is insignificant for all nonperishable goods, and the proportion having a positive and significant estimate is much lower for nonperishable goods than for services.

Table 8 summarizes results of the regression analysis of the wage differential for AR-LAPDs. The estimate of the wage differential is significant for some items of nonperishable goods. Still, the proportion having a positive and significant estimate is much lower for perishable and nonperishable goods than for services.

The results from Tables 7 and 8 indicate that the wage differential has a more significant effect on services than goods. It is likely that these results are concerned with tradability. Services are not tradable and their prices are directly affected by local wages. On the other hand, goods are tradable and products from regions of lower wages are traded even in regions of high wages.

Regressions containing simultaneously both the distance and wage differential variables, $DIST_{ij}$ and $WAGE_{ij}$, were executed. Their results are basically similar to the results mentioned above. For the sake of space, those results are not provided here.

7. Conclusion

This study has explored regional segmentation of consumer goods and services within Japan, based on 42 items and 47 cities during the period 2000-2022. The items were classified into three groups: perishable goods, nonperishable goods, and services. Segmentation is interpreted as the situation where a price differential remains between two regional markets in the long run. It was measured by two metrics; the SAPDs and the AR-LAPDs.

The results indicate that markets of services are generally the most highly segmented, and markets of nonperishable goods are the most highly integrated. Markets of perishable goods are intermediate. There are a few exceptions. A small number of nonperishable goods items, such as “ladies’ underwear” and “ladies’ shoes”, exhibit greater segmentation than some service items. The degree of segmentation varies from item to item. The effect of distance on segmentation is strongest with nonperishable goods, and weakest with services. The effect is intermediate with perishable goods. These results are consistent with the notion of tradability of goods and services. Generally, services are not tradable between different locations and arbitrage is not expected to work. It causes segmentation. It also causes distance and segmentation to be unrelated. Goods are tradable between two locations and arbitrage is expected to work. Yet, distance, which is regarded as being correlated with transportation cost, ham-

Table 5. Regression of SAPDs on distances between cities

	item	const	t-value	distance	t-value	adjusted R^2	A	B
Perishable goods								
1	tuna	0.193	8.115	6.295	1.599	0.001	+	
2	salmon	0.174	8.617	6.723	2.011	0.005	+	X
3	pork	0.032	3.785	10.545	7.434	0.048	+	X
4	chicken	0.112	9.987	1.277	0.687	0.000	+	
5	eggs	0.036	7.140	7.210	8.606	0.063	+	X
6	cabbages	0.108	9.401	10.152	5.332	0.025	+	X
7	onions	0.123	9.437	4.011	1.859	0.002	+	X
8	tomatoes	0.113	13.612	2.437	1.776	0.002	+	X
9	bananas	0.148	12.505	-0.571	-0.291	-0.001		
						C/D	0.89	0.67
Nonperishable goods								
1	rice	0.043	10.845	3.263	4.946	0.021	+	X
2	white bread	0.094	5.271	7.189	2.428	0.005	+	X
3	cup noodle	0.044	9.613	4.038	5.382	0.025	+	X
4	fish cake	0.148	7.541	9.288	2.865	0.008	+	X
5	sausage	0.073	8.484	5.165	3.644	0.011	+	X
6	milk	0.019	1.688	12.878	6.953	0.042	+	X
7	yogurt	0.064	13.059	2.028	2.514	0.005	+	X
8	tofu	0.176	6.015	13.116	2.708	0.006	+	X
9	cooking oil	0.094	13.349	3.835	3.284	0.009	+	X
10	chocolate	0.033	7.622	3.634	5.027	0.023	+	X
11	ice cream	0.060	8.540	1.434	1.225	0.000	+	
12	tea beverages	0.052	11.143	1.191	1.540	0.001	+	
13	beer	0.027	8.964	2.269	4.486	0.017	+	X
14	kerosene	-0.017	-2.599	15.134	13.853	0.150	+	X
15	bathroom paper	0.091	10.569	5.985	4.195	0.015	+	X
16	laundry detergent	0.089	13.099	1.540	1.373	0.001	+	
17	men's shirts	0.094	9.053	4.305	2.512	0.005	+	X
18	ladies' underwear	0.051	2.372	26.703	7.475	0.050	+	X
19	ladies' shoes	0.161	5.831	18.096	3.962	0.013	+	X
20	gasoline	0.003	1.175	4.690	9.835	0.081	+	X
21	notebook	0.125	8.937	0.196	0.085	-0.001	+	
						C/D	1.00	0.81
Services								
1	ramen	0.061	4.446	8.842	3.902	0.013	+	X
2	sushi	0.245	10.416	-8.984	-2.298	0.004		
3	Japanese barbeque	0.286	8.349	-5.790	-1.018	0.000		
4	rent	0.254	6.490	-8.952	-1.381	0.001		
5	laundering of men's shirts	0.074	3.417	18.953	5.277	0.024	+	X
6	car maintenance fee	0.153	5.303	9.803	2.050	0.003	+	X
7	garage fee	0.548	7.916	-10.117	-0.883	0.000		
8	tutoring school fee	0.197	9.292	1.768	0.503	-0.001	+	
9	gym fee	0.149	5.628	5.677	1.290	0.001	+	
10	veterinary fee	0.097	3.895	16.387	3.980	0.014	+	X
11	hair dressing fee	-0.234	-11.090	58.434	16.740	0.205	+	X
12	ladies' hair cut	0.013	0.570	24.209	6.212	0.034	+	X
						C/D	0.67	0.50

