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An Empirical Investigation of Tourism Demand Variability:
The Gini Index and Entropy Measure Approach

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ABSTRACT

Focusing on the tourism in Japan, this paper examined the seasonality of tourism demand in Japan by utilizing Gini coefficient and some kinds of entropy measures.

Regarding the estimated Gini coefficient, it is large in Hokkaido, Hiroshima, and Okinawa, and small in Tokyo and Osaka. In addition, the east Japan great earthquake happened in 2011 might affect seasonal fluctuations of many prefectures. After the earthquake, the seasonal fluctuations expressed by the Gini coefficient seem to vary from year to year in spite of the general variation of the number of tourists.

Several points were worth considering through the analysis by estimated entropy measure for the Japanese selected 10 prefectures in the sample period from the year 2008 to 2016. First, there is the one-time rapid increase in seasonality in tourism demand for major four prefectures in 2010 and rapid reversal in next year. In addition, the other two prefectures, have the same pattern in 2011 although the levels of fluctuations are relatively low.

The examination by utilizing the estimated Theil measure shows that the highest concentration of seasonality is recorded for Tokyo and for the other prefectures located in the east and west areas in Japan just like the case of entropy measure. In addition, Miyagi and Fukushima follow the same pattern in next year. Okinawa prefecture have the highest seasonality in 2014 during the period under our study.

The evolution patterns of seasonality for the prefectures described by the estimated relative Theil measure are almost the same as the ones measured by the two indicators described above.

The analysis by the entropy decompositions at the intra- and the inter-monthly levels are also conducted. The estimated seasonality of Japanese selected 10 prefectures that could be explained by the intra-monthly part of entropy measure revealed that the seasonality for the half of the total number of prefectures reflects a relative increase in 2010, and the one for the other two prefectures follows the same pattern in next year. The graphs of the estimated inter-monthly part of entropy measure described the increase in tourism demand seasonality in 2010 like the other measures. Tokyo experienced the relatively rapid reduction in seasonality in next year as a reactionary fall. Okinawa had a certain degree of increase in seasonality again in 2013, and had a fluctuation of seasonality during the following periods.

Finally, consideration of the tourism seasonality based on the relation between interest groups - origins and destinations - by applying the entropy theory are implemented. The estimated entropy measures for annual amount of arrivals from origin (*i*) to destination (*j*) for the selected major six courses are examined. In particular, the seasonality for the routes Hokkaido→Tokyo, Kyoto→Tokyo, and Okinawa→Tokyo decreased rapidly in 2009, and increased drastically in 2010 as a rebound. In short, the routes from the three major areas to Tokyo indicate temporal growth of seasonality.

All the measures based on the entropy theory show a very similar pattern in that the tourism seasonality has the temporal rapid growth in 2010 and the reactionary fall in 2011. Probably, the financial and economic crisis of global economy occurred around 2008 and 2009 had a negative influence on Japanese tourism in 2010. By the effect of the crisis, the number of visits or visiting frequency of tourism in Japan decreased, and its downturn might generate the concentration of tourism in specific season or month as a result of selective behavior by tourists during the hard times.

Key words: seasonality in tourism demand, Gini index, Entropy measure

JEL Classification Code: C33, R58, Z32, Z38

1. Introduction

Some previous studies on seasonal variations of tourism mainly deal with technical aspects to grasp the seasonality of tourism demand accurately and policy aspects to consider the means for tourism development and mitigation of seasonal variations on tourism. For instance, Baum and Lundtorp (2001) give a comprehensive explanation for seasonal variation of tourism, the fixed costs compensation, investment and employment issues, maintenance of the supply chain, and the continuity of transportation. Butler (2001) overviews the cause and effect of the seasonal variations in tourism and points out the practical difficulties of the measures to mitigate the variations. as a developed work of Butler (1994), known as a study of the tourism development cycle. Lundtorp (2001) discusses some approaches including seasonal variation index and Gini coefficient to understand seasonal variations of the tourism demand. To minimize the effects of the seasonal variation, many researchers including Kulendran and King (1997), Lim and McAleer (2001), Goh and Law (2002), and Koc and Altinay (2007) tried to estimate the tourism demand accurately. In particular, Koc and Altinay (2007) show that different combination for a number of visitors and the tourism expenditure in Turkey could be linked and that the seasonality can be recognized through the tourism expenditure, by using X-12-ARIMA. Nadal *et al.* (2004) focuses on the UK and German tourists who visit Balears Islands, and insist that an increase in GDP or a rise in the relative price would decrease the Gini index. It is an example to show that the economic conditions such as the income and the relative price are decisive factors to determine the number of visitors from the gravity theory perspective. Tourism seasonality also depends on the characteristics of the destination. Visitors for the nature-oriented destination such as the national park are influenced by the climate condition compared with the ones for the culture-oriented destination. By analyzing the three tourism destinations in Spain (Malaga, Granada, and Armenia), Morales (2003) insists that the culture-oriented policy such as cultural exhibition and performance at the theater contributes to mitigate the tourism seasonality. Cuccia and Rizzo (2011) show that the seasonality depends on the various cultural attractions by classifying the six destinations in Italy into four clusters based on their cultural attractiveness.

The seasonality in tourism demand is an issue for the supply side of tourism rather than the demand side, and its impact affects tourism management. The decision-making in investment and funds management by the manager of the accommodation, caterings, attractions, and tour operators, such as flexible employment, tourism, and differentiation strategy, is essential to ensure stable management and earnings. In this respect, mitigation policy for the seasonal variation is necessary for stable and profitable management as Lee *et al.* (2008) discuss. However, because the causes of tourism seasonality in natural- and socio-economic factors do not correspond with one another, various strategies and individual measures need to be implemented.

