Positioning and clustering of the world's top tourist destinations by means of dimensionality reduction techniques for categorical data

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Abstract

The present study aims to cluster the world's top tourism destinations based on the growth of the main tourism indicators over the period between 2000 and 2010. We rank the destinations regarding the average growth rate over the sample period. We find that both China and Turkey are at the top of the rankings of all variables. By assigning a numerical value to each country corresponding to its position, we compute Spearman's coefficient and find a negative correlation between a destination's dependency on tourism and the profitability of the tourism activity. Finally, we use several multivariate techniques for dimensionality reduction in order to cluster all destinations according to their positioning. We obtain three groups: China on the one hand, Turkey on the other, and the rest of the destinations. These results show that the persistent growth of the tourism industry poses different challenges in different markets regarding destination marketing and management.

Keywords: Tourism destinations; Positioning; Categorical Principal Components Analysis (CATPCA); Multidimensional Scaling (MDS); Perceptual maps; Destination marketing

1. Introduction

Tourism is one of the most important economic activities worldwide. Travel and passenger transport represent 30% of the world's exports of services, and 6% of overall exports of goods and services. While other commodity prices show decreasing prices, international tourism expenditure increased a 3.7% in real terms in 2014 (UNWTO, 2015). As a result, tourist destinations have to make major efforts in order to develop and manage their brand within an increasingly competitive market (Mariani et al., 2014; Datzira & Poluzzi, 2014; Wang & Pizam, 2011).

In this study we propose a methodology to position and cluster tourist destinations according to the evolution of their main tourism indicators with a dual purpose. On the one hand, we aim to contribute to destination research literature by analysing how the dynamic interaction between the main tourism indicators ultimately affects the positioning of destinations. On the other hand, we try to highlight the utility of multivariate techniques for destination marketing and management. In this study we apply two different multivariate techniques of optimal scaling for categorical variables: Categorical Principal Component Analysis (CATPCA) and Multidimensional Scaling (MDS). To our knowledge, this is the first study to compare the performance of both techniques in the clustering of tourist destinations.

First, we conduct a descriptive analysis of the annual percentage growth rates of the tourism indicators over the period comprised between 2000 and 2010. We complement the analysis by graphing the evolution of the series so as to visually represent the co-movements between tourism variables and economic growth. Then, we rank the world's top tourist destinations regarding the average growth rate over the sample period. By assigning a numerical value to each destination corresponding to its position in the rankings, we analyze the relationship between all the variables by means of the Spearman correlation coefficient. Finally, we cluster the destinations according to their position in the rankings by means of several multivariate techniques of optimal scaling.

We use data from the Compendium of Tourism Statistics provided by the World Tourism Organization (UNWTO – http://www2.unwto.org/content/data-0). Data include the annual number of overnight visitors, total expenditure, total number of rooms, and the percentage of the occupancy rates from 2000 to 2010. In Table 1 we present the frequency distribution of overnight visitors in the top ten world destinations during the sample period.

Table 1
Frequency distribution of overnight visitors (2000-2010)

The information in Table 1 indicates that the tourism sector is highly concentrated in few destinations, as the first five national markets (France, Spain, the United States, China and Italy) account for almost 50% of world tourism. The next five destinations (United Kingdom, Germany, Mexico, Turkey and Austria) represent an additional 20% of total overnight visitors.

Tourism demand is predominantly measured by the number of arrivals and the level of tourism expenditure. Some authors have made use of the length of stay (Claveria & Datzira, 2010). Given that ratios provide insight into the profitability and the sustainability of tourism activities, in this study we calculate the ratio of expenditure per tourist as a proxy of tourism demand.

As pointed out by Song et al. (2012), one of the problems with the existing tourism literature is the omission of economic indicators and the lack of attention paid to economic return. With the aim of covering this deficit, in this study we incorporate economic information. On the one hand, we incorporate the annual percentage growth rates of GDP and of total inbound expenditure over GDP. We also use the average growth of the Human Development Index (HDI) so as to assess the potential effect on tourism of development beyond a strictly economic sense. By using annual percentage growth rates instead of levels, we avoid the issues derived from working with non-stationary time series, since most tourism variables are non-stationary due to the steady growth in tourism (Chu et al., 2014).

The remainder of this study is organized as follows. The next section reviews the existing literature. Section 3 presents the descriptive and graphical analysis of the the data. In the next section, we present the rankings and the results of the correlation analysis. In Section 5 the results of the multivariate analysis are discussed. The final section summarizes the findings and the limitations of the study, and offers suggestions for further research.