Notes. A: positive estimate of distance denoted by +, B: positive and 10 percent significant estimate of distance denoted by X, C: proportion of positive estimates in each group, D: proportion of positive and significant estimates in each group.

Table 6. Regression of AR-LAPDs on distances between cities

	item	const	t-value	distance	t-value	adjusted R^2	A	B
Perishable goods								
1	tuna	0.137	3.345	8.142	1.203	0.000	+	
2	salmon	0.038	0.973	15.479	2.411	0.007	+	X
3	pork	0.051	1.425	4.586	0.769	0.000	+	
4	chicken	0.084	2.828	2.293	0.466	-0.001	+	
5	eggs	0.003	0.288	8.057	4.683	0.019	+	X
6	cabbages	0.072	3.981	5.969	1.992	0.003	+	X
7	onions	0.073	4.362	2.760	1.002	0.000	+	
8	tomatoes	0.064	4.055	2.517	0.962	0.000	+	
9	bananas	0.370	1.914	-40.814	-1.274	0.001		
						C/D	0.89	0.33
Nonperishable goods								
1	rice	0.037	5.605	0.261	0.239	-0.001	+	
2	white bread	0.113	4.443	2.893	0.688	0.000	+	
3	cup noodle	0.013	2.328	3.254	3.517	0.010	+	X
4	fish cake	0.222	3.557	-12.725	-1.231	0.001		
5	sausage	0.074	2.366	-1.846	-0.354	-0.001		
6	milk	-0.103	-1.112	35.632	2.333	0.004	+	X
7	yogurt	0.043	6.101	-0.238	-0.206	-0.001		
8	tofu	0.258	2.877	3.675	0.247	-0.001	+	
9	cooking oil	0.016	1.432	7.854	4.126	0.015	+	X
10	chocolate	0.014	2.400	1.588	1.627	0.002	+	
11	ice cream	0.022	1.526	7.196	2.970	0.007	+	X
12	tea beverages	-0.014	-0.843	9.861	3.565	0.011	+	X
13	beer	0.019	5.117	0.503	0.803	0.000	+	
14	kerosene	-0.055	-6.562	17.816	12.876	0.132	+	X
15	bathroom paper	0.050	4.937	1.668	0.991	0.000	+	
16	laundry detergent	0.016	1.319	6.277	3.089	0.008	+	X
17	men's shirts	0.099	4.316	0.462	0.121	-0.001	+	
18	ladies' underwear	0.018	0.360	27.634	3.372	0.010	+	X
19	ladies' shoes	0.198	0.344	41.902	0.439	-0.001	+	
20	gasoline	-0.004	-0.923	4.370	6.464	0.036	+	X
21	notebook	0.119	1.261	8.259	0.527	-0.001	+	
						C/D	0.90	0.43
Services								
1	ramen	-0.285	-1.175	88.635	2.209	0.004	+	X
2	sushi	-0.066	-0.124	62.386	0.712	0.000	+	
3	Japanese barbeque	0.243	1.458	8.791	0.317	-0.001	+	
4	rent	-0.141	-0.569	60.598	1.473	0.001	+	
5	laundering of men's shirts	0.584	2.342	-49.074	-1.189	0.000		
6	car maintenance fee	-1.359	-0.359	349.009	0.557	-0.001	+	
7	garage fee	2.697	1.078	-280.239	-0.676	-0.001		
8	tutoring school fee	-0.341	-0.170	151.376	0.456	-0.001	+	
9	gym fee	0.144	3.436	8.133	1.170	0.000	+	
10	veterinary fee	0.031	0.192	36.711	1.391	0.001	+	
11	hair dressing fee	4.829	1.893	-708.462	-1.677	0.002		
12	ladies' hair cut	-0.037	-0.332	38.384	2.101	0.003	+	X
						C/D	0.75	0.17