By applying and expanding the contribution by the previous studies described above, this paper analyzes seasonal variation in Japan by using the Gini coefficient and the entropy measure with the data of accommodation tourists in prefecture level. Because our data set includes information on origin and destination of tourists on prefectural levels, we can investigate the factors of seasonal variation concretely.

The paper is composed of the following chapters. In chapter 2, recent monthly tourism seasonality in Japan is explained. Chapter 3 examines seasonal fluctuation of tourism demand by the coefficient of variation and the Gini coefficient. The analysis of seasonality by the entropy measure is described in chapter 4. Chapter 5 is for the concluding remarks.

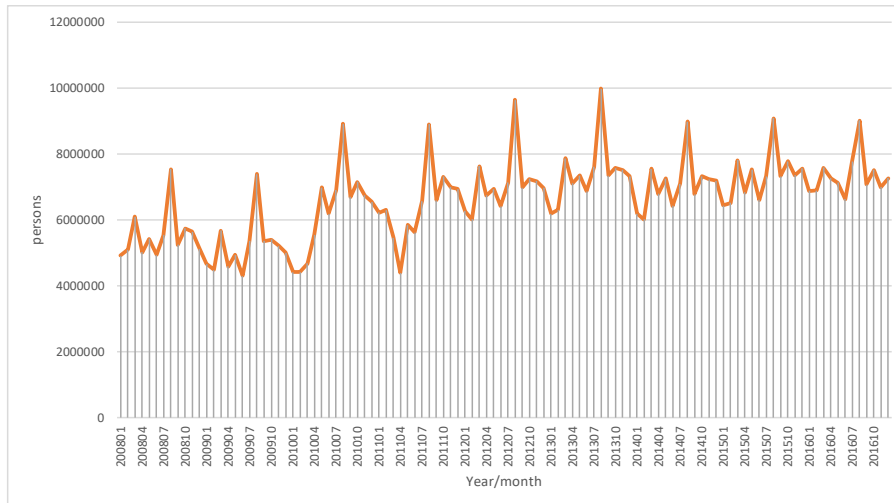
2. Tourism Seasonality and Measurement

2.1 The Data

The paper uses the data obtained from the “Tourism Statistics Survey”¹ of the Japan Tourism Agency, Ministry of Land, Infrastructure, Transport and Tourism. This statistic is based on the number of guests in each accommodation facility (hotels, ryokans (inns) and accommodations (companies, organizations, etc.), including the foreign residents.

¹ The data on “Tourism Statistics Survey” was retrieved from the website of Japan Tourism Agency, Ministry of Land, Infrastructure, Transport and Tourism: “<http://www.mlit.go.jp/kankocho/siryoutoukei/shukuhakutoukei.html>”.

Figure 1: Monthly Tourism Development in Japan (2008-2016)



Source: Accommodation travel statistics survey (<http://www.mlit.go.jp/kankocho/siryoutoukei/shukuhakutoukei.html>)

This data set indicates the residential areas, nationality, and some other characteristics of tourists as the monthly observation. The data used in this paper is based on the “Reference Table 2” in the “Tourism Statistics Survey” which presents the number of tourists by classifying the origin and the destination on the prefectural base.

2.2 Monthly Tourism Seasonality in Japan

Figure 1 shows the tourism development in Japan from 2008 to 2016. The figure illustrates the monthly fluctuations and the gradual increasing trend. Accommodation tourists tend to increase in August, and decrease in January and February, making a regular pattern of the seasonality as we can see in this figure. Due to the impact of the East Japan Great Earthquake in 2011, the number of tourists were declined significantly in April 2011.

3. Analysis of Seasonality by Coefficient of Variation and Gini Coefficient

3.1 Coefficient of Variation

The seasonal fluctuation of tourism demand is well known issue. In the case of Japan, tourism demand fluctuates greatly in monsoon climate season. Seasonal fluctuation of tourism has a significant influence on regional economic activities such as the operation of tourism-related service industry. In this sense, it is important to numerically perceive tourism seasonality. Since the pioneering work of Lundtorp (2001), seasonal fluctuation has been explained by grasping the regularity of the variations in the number of tourists. On the other hand, examination of seasonal variation has been conducted in several ways, for example, Koenig-Lewis and Bischoff (2005) and Lambert and Aronson (1993). Coefficient of variation (CV) and Gini coefficient (or Gini index) are regarded as the main methods for this topic. CV means the magnitude of the variance around the mean value. It shows the extent of the variation by concerning the average value of the variation. With the standard deviation (s) and the mean value (μ), it is defined as

$$CV = \frac{s}{\mu} \quad (1)$$

3.2 Gini Coefficient

The Gini coefficient is applied mainly to represent the state of the income distribution in economic context to the present. However, the Gini coefficient is often used for analyzing tourism fluctuation. According to Lundtorp (2001), the general expression of the Gini coefficient is:

$$\text{Gini coefficient} = \frac{2}{n} \sum_{i=1}^n (x_i - y_i) \quad (2)$$

Figure 2: Development Pattern of Gini Coefficient

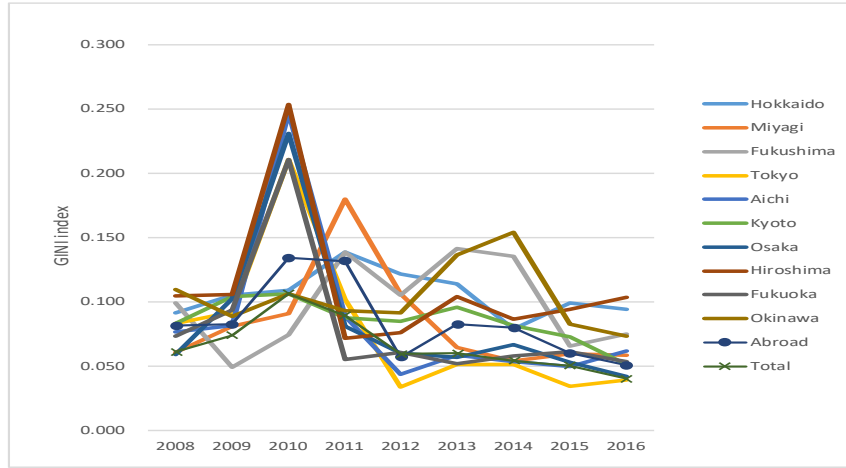


Table 1: Gini coefficient and Coefficient of Variation

	Hokkaido	Miyagi	Fukushima	Tokyo	Aichi	Kyoto	Osaka	Hiroshima	Fukuoka	Okinawa	Abroad	Total
2008	0.091	0.061	0.099	0.083	0.077	0.083	0.059	0.104	0.073	0.110	0.081	0.061
2009	0.105	0.081	0.049	0.092	0.081	0.104	0.102	0.105	0.093	0.088	0.082	0.074
2010	0.109	0.091	0.074	0.210	0.247	0.106	0.231	0.254	0.211	0.106	0.134	0.106
2011	0.138	0.179	0.139	0.101	0.089	0.088	0.081	0.072	0.055	0.093	0.131	0.089
2012	0.121	0.106	0.105	0.034	0.043	0.085	0.060	0.076	0.061	0.091	0.057	0.059
2013	0.114	0.065	0.141	0.051	0.058	0.096	0.057	0.104	0.052	0.136	0.082	0.060
2014	0.078	0.054	0.135	0.051	0.053	0.081	0.067	0.086	0.058	0.154	0.080	0.054
2015	0.099	0.060	0.065	0.034	0.049	0.073	0.053	0.094	0.061	0.083	0.060	0.050
2016	0.094	0.058	0.075	0.039	0.062	0.051	0.042	0.104	0.054	0.073	0.050	0.040
Average	0.106	0.084	0.098	0.077	0.084	0.085	0.083	0.111	0.080	0.104	0.084	0.066
STDdev	0.018	0.040	0.034	0.056	0.063	0.017	0.058	0.055	0.051	0.026	0.030	0.021
STD/Average	0.169	0.476	0.351	0.724	0.743	0.196	0.695	0.495	0.636	0.253	0.357	0.312

Source: Accommodation travel statistics survey

(<http://www.mlit.go.jp/kankocho/siryou/toukei/shukuhakutoukei.html>, 2017/08/25 access)

where n is the number of months ($n = 12$), x_i is the rank of fractiles ($x_i = \frac{i}{n}$), and y_i is the cumulated fractiles in the Lorenz curve.

Figure 2 displays the estimation results of Gini coefficient on a monthly basis from the year 2008 to 2016 for the selected Japanese prefectures and for the accommodation tourists from abroad. Table 1 shows their numerical values. Regarding the estimated Gini coefficient, the following points can be pointed out. First, pattern of seasonal fluctuation varies by prefecture. It is large in Hokkaido, Hiroshima, and Okinawa, and small in Tokyo and Osaka. Second, the east Japan great earthquake happened in 2011 might affect seasonal fluctuations of many prefectures although it did not affect all areas in Japan. After the earthquake, the estimated Gini coefficients are generally in the range from 0.05 to 0.10. Thirdly, in spite of the general variation of the number of tourists, the seasonal fluctuations expressed by the Gini coefficient seem to vary from year to year.

4. Analysis of Seasonality by Entropy Measure

4.1 Entropy Measure

The so-called Theil's entropy measure, which is often used for the income distribution analysis, can capture the feature of the objective in lower part of the distribution. It also can be applied to tourism demand analysis. Theil (1967) provides a tool for analyzing inequality by utilizing entropy theory. The general expression of Theil's entropy measure is the following form:

$$H(\beta) = \frac{1}{\beta(\beta-1)} \sum_i p_i \left[\left(\frac{y_i}{\mu} \right)^\beta - 1 \right], \quad \beta \neq 0, 1 \quad (3)$$

where the parameter β is the weight which is given to distances between objectives at different parts of the distribution taking any real value, p_i is the relative weights of the observations (for example, months, seasons), y_i

is the variable for observations (for instance, tourist demand, in the case of tourism analysis), and μ is the mean.² With respect to the value of β , this measure is more sensitive to changes in the lower tail of the distribution, while this measure is more sensitive to changes that affect the upper tail for higher values. The values of the general expression class of measures take the value between 0 (perfect equality) and ∞ (or 1 in the case of normalization). As β tends to $-\infty$ in the limit, Theil's measure focuses on the lower end. In contrast, the higher β is more sensitive to changes at the top of the ranking. Actually, for the value which is greater than 2, it seems to be sensitive to the changes among the highest value of the objective. In addition, careful attention should be paid to $H(\mathbf{0})$ and $H(\mathbf{1})$, and their algebraic expressions are:

$$H(\beta = 0) = -\sum_i p_p \ln\left(\frac{\mu}{y_i}\right) \quad (4)$$

$$H(\beta = 1) = -\sum_i p_p \left(\frac{y_i}{\mu}\right) \ln\left(\frac{y_i}{\mu}\right) \quad (5)$$

With respect to the property of decomposability which is applicable to the inequality literature, two different approaches are given: the group decomposition and the source decomposition. First, the distributive observations are divided into groups to distinguish which part of the total inequality should be attributed. In this context, the aggregate index, that is additively decomposable, could be described as the sum of the between-group component which would measure the average dissimilarity among the groups and the within-group component which would reflect the internal differences as a weighted average of the interior inequalities.