2. Literature review

As suggested by Pike (2008), the improved understanding of the market conditions allows the pursuit of competitiveness and sustainability at a destination level. There is abundant literature on the contribution of tourism to economic growth as well as to destination competitiveness (Pérez-Rodríguez et al., 2015; Chou, 2013; Croes, 2011; Schubert et al., 2011; Schubert & Brida, 2009; Capó et al., 2007; Crouch & Richie, 2006; Oh, 2005; Durbarry, 2004; Balaguer & Cantavella-Jordá, 2002). Skerritt & Huybers (2005) examine the net effect of international tourism on GDP per capita in 37 developing economies, finding that tourism positively affects economic development. Tang & Tan (2015) test the tourism-led growth hypothesis in Malaysia and find that tourism is an effective long-term engine of growth. In a similar study, Hye & Khan (20013) confirm the long-run relationship between income from tourism and economic growth in Pakistan.

Recent literature highlights the role of capital formation, arguing that the mechanism underlying tourism's welfare-promoting effect heavily relies on capital goods imports (Nowak et al., 2007; Cortés-Jiménez et al. 2011). Foreign direct investment, trade volume, and exchange rates are also linked to tourism (Santana-Gallego et al., 2010, 2011; Wong & Tang, 2010).

The most commonly considered determinants of tourism demand are the income of origin, the prices in the destination, and the substitute prices of alternative destinations (Song et al, 2009; Claveria & Datzira, 2009). An additional variable that affects tourist's decisions is the marketing expenditure at the destination level (Zhang et al., 2010; Kulendran & Dwyer, 2009). Globalization has led to an increasing market interdependence, as tourism demand in one destination tends to be affected by demand for alternative destinations. These interdependences have been addressed by means of VAR models and co-integration techniques (Seo et al., 2010; Torraleja, 2009), nevertheless few studies have used multivariate techniques (Chandra & Menezes, 2001).

Multivariate analysis techniques can be classified into two major categories: dependency and interdependency techniques. While the former assume that a set of variables is explained by other variables, interdependency techniques involve the simultaneous analysis of all the variables in the dataset. Cluster analysis is an example of an interdependent procedure. The main purpose of these techniques is to reduce the dimensionality, and to detect underlying structures in the relationships between variables. For a detailed description of these techniques see Hair et al. (2009) and Sharma (1996).

The use of multivariate techniques for dimensionality reduction in tourism is mainly limited to market segmentation studies (Sinclari-Maragh et al., 2015; Donaire et al, 2014; Rid et al., 2014; Dey & Sarma, 2010; Park & Yoon, 2009; Voges, 2007; Lee et al., 2006; Upchurch et al., 2004; Arimond & Elfessi, 2001; Keng & Cheng, 1999). Guo et al. (2015) conduct a conjoint and cluster analyses to segment Chinese spa customers in Hong Kong. In a recent study, Mikulić et al. (2015) make use of Principal Component Analysis (PCA) and impact-asymmetry analysis to identify critical factors in the Croatian yachting tourism.

Artificial intelligence-based techniques such as Self-Organizing Map (SOM) analysis (Kohonen, 1982, 2001) are used to generate visual representations of different phenomena. SOMs organize data in order to disclose unknown patterns. A SOM analysis can be considered a nonlinear generalization of PCA (Liu & Weisberg, 2005). SOMs are starting to be used in economic studies (Sarlin & Peltonen, 2013; Sarlin & Marghescu, 2011; Lu & Wang, 2010). As far as we know, the only application in tourism is that of Bloom (2005), who uses a SOM artificial neural network for segmenting the international tourist market to Cape Town.

3. Data

3.1. Descriptive Analysis

In this section, we first conduct a descriptive analysis of the annual percentage growth rates of:

- The main indicators provided by the UNWTO: overnight visitors (thousands), total expenditure (US$ millions), occupancy rate (%), rooms, and inbound expenditure per GDP (%). Unlike the total arrivals, that include excursionists, the indicator ‘overnight visitors’ stands for international inbound tourists.
- The calculated ratio of expenditure per tourist.
- The GDP at market prices based on constant local currency provided by the World Bank (http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG)

By using annual percentage growth rates, which are dimensionless measures of the amount of increase (or decrease) of a specific variable from one year to another in percentage terms, we are able to undertake a comparative analysis of the evolution of the different tourism indicators (Table 2).