Notes. A: positive estimate of distance denoted by +, B: positive and 10 percent significant estimate of distance denoted by X, C: proportion of positive estimates in each group, D: proportion of positive and significant estimates in each group.

Table 7. Regression of SAPDs on wage differentials

	item	const	t-value	wage diff.	t-value	adjusted R^2	A	B
Perishable goods								
1	tuna	0.248	50.773	-0.610	-4.666	0.019		
2	salmon	0.218	48.364	-0.102	-0.896	0.000		
3	pork	0.104	58.083	-0.294	-6.139	0.033		
4	chicken	0.124	53.227	-0.135	-2.178	0.003		
5	eggs	0.080	73.860	-0.027	-0.941	0.000		
6	cabbages	0.177	73.895	-0.280	-4.383	0.017		
7	onions	0.156	58.227	-0.319	-4.450	0.017		
8	tomatoes	0.134	78.865	-0.233	-5.129	0.023		
9	bananas	0.149	60.797	-0.148	-2.264	0.004		
						C/D	0.00	0.00
Nonperishable goods								
1	rice	0.061	73.158	0.065	2.929	0.007	+	X
2	white bread	0.148	40.185	-0.386	-3.910	0.013		
3	cup noodle	0.070	74.236	-0.089	-3.505	0.010		
4	fish cake	0.208	49.951	-0.164	-1.519	0.001		
5	sausage	0.109	61.204	-0.176	-3.716	0.012		
6	milk	0.097	40.984	-0.041	-0.645	-0.001		
7	yogurt	0.077	75.890	-0.037	-1.355	0.001		
8	tofu	0.239	39.448	0.546	3.373	0.010	+	X
9	cooking oil	0.116	78.969	0.039	0.981	0.000	+	
10	chocolate	0.057	64.903	-0.099	-4.206	0.016		
11	ice cream	0.073	49.868	-0.132	-3.394	0.010		
12	tea beverages	0.055	57.823	0.132	5.176	0.023	+	X
13	beer	0.042	65.928	-0.038	-2.218	0.004		
14	kerosene	0.072	48.291	0.064	1.610	0.001	+	
15	bathroom paper	0.128	71.237	-0.047	-0.979	0.000		
16	laundry detergent	0.105	75.720	-0.230	-6.245	0.034		
17	men's shirts	0.127	59.590	-0.263	-4.614	0.018		
18	ladies' underwear	0.215	46.785	-0.141	-1.161	0.000		
19	ladies' shoes	0.273	47.418	-0.136	-0.884	0.000		
20	gasoline	0.032	51.612	-0.024	-1.429	0.001		
21	notebook	0.132	45.318	-0.195	-2.525	0.005		
						C/D	0.24	0.14
Services								
1	ramen	0.119	41.930	-0.197	-2.592	0.005		
2	sushi	0.196	39.861	-0.147	-1.116	0.000		
3	Japanese barbeque	0.246	34.423	0.205	1.074	0.000	+	
4	rent	0.049	8.969	5.278	36.155	0.547	+	X
5	laundering of men's shirts	0.187	41.106	0.011	0.094	-0.001	+	
6	car maintenance fee	0.207	34.526	0.167	1.042	0.000	+	
7	garage fee	0.329	25.480	5.523	16.026	0.192	+	X
8	tutoring school fee	0.201	45.635	0.238	2.046	0.003	+	X
9	gym fee	0.143	27.066	1.409	10.003	0.087	+	X
10	veterinary fee	0.191	36.750	0.145	1.048	0.000	+	
11	hair dressing fee	0.111	22.655	0.171	1.308	0.001	+	
12	ladies' hair cut	0.156	31.449	0.075	0.563	-0.001	+	
						C/D	0.83	0.33