Generally, an index I is additively decomposable if the decomposition format can be expressed as

$$I = \sum_g w_g I_g + I_b \quad (6)$$

where w_g is the weight for each group, I_g describes the inner-inequality for each group, and I_b is the inequality among groups. The Theil Index is also additively decomposable so far as its format follows equation (6). According to Shorrocks (1984), the group decomposition of $T(0)$ generates less ambiguity if the structure of the model is expressed as:

$$H(0) = H(0)_w + H(0)_b = \sum_g \frac{1}{g} + \sum_g \frac{1}{g} \ln\left(\frac{\mu}{y_i}\right), \quad (7)$$

where $T(0)_w$ represents the aggregate between-groups inequality component, $T(0)_b$ is the internal inequality in group "g", y_i is the tourism activity in month "i", and μ is the average annual average on tourism activity indicator.

4.2 Theil Measure

We can interpret the discussion in the previous section by a simple way. Theil's entropy measure is simply described by

$$H = \sum_i p_i \ln\left(\frac{1}{p_i}\right), \quad (8)$$

where p_i is the probability of an event. In this respect, Theil's entropy measure shows that "entropy" is the weighted summation of information value for each event. It takes the maximum value if all events occur with the same probability.

This measure has been applied to some kinds of social problem, for example, income distribution, tourism seasonality. Let us consider a demand for tourism, x_i instead of p_i , and impose a normalization as $\sum_i x_i = 1$. Then, the entropy for distribution of tourism demand takes the maximum value, $\ln(n)$, if tourism demands are distributed equally (i.e. flat distribution) to each area of tourism where n represents the number of area for the analysis. In this sense, " $\ln(n) - H$ " describes the measure of inequality. Therefore, the so-called "Theil measure" for normalized distribution $\mathbf{x} = (x_1, \dots, x_n)$ is expressed as

$$T(\mathbf{x}) = \ln(n) - \sum_i x_i \ln\left(\frac{1}{x_i}\right) = \sum_i x_i \ln(nx_i). \quad (9)$$

² See Duro (2012) for a reference.

Since the total tourism demand is normalized to 1, x_i virtually means the share of tourism demand for the i th area. Therefore, Theil measure is a decreasing function of the weighted summation of reciprocal of tourism demand share in logarithm. It takes a value of 0 (zero) when there is no seasonality in tourism (i.e. inequality of tourism demand) and a maximum value ($\ln(n)$) when all activities in tourism are concentrated in a single moment.

Theil measure satisfies the conditions of Pigou–Dalton principle in terms of equivalent income and constant relative inequality-aversion since it depends only on the share of tourism demand. It used to express economic inequality based on information theory. The entropy index is often applied to income inequality analysis based on Pigou-Dalton's transfer principle. In this line of discussion, consider the case of the seasonality of tourism and assume that the number of tourists in the whole year be constant. Then, the PD condition is satisfied in that the level of the seasonal variation changes if the number of visitors in a non-concentrated period decline while the visiting frequency of the concentrated period increase. In other words, under the PD condition, the indicator of the seasonal variation based on entropy theory is affected by the distribution of tourists in each month.

One of the problems that we have to take into account in the context of our empirical study is the fact that the range of Theil measure varies with the number of elements. For instance, in the case of annual data, there are 365 days for non-leap years and 366 days for leap years. To deal with this problem, relative Theil measure (relative redundancy measure) is proposed.

$$R = 1 - \frac{H}{\ln(n)} \quad (10)$$

It takes 0 (zero) in the case of no seasonality and 1 (one) if we have perfect seasonality, respectively.

4.3 Decomposition of Entropy Measure and Relation between Interest Groups

One of the properties of the entropy measure is its additive nature. In short, the total entropy can be decomposed into the weighted summation of entropies within groups and among groups. The entropy within groups is

$$H(X_\tau) = \sum_{x_t \in A_\tau} \frac{x_t}{X_\tau} \ln \left(\frac{1}{\frac{x_t}{X_\tau}} \right). \quad (11)$$

On the other hand, the entropy among groups is defined as:

$$H(X_1, \dots, X_m) = \sum_{\tau=1}^m \frac{X_\tau}{X} \ln \left(\frac{1}{\frac{X_\tau}{X}} \right), \quad (12)$$

where $X_\tau = \sum_{x_t \in A_\tau} x_t$ and A_τ is a subset for a $\tau = 1, \dots, m \leq n$.

Totally, the decomposition of the Theil's entropy measure based on its additive nature is described as:

$$\begin{aligned} H &= \sum_{t=1}^n p_t \ln \left(\frac{1}{p_t} \right) = \sum_{\tau=1}^m \sum_{x_t \in A_\tau} \frac{x_t}{X} \ln \left(\frac{1}{\frac{x_t}{X}} \right) \\ &= \sum_{\tau=1}^m \frac{X_\tau}{X} H(X_\tau) + H(X_1, \dots, X_m), \end{aligned} \quad (13)$$

where the first element is the weighted summation of entropies within groups and the second one represents the entropy among groups.