Table 2
Annual percentage growth rates of the UNWTO tourism indicators – Summary (2000-2010)

In Table 2 we present a summary of the descriptive analysis by the different indicators. The results in Table 2 show that during the sample period the mean growth of the proxies of tourism demand (overnight visitors, tourism expenditure and occupancy rate) experience an increase, whereas on the supply-side, the number of rooms slightly decreased on average. We can also see that the evolution of the expenditure per tourist is lower than the evolution of the rest of the proxies of tourism demand, which suggests that the decrease in the number of rooms may have resulted from an attempt from the industry to maintain the profitability. The evolution in the number of rooms displays on average higher dispersion between destinations than the rest of the variables, with peaks close to 80%.

3.2. Graphical Analysis

In order to visually represent the evolution the co-movements between the main tourism indicators and the economic growth in each country, we complete the descriptive analysis with a graphical analysis of the main variables (Fig. 1 and Fig. 2). The graphical analysis allows us to locate these oscillations during the sample period. First, we find that the 2008 financial crisis had an impact on 2009 tourism growth, but in 2010 all variables started growing again. This result is in line with previous research on demand for hotel rooms in Hong Kong by Song et al. (2011), and in the US lodging industry by Singh et al. (2014).

Second, we observe that annual percentage growth rates of overnight stays show more differences across destinations than the growth rates of expenditure per tourist. While growth in Austria and France is stable, Turkey shows high growth rates in spite of a decreasing trend (Fig. 1). Italy displays a counter-cyclical evolution with respect to the evolution of overnight visitors worldwide.

Regarding the annual percentage growth rates of total expenditure per tourist (Fig. 2), with the exception of China and Turkey, all destinations show a similar cyclical behavior. The United States, Mexico and Germany present a stable pattern of moderate growth. When comparing the evolution of the annual percentage growth rates of the expenditure per tourist and the number of overnight stays in each destination (Fig. 2), we can see that both variables seem positively correlated in most countries after 2001. In Turkey, the rhythm of growth of the expenditure per tourist does not increase after the crisis. In Germany, the recovery in the evolution of tourist arrivals is faster than in terms of expenditure per tourist.

In terms of the evolution of the expenditure per tourist, most destinations follow the global trend, with the exception of the United States. By contrast, the growth rates of tourist arrivals show different patterns in each destination. The distance factor could be explaining to some extent the different regional patterns in the annual percentage growth rates of arrivals. Lee et al. (2012) analyse the changes of destination choice over time and find evidence that pleasure travellers did not travel further distances during the first decade of this century. Huang et al. (2013) and Ng et al. (2007) analyse the positive impact of cultural distance on tourists' intention to visit a country.

Fig. 1. Overnight visitors in each country vs. international inbound tourists

Fig. 2. Expenditure per tourist vs. overnight visitors in each country

4. Positioning

In this section we first rank the destinations according to the average annual growth experienced over the period comprised from 2000 to 2010 (Table 3). Apart from the six tourism indicators described in Section 3, we also include the average growth of the Human Development Index (HDI) provided by the United Nations (UN) in order to analyse the relationship between tourism and development beyond a strictly economic sense.

Table 3
Ranking of countries

The rankings in Table 3 confirm the results of the previous section. We find that both China and Turkey are at the top of the rankings for all variables, the only exception being Turkey in terms of expenditure per tourist growth, and China with respect to the growth of inbound expenditure per GDP. These results suggest that although total income from inbound tourism to Turkey is increasing, the returns are decreasing as a consequence of comparatively lower individual expenditure. See Ozturk & van Niekerk (2014) and Köseoglu et al. (2015) for a further analysis on this issue.

The rankings also show that China's economic growth in terms of GDP is considerably higher than in terms of tourism (measured by inbound expenditure). Jones et al. (2011) analyze the effect of the top impacts of the financial 2008 crisis in sales, marketing and revenue management in the Chinese hospitality industry.

Spain's position at the bottom of the ranking in terms of occupancy rates growth may be a sign of saturation in the Spanish market and of oversupply of rooms. See Kozak (2002) for an assessment of Spain vis-à-vis a competing destination (Turkey). Germany, Austria and Italy are usually in the middle positions, while the United States and the United Kingdom are the destinations showing a higher dispersion across variables in terms of their positioning.

By assigning a numerical value to each destination corresponding to its position in the rankings of Table 3, we compute Spearman's rank correlation coefficients between each two items (Table 4). We obtain three statistically significant correlations. On the one hand, the position according to the average growth in the number of tourist arrivals is correlated to the position regarding the average growth of both total expenditure and the occupancy rate.