Notes. A: positive estimate of distance denoted by +, B: positive and 10 percent significant estimate of distance denoted by X, C: proportion of positive estimates in each group, D: proportion of positive and significant estimates in each group.

Table 8. Regression of AR-LAPDs on wage differentials

	item	const	t-value	wage diff.	t-value	adjusted R^2	A	B
Perishable goods								
1	tuna	0.196	24.212	-0.351	-1.621	0.002		
2	salmon	0.114	13.249	0.531	2.431	0.007	+	X
3	pork	0.082	10.916	-0.096	-0.482	-0.001		
4	chicken	0.103	16.701	-0.177	-1.075	0.000		
5	eggs	0.048	22.109	0.111	1.915	0.000	+	X
6	cabbages	0.113	30.237	-0.198	-1.973	0.003		
7	onions	0.099	28.773	-0.334	-3.647	0.011		
8	tomatoes	0.085	26.141	-0.219	-2.510	0.005		
9	bananas	0.151	3.755	-0.860	-0.802	0.000		
						C/D	0.22	0.22
Nonperishable goods								
1	rice	0.032	24.101	0.212	5.902	0.030	+	X
2	white bread	0.138	26.199	-0.264	-1.883	0.002		
3	cup noodle	0.033	28.075	-0.008	-0.252	-0.001		
4	fish cake	0.157	11.806	-0.350	-1.022	0.000		
5	sausage	0.070	10.784	-0.240	-1.380	0.001		
6	milk	0.117	6.129	-0.236	-0.461	-0.001		
7	yogurt	0.043	29.763	-0.065	-1.678	0.002		
8	tofu	0.264	14.223	0.545	1.097	0.000	+	
9	cooking oil	0.061	25.453	0.083	1.297	0.001	+	
10	chocolate	0.024	20.324	-0.026	-0.832	0.000		
11	ice cream	0.065	21.388	0.009	0.108	-0.001	+	
12	tea beverages	0.035	10.206	0.335	3.618	0.011	+	X
13	beer	0.022	28.391	0.003	0.158	-0.001	+	
14	kerosene	0.050	26.925	0.060	1.214	0.000	+	
15	bathroom paper	0.054	25.991	0.198	3.536	0.011	+	X
16	laundry detergent	0.057	22.389	-0.118	-1.727	0.002		
17	men's shirts	0.107	22.394	-0.163	-1.280	0.001		
18	ladies' underwear	0.197	19.079	-0.472	-1.730	0.002		
19	ladies' shoes	0.494	4.137	-1.585	-0.496	-0.001		
20	gasoline	0.022	25.673	0.008	0.362	-0.001	+	
21	notebook	0.169	8.561	-0.004	-0.008	-0.001		
						C/D	0.45	0.14
Services								
1	ramen	0.222	4.419	0.811	0.603	-0.001	+	
2	sushi	0.341	3.096	-1.169	-0.397	-0.001		
3	Japanese barbeque	0.245	7.074	1.751	1.888	0.002	+	X
4	rent	0.059	1.158	5.646	4.129	0.015	+	X
5	laundering of men's shirts	0.346	6.694	-1.946	-1.409	0.001		
6	car maintenance fee	0.732	0.933	-0.108	-0.005	-0.001		
7	garage fee	0.849	1.636	5.941	0.428	-0.001	+	
8	tutoring school fee	0.673	1.612	-3.654	-0.331	-0.001		
9	gym fee	0.162	18.741	1.072	4.647	0.020	+	X
10	veterinary fee	0.260	7.857	-0.330	-0.374	-0.001		
11	hair dressing fee	0.968	1.828	-13.192	-0.932	0.000		
12	ladies' hair cut	0.177	7.716	0.570	0.930	0.000	+	
						C/D	0.50	0.25