For the empirical analysis using a monthly dataset, X_τ is composed of $\tau = 1, \dots, 12$ and the monthly temporal aggregation is:

$$H = \sum_{\tau=1}^{12} \frac{X_\tau}{X} H(X_\tau) + \sum_{\tau=1}^{12} \frac{X_\tau}{X} \ln \left(\frac{1}{\frac{X_\tau}{X}} \right), \quad (14)$$

where the first addend represents the weighted intra-monthly entropy and the second one is the inter-monthly entropy. In the empirical analysis, a part of the inter-monthly entropy is generated by the differences of the length of month, since the days of each month are not all the same.³

³ See Rossello and Sanso (2017) for details.

In addition to the above discussions, we can consider the relation between interest groups, for example, tourism origin and destinations, by applying the entropy theory. The entropy measure for annual amount of arrivals from origin (i) to destinations (j) is described as:

$$H_{ij}(x_{ijt}) = \sum_{t=1}^n \frac{x_{ijt}}{x_{ij.}} \ln \left(\frac{x_{ij.}}{x_{ijt}} \right), \quad (15)$$

where $x_{ij.} = \sum_{t=1}^n x_{ijt}$. This measure is able to be utilized seasonality analysis for tourism.

4.4 Empirical Analysis by the Entropy Measures

In this section, empirical analysis by applying some kinds of the entropy measures described in above sections is conducted. The analysis of the seasonality in tourism demand is implemented with the monthly data set⁴ which is the same as the one used in sections 2 and 3. The data on tourism arrivals is applied as the proxy variable for the tourism demand. The entropy measure, the Theil measure, the relative Theil measure, the intra-monthly decomposition part of entropy measure, and the inter-monthly decomposition part of entropy measure are estimated. In addition, the entropy measure for annual amount of arrivals from origin to destination is considered.⁵

In our analysis, major 10 prefectures in terms of their annual tourism demands are focused on. In order of demand, the following prefectures are included: Hokkaido, Miyagi, Fukushima, Tokyo, Aichi, Kyoto, Osaka, Hiroshima, Fukuoka, and Okinawa. These prefectures typically have strong tourism demands, and the reason for including Fukushima is as follows. Fukushima prefecture suffered a certain damage by the Tohoku earthquake and tsunami that hit Japan in March 2011. Whether it can recover the tourism demand is a continuous topic for discussion in Japan. In this respect, Fukushima is turned into an object of our analysis.

Figure 4 displays the estimated entropy measures with respect to the tourism demand for the Japanese selected 10 prefectures in the sample period from the year 2008 to 2016. Several points are worth considering. First, there is the one-time rapid increase in seasonality (decrease in the value of measure) in tourism demand for Tokyo, Osaka, Hiroshima, and Aichi in 2010 and rapid reversal in next year. Second, the other two prefectures, Fukushima and Miyagi, have the same pattern in 2011 although the levels of fluctuations are relatively low. Third, the entropy measure for Fukushima prefecture continually fluctuates during the sample period.

Figure 5 shows the seasonality which is identified by the estimated Theil measure during the period under our study. Just like the case of entropy measure, the highest concentration of seasonality is recorded for Tokyo and for the other prefectures located in the east and west areas in Japan. In addition, Miyagi and Fukushima follow the same pattern in next year. Okinawa prefecture have the highest seasonality in 2014.

Figure 6 describes the seasonality estimated by the relative Theil measure for our sample period. The evolution patterns of seasonality for the prefectures are almost the same as the ones measured by the two indicators described above.

The analysis can be taken further by applying the decomposition property of the Theil's entropy measure based on the additive nature described in the former section. Namely, the entropy decompositions at the intra- and the inter-monthly levels are applied here. The estimated seasonality of Japanese selected 10 prefectures that could be explained by the intra-monthly part of entropy measure is highlighted in Figure 7. As the graphs show, the seasonality for the half of the total number of prefectures reflects a relative increase in 2010, and the one for the other two prefectures follows the same pattern in next year. Except 2010 and 2011, the values of the intra-monthly measure fluctuate in a relatively stable manner.

Figure 8 represents the estimated inter-monthly part of entropy measure with the lowest about 2.3 and the highest about 3.12. The graphs of this measure describe the increase in tourism demand seasonality in 2010 like the other measures explained above. Tokyo, the capital city, experienced the relatively rapid reduction in seasonality in next

⁴ In any case, the adoption of the longer period would tend to increase the inequality inside the groups, and to reduce the between-group inequality.

⁵ With respect to the methodology in tourist applications, see Fernandez-Morales (2003) for example.