On the other hand, the negative link between the position with respect to the average growth in inbound expenditure per GDP and the position in terms of the average growth in the expenditure per tourist, indicates that higher positions regarding the growth of the relative weight of tourism income in a destination's economy correspond to lower positions regarding the growth of expenditure per tourist. This result suggests a negative correlation between a destination's dependency on tourism revenues and the profitability of the tourism activity.

Table 4
Correlation analysis – Spearman's rank correlation coefficients

In spite of not being statistically significant at the 5% level, the position in terms of the average growth of the HDI is positively correlated with the position regarding the average growth of both total expenditure and the occupancy rate. These results are indicative of the importance of tourism for growth beyond a strictly economic sense.

5. Cluster analysis of the rankings

In this section we conduct a cluster analysis of the categorical data provided by the rankings. The grouping of all seven rankings in Table 3 is done by means of two different multivariate techniques of optimal scaling for categorical variables: CATPCA and MDS. Both CATPCA and MDS can be regarded as alternative dimensionality reduction techniques for multivariate categorical data.

These procedures are used to reduce the dimensionality of data by transforming the original set of correlated variables into a smaller and more understandable set of uncorrelated variables (Jolliffe, 2002). CATPCA is a complementary technique to multiple correspondence analysis (MCA) that can handle nominal, ordinal and numerical variables simultaneously and can deal with nonlinearities in the relationships between them. CATPCA can be regarded as an intermediate technique between linear PCA and nonlinear MCA. MDS is a multivariate analytical procedure for visualizing the level of similarity of individual cases of a dataset. The proximity of individuals to each other in the generated perceptual map indicate how similar they are. MDS is often used in marketing to visually analyze perceptions of consumers.

By assigning a numerical value to each country corresponding to its position in Table 3, we can reduce the information of all rankings into two dimensions, which can be regarded as two synthetic indicators that maintain the original ordinal structures. In Table 5 we present a summary of the models. The first dimension obtained with CATPCA accounts for almost 96% of the variance of the variables under analysis, indicating the goodness of fit of the components.

Table 5
Multivariate analysis - Summary

Fig. 3. Scatterplot of the scores of the first two dimensions – CATPCA

Fig. 4. Scatterplot of the scores of the first two dimensions – MDS

Figures 3 and 4 are two-dimensional perceptual maps that represent the coordinates of the first two dimensions for each destination. While Fig. 3 shows the projection obtained by means of the CATPCA, Fig. 4 graphs the projection of the first two dimensions obtained by means of MDS. Both techniques yield a very similar grouping of the destinations with respect of their positioning in the rankings of Table 3. In both Fig. 3 and Fig. 4, China and Turkey are clustered at opposite ends of the scatterplot, while the rest of the destinations are clustered together at another extreme. These findings are consistent with those in Section 3 and Section 4. These results may be due in part to the fact that both China and Turkey present higher rates of growth, and subsequently higher dispersion levels than the rest of the countries.

However, while China is an emerging destination, Turkey seems to show signs of stagnation, especially in terms of revenues from the tourist activity. Regarding Turkey, Ozturk & van Niekerk (2014) provide an historical look at Turkey's nine ‘five-year-development plans' since 1963 and identify the factors that have caused the decline in the rate of growth of tourism receipts. In a recent study Köseoglu et al. (2015) analyze the Turkish hotel industry, and draw attention to a differentiation strategy based largely on price reduction. Therefore it seems that the Turkish market is at a crossroads between volume and value.

With respect to China, there are multiple studies that highlight different aspects of the increasing importance of China's tourism industry. Sun et al. (2015) find evidence of the growth in total factor productivity of China's tourism industry. Chan & Ni (2011) determine the factors behind the growth of budget hotels. Wen & Sinha (2009) signal the high growth of inbound tourism to China, and the increasing regional inequalities. Jackson (2006) also highlights the differences between inland and coastal regions, and the vast potential for improvement. In this sense, the persistent growth of the tourism industry in China poses profound challenges from the perspective of destination marketing and management (Xiao, 2013).

6. Summary and concluding remarks

6.1. Discussion

The present study analyses tourism trends in the world's ten most important destinations over the period comprised between 2000 and 2010. The statistical analysis of the evolution of the UNWTO annual tourism indicators yields the following results. First, we find that the 2008 financial crisis had an impact on 2009 tourism growth, but from 2010 on, growth rates started raising again. Second, we detect that most destinations show a similar pattern in terms of growth of expenditure per tourist but not of overnight visitors. Finally, we observe that both China and Turkey have experienced the highest annual percentage growth rates during this period.