Notes. A: positive estimate of distance denoted by +, B: positive and 10 percent significant estimate of distance denoted by X, C: proportion of positive estimates in each group, D: proportion of positive and significant estimates in each group.

pers arbitrage. When a service is not tradable between two locations, arbitrage does not work no matter what the distance, and the degree of segmentation is independent of distance. When goods are classified into perishable and nonperishable goods, nonperishable goods are the more tradable of the two. In terms of tradability, perishable goods are between nonperishable goods and services. It is shown that the results are also affected by wage differentials. The wage differentials most strongly affect services. This result is consistent with the notion of tradability, again. Services are not tradable and, therefore, the regional wage differentials directly affect the regional price difference. However, tradability of goods cancels the effects of the wage differentials. The classical dichotomy of goods and services asserts that markets of goods are integrated and markets of service are segmented. The results in this study imply that one should look at the difference in tradability even among goods. The simple classical dichotomy is not supported.

This study has not yet examined changes in segmentation over time. A change in distribution system is expected to affect segmentation. In particular, a rise in internet transactions is expected to influence integration and segmentation of regional markets. The pandemic of COVID-19 had serious effects on the economy. Presumably it caused troubles in the distribution systems in Japan. These issues should be explored next.

Notes

1) Engle (1999) is a seminal work, and his methodology is used in many studies in international economics including Burstein et al. (2005), Betts and Kehoe (2006), Parsley and Popper (2010), Basche et al. (2013), and Ouyang and Rajan (2013).
2) Outline of the 2020-Base Consumer Price Index (https://www.stat.go.jp/english/data/cpi/1590.html). List of information for items of the 2020-Base CPI (https://www.stat.go.jp/english/data/cpi/pdf/2020base-list.pdf).
3) "The Retail Price Survey" (https://www.stat.go.jp/english/data/kouri/index.html).
4) Parsley and Wei (1996) and Cecchetti et al. (2002) are the most prominent seminal studies, and both investigate the US case. See Ikeno (2014a, 2014b) for the Japanese case.
5) Since the group average for nonperishable goods is close to 0.1, a value of 0.1 is used as the reference. The same argument applies in the case of the AR-LAPD.
6) Choi et al. (2017) estimate the AR-LAPD using the US data for consumer goods and services, and observe skewness in the estimates.
7) Among these are Choi et al. (2017) and Cecchetti et al. (2002). Kano et al. (2013) confirm that geographical distance represents transportation cost fairly well, using prices of agricultural products in Japan. Choi and Choi (2014) is an exceptional work which attempts to distinguish between distance and the transportation cost.
8) The data source is the homepage of the Geographical Authority of Japan (https://www.gsi.go.jp/common/000195510.pdf).
9) The data source is the homepage of the Ministry of Health, Labour and Welfare (https://www.mhlw.go.jp/