Figure 4: Estimated Entropy Measure

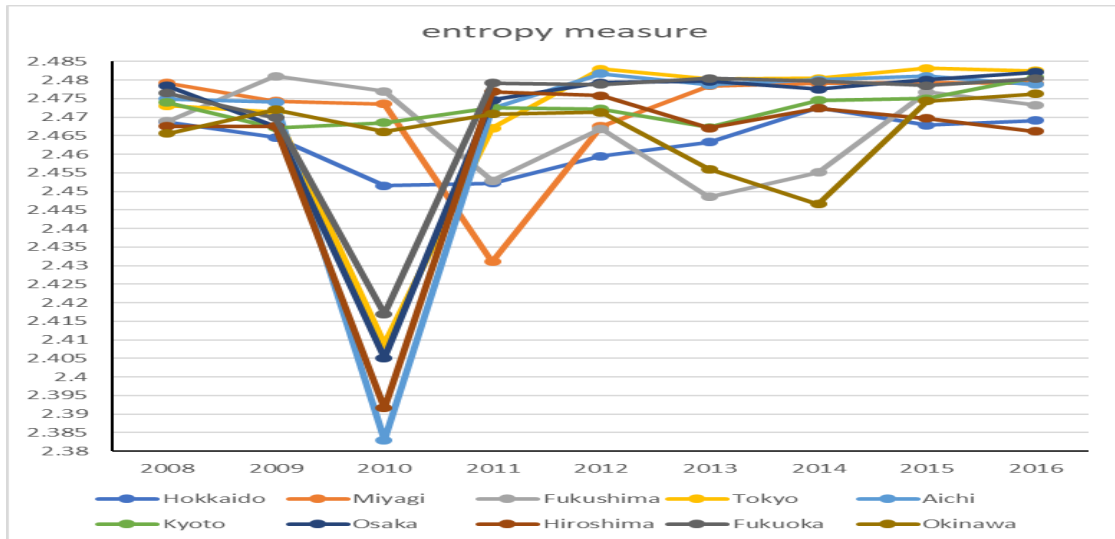


Figure 5: Estimated Theil Measure

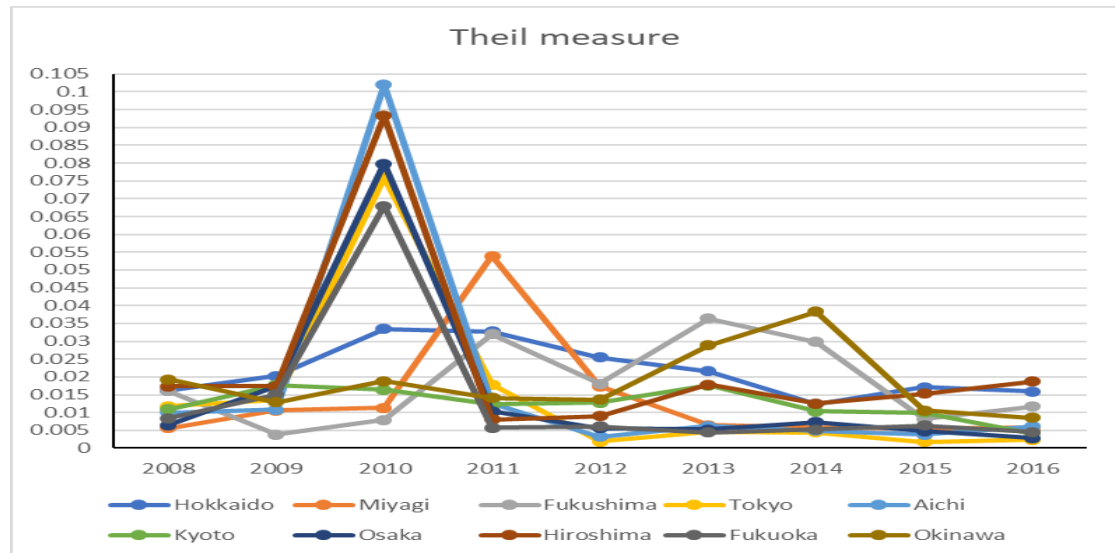


Figure 6: Estimated Relative Theil Measure

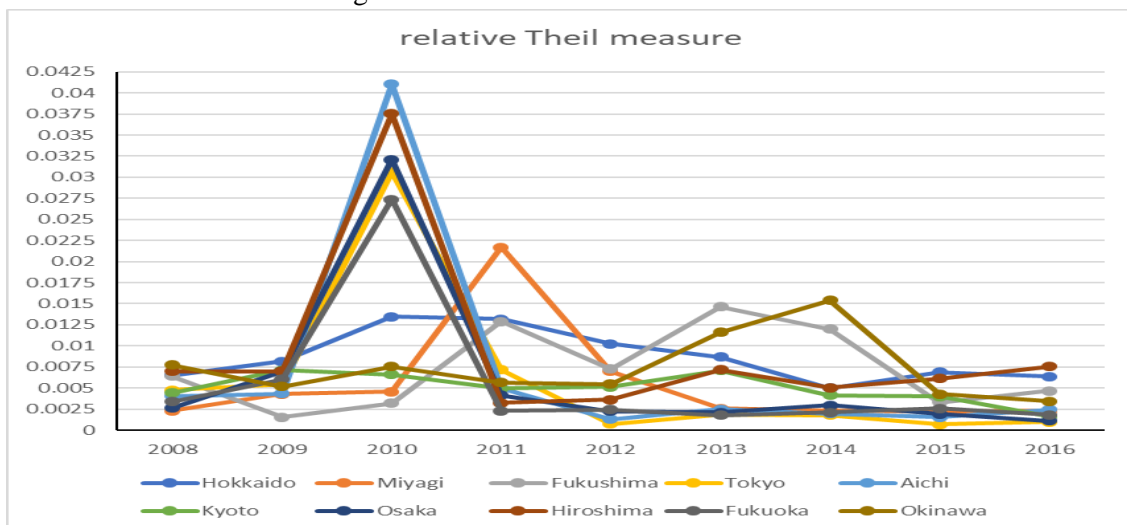


Figure 7: Estimated intra-monthly decomposition part of entropy measure

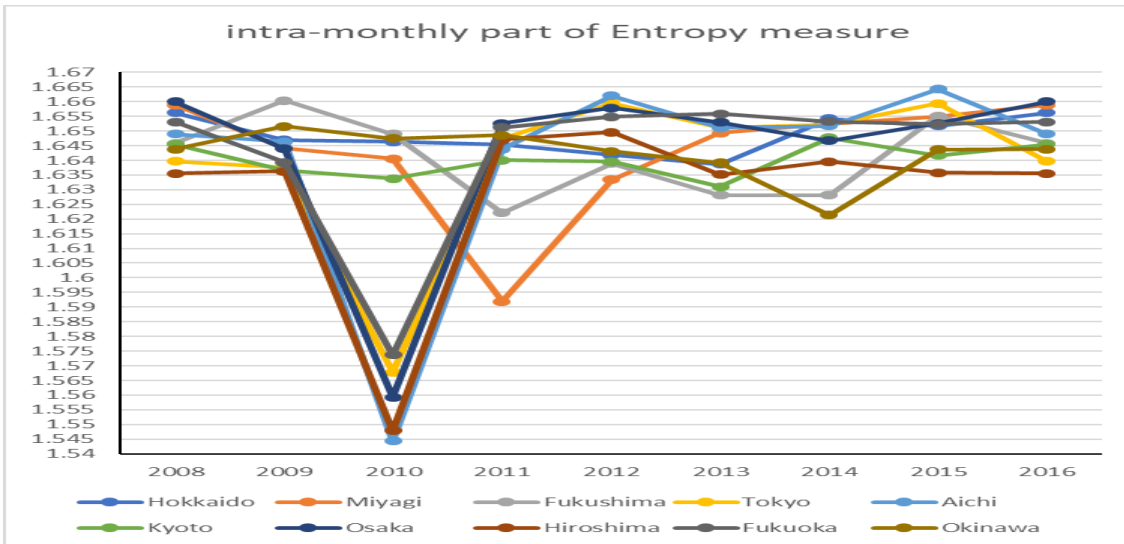