Destinations are then ranked according to the average growth experienced by the seven tourism indicators during the sample period. This ranking allows us to compute Spearman's correlation coefficients between all variables. We find a negative and significant correlation between the position with respect to the average growth in inbound expenditure per GDP and the position in terms of the average growth in expenditure per tourist, which indicates that higher positions regarding the growth of the relative weight of tourism income in a destination's economy correspond to lower positions regarding the growth of expenditure per tourist.

Finally, by means of several multivariate techniques based on optimal scaling we cluster the ten destinations. On the one hand, we have European and American countries (Austria, France, Germany, Italy, Spain, the United Kingdom, Mexico and the United States). On the other hand, we find China and Turkey, which at the same time are at opposite extremes between them. Both China and Turkey present higher annual percentage growth rates than the rest of the destinations, but while the Turkish market seems to show signs of stagnation in terms of revenues from the tourist activity, China is booming and has established itself as one the world's main tourist destinations.

6.2. Conclusion

These results show how the dynamics of growth in the tourism industry pose different challenges to each destination. It is empirically demonstrated that destination planning and policy directly influence the growth of tourism receipts, therefore this study aims to provide managers and policy makers with an overview of the main trends in the world's top ten destinations during the years preceding and after the 2008 financial crisis, shedding some light on how the interactions between the main tourism indicators ultimately affects the positioning of destinations.

This research analyses the role of clustering techniques to position tourist destinations. Multivariate techniques for dimensionality reduction allow to reduce the number of mutually correlated variables, and to detect underlying patterns in the relationships between variables. By working with annual percentage growth rates of tourism indicators in the world's main tourist destinations, the generated perceptual maps offer a visual representation of the dynamics in the international tourism market during the last decade.

The proposed approach facilitates the identification of attributes that are the most relevant to tourism destinations. Perceptual maps allow the visualization of the strengths and weaknesses of competing destinations. As a result, we aim to provide tourism organizations with a practical methodology for market segmentation that helps to develop and improve destination marketing strategies.

6.3. Limitations

Despite the usefulness of the proposed approach for positioning destinations with respect to their competitors, this study is not without limitations. A separate analysis for each destination in order to delve into the specific causes behind the oscillations in tourism activity would be key at the destination level. The analysis of other indicators such as employment or the average expenditure per day could shed more light on the impact of tourism in the destination. Furthermore, incorporating residents' perception about incoming tourism would serve as a proxy for the carrying capacity of tourist destinations, and could help policymakers to manage the problems derived from congestion.

6.4. Lines of future research

As for further research, on the one hand, a comparison between a major number of tourist destinations would provide a more complete picture of the tourism market. On the other hand, by incorporating a wider range of tourism and economic indicators, a greater understanding of the marketplace and of the main attributes could be achieved. Furthermore, there is the question of whether the implementation of artificial intelligence techniques such as Self-organizing maps could improve the clustering of the destinations.

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Table 1
Frequency distribution of overnight visitors (2000-2010)

Country	Annual mean	Total 2000-2010	Relative frequency	Cumulative relative frequency
France	76,934	846,272	14.4%	14.4%
Spain	53,019	583,214	9.9%	24.4%
United States	50,719	557,911	9.5%	33.9%
China	44,269	486,960	8.3%	42.2%
Italy	40,731	448,042	7.6%	49.8%
United Kingdom	26,470	291,165	5.0%	54.8%
Germany	21,711	238,818	4.1%	58.9%
Mexico	21,167	232,842	4.0%	62.8%
Turkey	19,998	219,980	3.8%	66.6%
Austria	19,956	219,513	3.7%	70.3%