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Appendix

Items selected for statistical works in this study

	item	weight in CPI (Per 10000)	start	end	# of covered cities
Perishable goods					
1	tuna	22	Jan.2000	Jul.2022	47
2	salmon	21	Feb.2000	Jul.2022	37
3	pork	54	Jan.2000	Jul.2022	47
4	chicken	45	Jan.2000	Jul.2022	47
5	eggs	25	Jan.2000	Jul.2022	47
6	cabbages	10	Jan.2000	Jul.2022	47
7	onions	10	Jan.2000	Jul.2022	47
8	tomatoes	24	Jan.2000	Jul.2022	47
9	bananas	15	Jan.2000	Jul.2022	47
Nonperishable goods					
1	rice	39	Jan.2000	Jul.2022	47
2	white bread	32	Jan.2000	Jul.2022	47
3	cup noodle	20	Jan.2000	Jul.2022	47
4	fish cake	10	Jan.2000	Jul.2022	43
5	sausage	21	Jan.2000	Jul.2022	47
6	milk	41	Jan.2000	Jul.2022	47
7	yogurt	37	Jan.2000	Jul.2022	47
8	tofu	15	Jan.2000	Jul.2022	47
9	cooking oil	11	Jan.2000	Jul.2022	47
10	chocolate	30	Jan.2000	Jul.2022	46
11	ice cream	35	Jan.2000	Jul.2022	47
12	tea beverages	22	Jan.2005	Jul.2022	47
13	beer	31	Jan.2000	Jul.2022	47
14	kerosene	38	Jan.2000	Jul.2022	47
15	bathroom paper	14	Jan.2000	Jul.2022	47
16	laundry detergent	17	Jan.2000	Jul.2022	47
17	men's shirts	5	Jan.2000	Jul.2022	47
18	ladies' underwear	8	Sep.2000	Jul.2022	46
19	ladies' shoes	16	Jan.2000	Jul.2022	47
20	gasoline	182	Jan.2000	Jul.2022	47
21	notebook	11	Jan.2000	Jul.2022	46
Services					
1	ramen (eating out)	30	Jan.2000	Jul.2022	47
2	sushi (eating out)	37	Jan.2000	Jul.2022	46
3	Japanese barbeque (eating out)	48	Jan.2005	Jul.2022	46
4	rent	225	Jan.2000	Jul.2022	47
5	laundering of men's shirts	7	Jan.2000	Jul.2022	47
6	car maintenance fee	37	Sep.2000	Jul.2022	47
7	garage fee	45	Jan.2000	Jul.2022	47
8	tutoring school fee for junior high students	36	Jan.2000	Jul.2022	46
9	gym fee	17	Jan.2005	Jul.2022	46
10	veterinary fee	24	Jan.2000	Jul.2022	47

11	hair dressing fee	26	Jan.2000	Jul.2022	47
12	ladies' hair cut	34	Jan.2000	Jul.2022	47

（要旨）

この研究は，日本の消費財・サービスの地域市場が相互に統合されているか，あるいは，分断されているかを検証する。分断の程度の指標として，長期的に残存する価格差を用いる。地域間価格差のサンプル期間平均と，地域間価格差の自己回帰線形方程式における定数項を指標としている。具体的には都道府県庁所在地の消費財・サービスの小売価格をデータとして用いる。42 品目が選ばれ，生鮮品，保存可能品，サービスの 3 つのグループに分けられた。主な結果は以下のとおりである。3 つのグループのうち，保存可能品の市場が最も分断の程度が小さい。生鮮品の市場は地域間の分断の程度が大きく，サービス市場はもっとも分断の程度が大きい。どちらも財に分類されるが，生鮮品と保存可能品の市場では分断の度合いが異なる。市場の分断は，地域間の地理的距離と賃金格差に影響される。保存可能品の市場の分断の程度は，生鮮品のそれよりも距離と強く関連している。サービスの市場の分断の程度は距離の影響を受けない。一方，サービスの市場の分断は，生鮮品・保存可能品の市場の分断よりも賃金格差と強い相関がある。