Figure 8: Estimated inter-monthly decomposition part of entropy measure

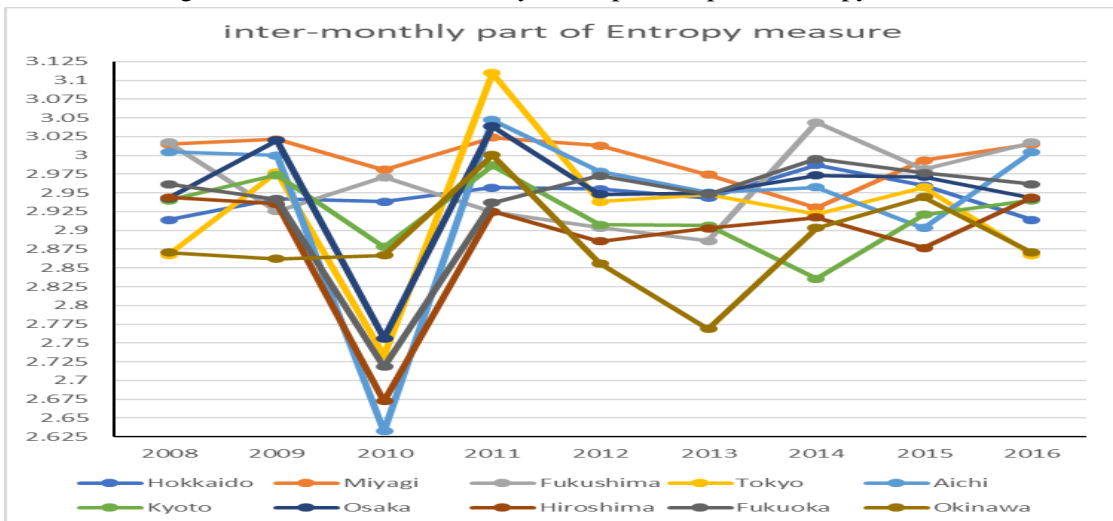
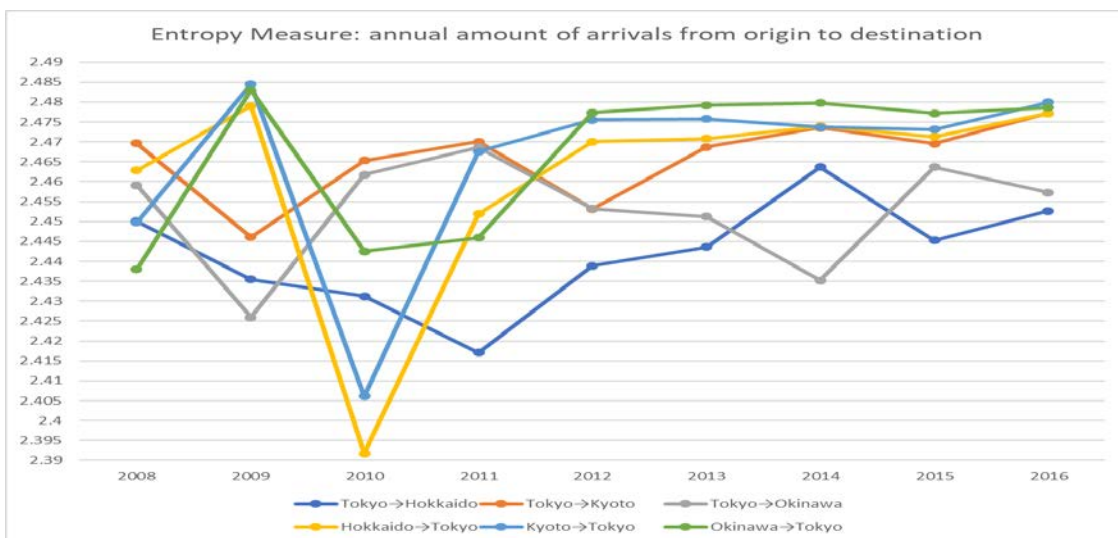


Figure 9: Estimated entropy measure for annual amount of arrivals from origin to destinations



year as a reactionary fall. Okinawa had a certain degree of increase in seasonality again in 2013, and had a fluctuation of seasonality during the following periods.