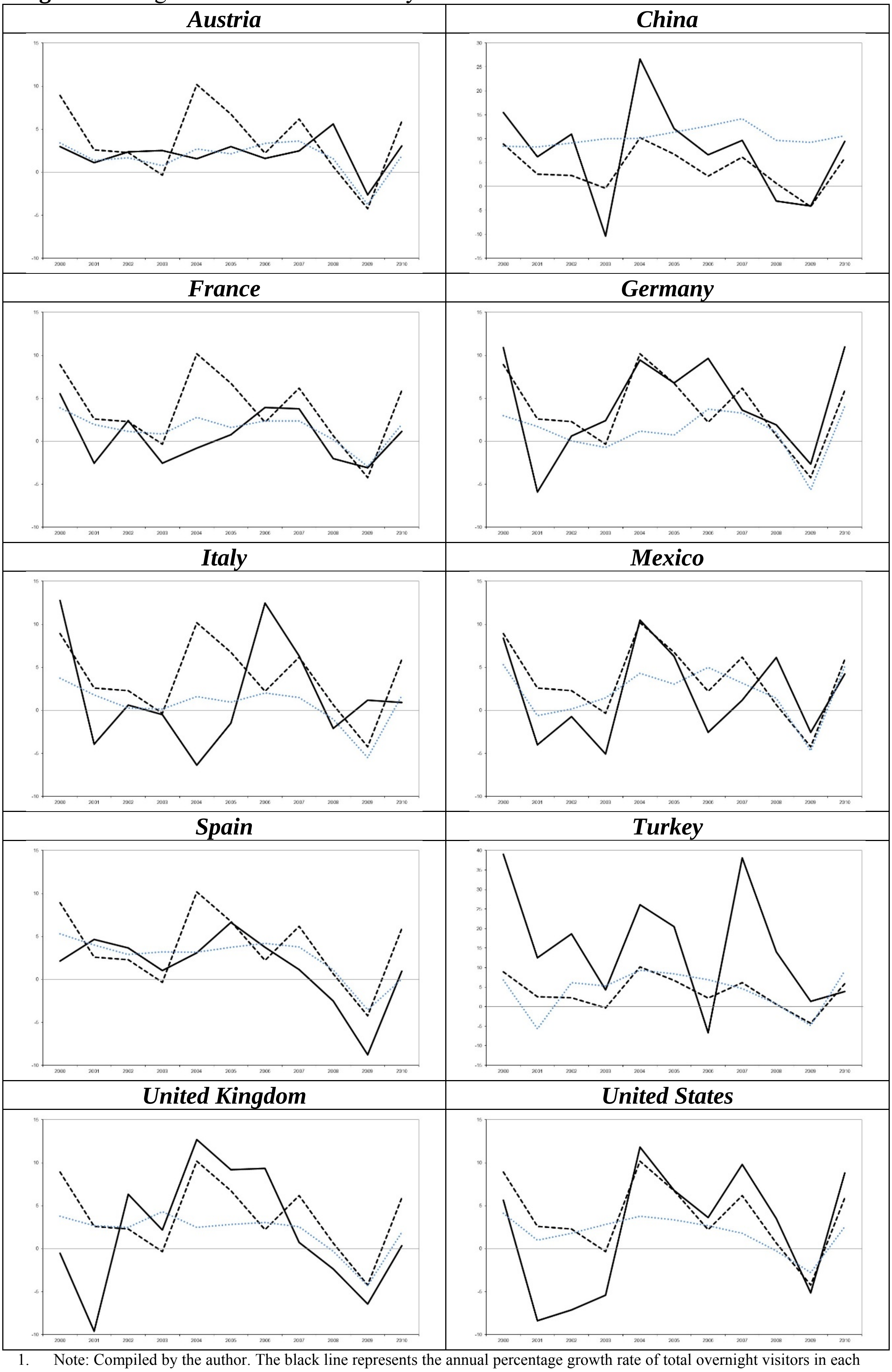
Note: Overnight visitors are measured in thousands.

Table 2
Annual percentage growth rates of the UNWTO tourism indicators – Summary (2000-2010)

Variable	Mean	Median	Standard Deviation	Maximum	Minimum
Overnight visitors	2.44	2.75	7.82	24.14	-19.40
Total expenditure	3.92	2.50	8.29	39.07	-10.41
Occupancy rate	6.42	6.75	11.27	48.37	-16.68
Rooms	-0.19	-1.30	12.69	78.57	-23.77
GDP	2.80	2.54	3.76	14.19	-5.70
Inbound expenditure / GDP	2.52	1.58	4.64	24.68	-14.64
Expenditure per tourist	0.38	0.39	4.57	23.90	-14.18