Since lengths of the months are not all the same, part of the inter-monthly entropy is generated by these differences. It might be the cause of the fact that the summation of the intra- and the inter-monthly values is not equal to the one of the original entropy measure.

Results derived by the method of decomposition analysis may be the way of testing the usefulness of the temporal aggregation. If we acknowledge that most of the annual seasonality inequalities are attributable to intra-groups disparities, we might consider that informative relevance of the month-partitions would be limited. This is because internal coherence within groups would be small, losing the significance of these groupings. However, it does not seem to be the case of our analysis.

Finally, we consider the tourism seasonality based on the relation between interest groups, in short, origins and destinations of tourism, by applying the entropy theory explained in section 4.3. The estimated entropy measures for annual amount of arrivals from origin (i) to destination (j) for the selected major six courses, Tokyo \rightarrow Hokkaido, Tokyo \rightarrow Kyoto, Tokyo \rightarrow Okinawa, Hokkaido \rightarrow Tokyo, Kyoto \rightarrow Tokyo, and Okinawa \rightarrow Tokyo, are summarized in Figure 9. In particular, the seasonality for the routes Hokkaido \rightarrow Tokyo, Kyoto \rightarrow Tokyo, and Okinawa \rightarrow Tokyo decreased rapidly in 2009, and increased drastically in 2010 as a rebound. In short, the routes from the three major areas to Tokyo indicate temporal growth of seasonality. The opposite directions did not always set forth a trend like that.

All the measures described above show a very similar pattern in that the tourism seasonality has the temporal rapid growth in 2010 and the reactionary fall in 2011. Probably, the financial and economic crisis of global economy occurred around 2008 and 2009 had a negative influence on Japanese tourism in 2010. By the effect of the crisis, the number of visits or visiting frequency of tourism in Japan decreased, and its downturn might generate the concentration of tourism in specific season or month as a result of selective behavior by tourists during the hard times.

5. Concluding Remarks

Focusing on the tourism in Japan, this paper examined the seasonality of tourism demand in Japan by utilizing Gini coefficient and some kinds of entropy measures. Our analysis found the following facts.

Regarding the estimated Gini coefficient, pattern of seasonal fluctuation varies by prefecture. It is large in Hokkaido, Hiroshima, and Okinawa, and small in Tokyo and Osaka. In addition, the east Japan great earthquake happened in 2011 might affect seasonal fluctuations of many prefectures although it did not affect all areas in Japan. After the earthquake, the estimated Gini coefficients are generally in the range from 0.05 to 0.10. Further, in spite of the general variation of the number of tourists, the seasonal fluctuations expressed by the Gini coefficient seem to vary from year to year.

Several points were worth considering through the analysis by estimated entropy measure for the Japanese selected 10 prefectures in the sample period from the year 2008 to 2016. First, there is the one-time rapid increase in seasonality (decrease in the value of measure) in tourism demand for major four prefectures in 2010 and rapid reversal in next year. In addition, the other two prefectures, have the same pattern in 2011 although the levels of fluctuations are relatively low.

The examination by utilizing the estimated Theil measure shows that the highest concentration of seasonality is recorded for Tokyo and for the other prefectures located in the east and west areas in Japan just like the case of entropy measure. In addition, Miyagi and Fukushima follow the same pattern in next year. Okinawa prefecture have the highest seasonality in 2014 during the period under our study.

The evolution patterns of seasonality for the prefectures described by the estimated relative Theil measure are almost the same as the ones measured by the two indicators described above.

The analysis can be taken further by applying the decomposition property of the Theil's entropy measure based on the additive nature - the entropy decompositions at the intra- and the inter-monthly levels. The estimated seasonality of Japanese selected 10 prefectures that could be explained by the intra-monthly part of entropy measure revealed

that the seasonality for the half of the total number of prefectures reflects a relative increase in 2010, and the one for the other two prefectures follows the same pattern in next year. Except 2010 and 2011, the values of the intra-monthly measure fluctuate in a relatively stable manner.

The graphs of the estimated inter-monthly part of entropy measure described the increase in tourism demand seasonality in 2010 like the other measures explained above. Tokyo, the capital city, experienced the relatively rapid reduction in seasonality in next year as a reactionary fall. Okinawa had a certain degree of increase in seasonality again in 2013, and had a fluctuation of seasonality during the following periods.

Finally, consideration of the tourism seasonality based on the relation between interest groups - origins and destinations - by applying the entropy theory are implemented. The estimated entropy measures for annual amount of arrivals from origin (*i*) to destination (*j*) for the selected major six courses are examined. In particular, the seasonality for the routes Hokkaido → Tokyo, Kyoto → Tokyo, and Okinawa → Tokyo decreased rapidly in 2009, and increased drastically in 2010 as a rebound. In short, the routes from the three major areas to Tokyo indicate temporal growth of seasonality.

All the measures based on the entropy theory described above show a very similar pattern in that the tourism seasonality has the temporal rapid growth in 2010 and the reactionary fall in 2011. Probably, the financial and economic crisis of global economy occurred around 2008 and 2009 had a negative influence on Japanese tourism in 2010. By the effect of the crisis, the number of visits or visiting frequency of tourism in Japan decreased, and its downturn might generate the concentration of tourism in specific season or month as a result of selective behavior by tourists during the hard times.

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