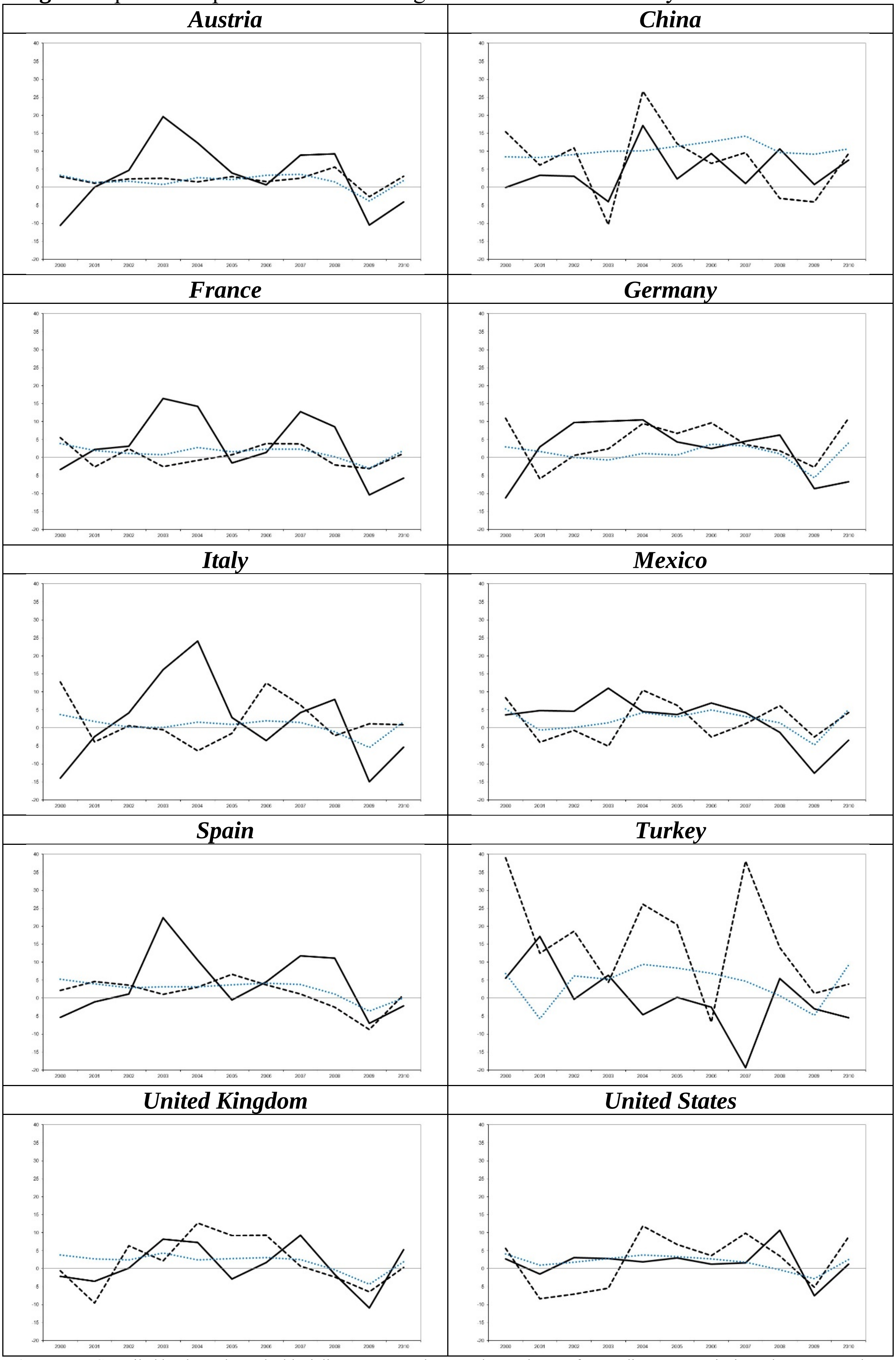
Notes: Statistics are conducted for the ten destinations. The Skewness and the Kurtosis indicators respectively measure the asymmetry and the shape (“peakedness”) of the probability distribution. Negative skew indicates that the tail on the left side of the probability density function is longer than the right side.

Fig. 1. Overnight visitors in each country vs. international inbound tourists



1. Note: Compiled by the author. The black line represents the annual percentage growth rate of total overnight visitors in each country. The black dotted line represents the growth rate of international inbound tourists (overnight visitors worldwide). The grey dotted line represents the annual percentage growth rate of GDP in each country.

Fig. 2. Expenditure per tourist vs. overnight visitors in each country



2. Note: Compiled by the author. The black line represents the annual growth rate of expenditure per tourist in each country, and the black dotted line represents the growth rate of total overnight visitors in each country. The grey dotted line represents the annual percentage growth rate of GDP in each country.

Table 3
Ranking of countries

Tourist arrivals	Total expenditure	Rooms	Occupancy	Expenditure per tourist	Inbound expenditure per GDP	HDI
Turkey	Turkey	China	Turkey	China	Turkey	China
China	China	Turkey	China	Spain	Germany	Turkey
Germany	Germany	Mexico	Germany	France	US	Mexico
US	Spain	Spain	Austria	Austria	Austria	Italy
Austria	Austria	UK	UK	Mexico	UK	Germany
UK	Mexico	US	France	Germany	France	Austria
Mexico	US	Italy	Mexico	Italy	Italy	France
Italy	France	Germany	Italy	US	Spain	Spain
Spain	Italy	France	US	UK	Mexico	UK
France	UK	Austria	Spain	Turkey	China	US

Notes: HDI stands for the annual average growth rate of the Human Development Indicator during 2000-2010.

Table 4
Correlation analysis – Spearman's rank correlation coefficients

	Tourist arrivals	Total expenditure	Rooms	Occupancy	Expenditure per tourist	Inbound expenditure per GDP
Tourist arrivals	1					
Total expenditure	**0.661**	1				
Rooms	0.139	-0.127	1			
Occupancy	**0.733**	0.564	0.103	1		
Expenditure per tourist	-0.333	0.224	-0.091	-0.127	1	
Inbound expenditure per GDP	0.455	0.152	-0.539	0.333	**-0.697**	1
HDI	0.430	0.588	0.430	0.612	0.164	-0.248

Notes: Bold - Spearman's rho significant at the 0.05 level.
HDI stands for the annual average growth rate of the Human Development Indicator during 2000-2010. (See notes at bottom of Table 9).

Table 5
Multivariate analysis - Summary

CATPCA Model				
Dimension	**Cronbach's alpha**	**Variance**		
		Total (eigenvalue)	Inertia	% of variance
1	0.99	6.70	0.96	95.76
2	0.96	5.51	0.79	78.65
Total		12.21	1.74	
Mean	0.976*	6.10	0.87	87.21
MDS Model				
Stress	0.11	**RSQ**	093	

Notes: *Cronbach's alpha mean is based on the mean of the eigenvalue.
Kruskal's stress values indicate the amount of distortion in distances to tolerate. Stress values range from zero to one, zero indicating a perfect representation of the input data in two dimensions. The RSQ stands for the squared correlations in distances. RSQ values are the proportion of variance of the scaled data (disparities) in the partition which is accounted for by their corresponding distances.

Fig. 3. Scatterplot of the scores of the first two dimensions – CATPCA

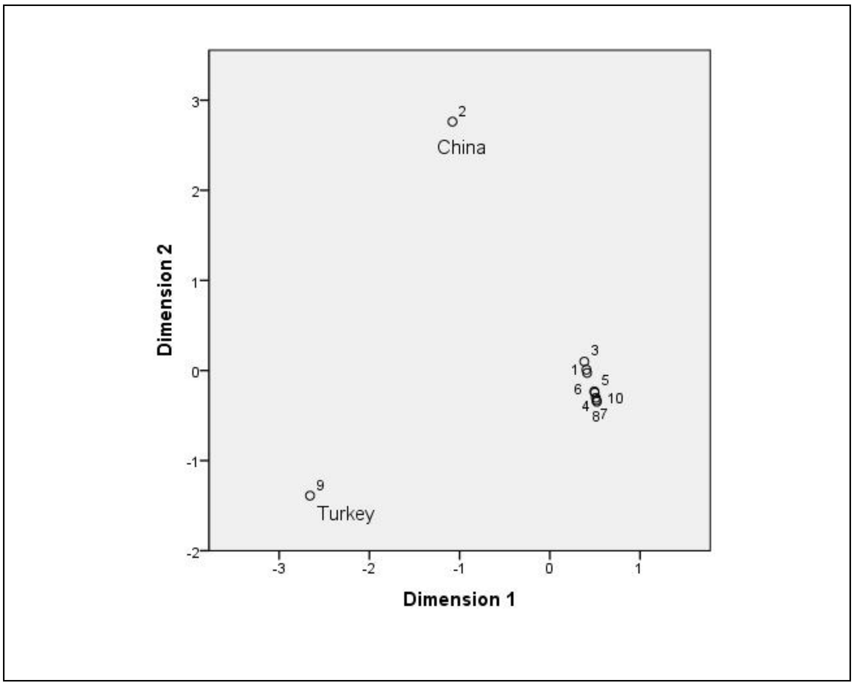


Fig. 4. Scatterplot of the scores of the first two dimensions – MDS